SSEN DISTRIBUTION RIIO-ED2

ENVIRONMENTAL ACTION PLAN

RIIO-ED2 Business Plan Annex 13.1

Scottish & Southern Electricity Networks

Contents

EXECUTIVE SUMMARY

We believe that our network will become a key enabler of the energy transition, while continuing to provide a vital service to our communities. We will lead by example in reducing our own environmental impact in a transparent, credible way. Delivering resilient, agile, reliable, and decarbonised energy that customers depend on, in a way that is environmentally and economically sustainable and inclusive. Our Environmental Action Plan (EAP) is founded on an ambitious 1.5°C Science Based Target (SBT) that goes beyond minimum requirements and addresse the global biodiversity crises. It Delivers on current policy, and these are baked into the core of our submission.

Our EAP is a critical part of our RIIO-ED2 submission. It delivers for stakeholders in our local environments and beyond. We will do this through targeted business plan outputs that focus on the decarbonisation of our network, and the impact of its operations; enhancing our local environmental performance whilst ensuring a longer-term plan to achieve net zero.

Our EAP approach fully supports our Strategic Objective to 'accelerate' net zero for our electricity network and supports Scottish and Westminster Governments' net zero targets whilst enabling our customers and stakeholders on their own journey. Through targeted intervention, delivering our EAP will create a fair and just decarbonised electricity network which will bring societal value during RIIO-ED2 and be fit to face the challenges that lie ahead.

Working closely with our stakeholders and listening to their needs we have phased our work to ensure that efficient investment happens at the scale and pace required to meet the challenge. Stakeholders have been instrumental in building our plan and setting its high standard of ambition. They have encouraged us to be bold but credible with our target setting, creating a clear transparent and ethical pathway to net zero. Our stakeholders fully support our overarching sustainability commitments and that our plans are founded in globally recognised frameworks like the UN Sustainable Development Goals (SDGs) and targets accredited by the Science Based Target initiative (SBTI).

Credible qualitative and quantitative engagement has shaped our plans, the level of ambition has increased over the last year from pre pandemic times, awareness on climate related issues has never been stronger and has encouraged a 'step change' in leadership that will reduce our Business Carbon Footprint (BCF), improve our focus on biodiversity, and reduce the impact of our current operations. These stakeholder priorities have shaped our eight core sustainability goals that will drive our ambition in RIIO-ED2 and beyond. We are proud to be the first UK Distribution Network Operator (DNO) to set an accredited 1.5-degree Science-Based Target (SBT)[1] for greenhouse gas emission reduction in October 2021, underpinning our ambitious programme of activities to drive down our carbon impact and to support others as they reduce theirs. Our 1.5°C SBT is in line with the latest climate science, going a step further than the original Paris Agreement and will include electrical losses in line with the Green House Gas (GHG)

[1] https://sciencebasedtargets.org/

Protocol[2]. This targets a 55% reduction in GHG emissions by 2033, meaning at least a 35% reduction in our combined Scope 1 & 2 emissions in RIIO-ED2. We have chosen to follow the 1.5°C trajectory that was originally above Ofgem minimum requirements , however Ofgem have now confirmed to all DNO's that a 1.5-degree pathway is now the new baseline expectation as this is the only trajectory that aligns with current government policy. We believe that this process of negotiation demonstrates our leadership and ambition in our short- and long-term plans. We will meet Net Zero by latest 2045, and will aim to better this date through legitimate, transparent, and fair methods. We will be committed to continued innovation, natural capital investment and our whole system approach including flexibility offerings and DSO functionality to reduce all carbon related emissions – including embodied carbon installations on our network. We have also set a voluntary SBTs to tackle our Scope 3 Emissions, and ultimately our embodied carbon. 35% of our Supply chain will have set their own SBTs by 2026.

We have developed our EAP against the backdrop of a climate change emergency, the introduction of legally binding targets to reach net zero by 2045 in Scotland and 2050 in England, and many local authorities declaring 'climate emergencies' through the course of 2019 and 2020 (87% of local authorities within our network areas). We must reduce our environmental impact and recognise this requires a step-change in our approach. Our plan sets out how we intend to build a sustainable, green electricity network that benefits everyone and supports the decarbonisation of the wider economy. A high-level breakdown of what our plan will deliver and what it will cost can be seen in Figure 1 below and is supported by our outputs table in section 6. Climate change is also having seriously negative effects on our biodiversity which affects us now and will impact on our ability to secure a sustainable future. These shouldn't be tackled separately and in order to achieve a credible net zero we must tackle both, climate change and biodiversity are inextricably linked, and enhancing biodiversity will help both mitigate future climate change through locking carbon in our habitats and soils and also provide opportunities to not only improve ecosystems that we depend on but also to help us adapt to the changes which have, and that will continue to happen. Our plan puts biodiversity and natural capital investment as a priority as we take responsibility to tackle this combined crisis. There are several challenges unique to our sector. One is electricity losses, responsible for 91% of our Business Carbon Footprint (BCF). Another is leaked SF_6 gas used as a standard insulator within electrical switchgear. It is an extremely dangerous greenhouse gas being 23,800 times more potent than CO_2. Our plan details our response and the changes we will implement to reduce environmental impacts. We face further challenges that are specific to our network and the island communities we serve, where diesel generation still plays an important role in ensuring a reliable supply of electricity. We are committed to exploring alternative solutions. **Biodiversity and investment in restoration of the worlds natural capital plays an ever-increasing role and the latest research suggests that it needs to be a corner stone in any plan to deliver net zero. More details of our commitments can be seen in section 8.5.** The period from now until 2030 has been declared by the United Nations General Assembly in New York as the "UN Decade on Ecosystem Restoration". This 'call to action' was put forward to motivate people, communities, and countries across the world to increase the speed at which we are restoring degraded ecosystems. The Bonn Challenge was set in 2011 with a goal to restore 350 million hectares of degraded and deforested terrestrial ecosystems by 2030.

We agree with Get Nature Positive's goal to position nature at the heart of our business agenda, and through the Nature Handbook, we will seek to continuously enhance our understanding of our nature-

[2] https://ghgprotocol.org/

related business impacts and identify opportunities to take Nature Positive action and where possible share case studies and learnings of our journey towards nature positivity.

Our EAP sets out targeted outputs that will be key to **decarbonising our network; managing and reducing the wider environmental impact of our activities** and enhance our environmental performance alongside our longer-term plan to achieve net zero. Our proposed investment is £172.3m across both license areas. Additionally, our EAP will deliver an integrated approach to ensure that true sustainability thinking is at the heart of all of our projects, we aspire to do better for our consumers and customers by providing a sustainable business. Everything we do for RIIO-ED2 shall be challenged from an environmental perspective, accounted for, monitored and part of an enduring cross price control plan to ensure a positive impact on our climate for this price control and by laying strong, credible foundations for further delivery in RIIO-ED3 and beyond.

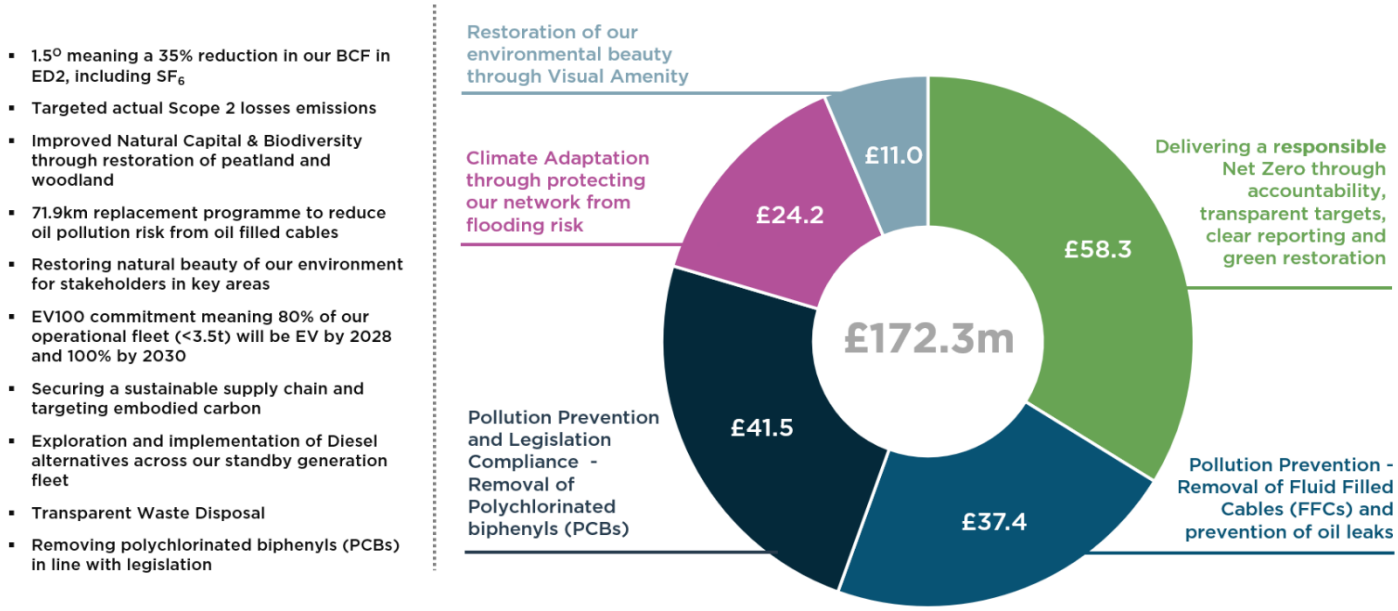


Figure 1 - EAP Cost Wheel

BEYOND OUR OWN NETWORK

The Climate Change Committee forecasts that the mass uptake of low carbon technologies such as renewables, electric vehicles, batteries, and heat pumps, will more than double electricity demand by 2050, creating significant new supply and demand patterns for our part of the energy ecosystem.

We're already rising to the challenge of helping our communities reach their own net zero ambitions and are working with them to enable their net zero transition: we're doing this by delivering upgrades to network infrastructure, facilitating the connection of low carbon technologies, and taking the first steps towards implementing innovative and flexible approaches to investment and network connections. We're especially committed to protecting customers in vulnerable circumstances and adapt our service provisions to ensure that no one is left behind. More information can be found in our ***Vulnerability Strategy (Annex 4.2).***

BALANCING THE TRILEMMA

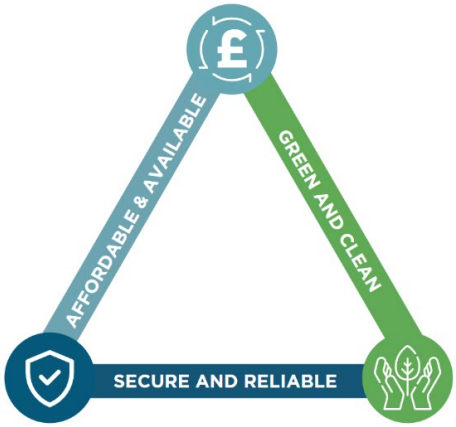
We know that climate change is generally expected to disproportionally affect low-income and vulnerable customers and communities. Our plan demonstrates how our activities and business practices will deliver social value to the regions we serve.

The Energy Trilemma describes the balance between secure energy supplies, social impact and environmental sensitivity. Three vital, but often competing, policy outcomes must be delivered:

- Decarbonisation – carbon and other greenhouse gas (GHG) emissions from energy supply and use must be reduced in order to reduce climate change impacts.
- Security of supply – an adequate security of energy supply must be maintained, including resilience to both short-term and long-term challenges.
- Cost – the cost of energy must be affordable for consumers.

Our stakeholders ranking of the trilemma was taken back in 2019 and has been retested throughout our engagement. The response does fluctuate and has transitioned more towards sustainability, with a return to affordability immediately as the pandemic took hold in March of 2020, and then again back to sustainability as support for a green recovery emerged. That said Reliability and ensuring our network service is available whenever needed remained a consistent priority across most stakeholder groups. This highlights that all elements of the trilemma are still valid, and we need to find a way to deliver on all aspects in a sustainable and responsible way. We have continued to test our proposed outputs throughout our engagement phases and have actually found that the support for the elements in our EAP have grown, that said however we have been considerate of the affordability concerns raised, that is why from draft to final that was our focus, and as a result have refined down the costs associated with our EAP (with the exception of Polychlorobiphenyl's (PCBs)). We think we have found a good balance and still being able to deliver on our commitments to deliver our credible net zero.

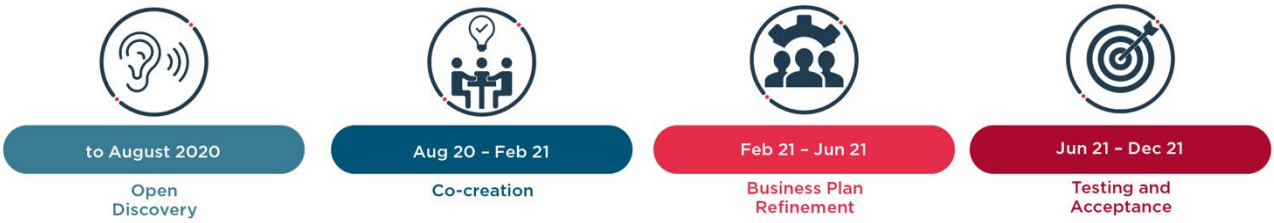
Balancing these three drivers is complex. Action must be taken on decarbonisation and security of supply, but measures cannot be considered in isolation and those selected must be cost-effective.



- Secure and Reliable – the reliability of energy infrastructure and the ability to meet current and future energy demands.
- Green and Clean – development of energy supplies from renewable sources and other low carbon sources. Use of low carbon technologies.
- Affordable and available – accessibility and affordability of energy supply.

We have introduced a shareholder financed £500,000 annual 'Powering Communities to Net Zero' fund to support LCT accessibility initiatives for those in vulnerable situations, and community led environmental and resilience schemes. Totalling £2.5m over the five years.

1. ENHANCED ENGAGEMENT



Our Environmental Action Plan has been informed by our Enhanced Engagement programme, full details of which are set out in Annex A. Our draft plan was underpinned by three phases of stakeholder and customer engagement (illustrated in the diagram above). The details of this engagement and insights are set out in Appendix A to this Annex and provide a clear line of sight between what stakeholders told to our EAP strategy and outputs.

1.1 FINAL ENVIRONMENTAL ACTION PLAN TESTING AND ACCEPTANCE

We have refined our final EAP strategy and outputs based on Phase 4 of our Enhanced Engagement, which involved direct testing of the strategy, outputs and costs with 1,680 stakeholders through 14 events. The table below sets out the clear line of sight of the changes between our draft and final EAP strategy and outputs based on this engagement.

1.2 ENGAGEMENT EVIDENCE TRIANGULATION AND CHANGES BETWEEN DRAFT AND FINAL PLAN

The table below provides a clear line of sight summary between stakeholder and consumer insights and our EAP and outputs. For our draft EAP and outputs, based on phases 1 to 3 of our enhanced engagement program we demonstrated how engagement insights had informed our outputs using these keys:

 Findings converge to support proposals.

 Findings generate new insights that lead to further refinement of proposal.

 The proposed approach diverges from the findings.

To demonstrate the line of sight between the scope of change between draft and final, based on testing our draft proposals with stakeholders and consumers, we use theses keys:

NEW – the output is a new output for the final plan **ENHANCED** – the draft output has increased in ambition for final plan **REFINED** – more clarity is provided in final plan

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
Overall Environmental Action Plan **ENHANCED** **Output**: Produce and report annually on an Environmental Action Plan (EAP)	**Stakeholders said** We should have ambitious Environmental targets and programs **Our response**  We support the most ambitious option subject to further investigation of consumer and stakeholder views on the bill impacts.	**Stakeholders said** When the strategy and associated costs were tested with stakeholders, they were supported as sufficiently ambitious and comprehensive. Some stakeholder segments wanted to ensure that we would be transparent and accountable for outcomes and that the bill impacts would be the lowest possible. Future Customers urged SSEN to fund environmental initiatives. **Our response** We shall be reporting annually on all of our targets through our Annual Environmental Report so we stay accountable. We have also introduced a ***shareholder financed*** £500,000 annual 'Powering Communities to Net Zero' fund to support LCT accessibility initiatives for those in vulnerable situations, and community led environmental and resilience schemes. Totalling £2.5m over the five years.	79% for *Accelerated progress towards a net zero world* strategic outcome

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
ENHANCED **Output**: Set an ambitious 1.5 degree SBT (including losses) requiring at least a 35% reduction in our carbon footprint by 2028.	**Stakeholders said** Stakeholders supported the net zero elements of our SBTs, recognising that 1.5 degrees is a legal policy. They prioritised a large reduction in our business carbon footprint in our WtP research. **Our response**  We were the first UK DNO to commit to setting SBTs with SBTi and have gone beyond minimum requirements by committing to 1.5 degree reduction (a 55% reduction in Scope 1 and 2 carbon emissions by 2033), equating to a minimum 35% reduction by the end of ED2. We have also classified electrical losses as a Scope 2 emission.	**Stakeholders said** All stakeholder segments commended the 1.5 degrees target with debate around how offsetting should be implemented including additional focus on peatland restoration and woodland restoration. **Our response** We submitted our targets to the SBTi and had them accredited as a pathway in line with 1.5 degrees in October 2021. We have expanded our nature-based solutions proposals to include peatland restoration.	79%
ENHANCED **Output:** Reduce SF_6 emissions from our assets by a minimum of 35%, and begin reducing our holdings	**Stakeholders said** Managing SF_6 on our network is a priority although the high costs needed to be managed. **Our response** We are addressing this through our Enhanced SF_6 leakage reduction strategy and emissions target which will drive alternatives	**Stakeholders said** Consider alternatives to address SF_6. **Our response** Our proposal and costings include consideration of alternatives.	Not tested
ENHANCED **Output**: Implement a strategy to efficiently manage losses on our network in the long-term:	**Stakeholders said** DNOs should set targets for losses reduction despite the removal of incentives. We need to design the electricity distribution network	**Stakeholders said** The losses reduction strategy should consider the efficiency of the actual lines as well as the losses between transmission and distribution.	Not tested

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
re-classify losses as a Scope 2 emission and act to reduce actual losses	strategically to minimize electricity losses. **Our response** Our EAP includes a losses reduction strategy and we have reclassified losses as Scope 2 emissions so it is included in our BCF reduction target.	**Our response** Our strategy commits to do more to understand where the losses are actually occurring on our network so that we can target investment and inform decision making. We have also increased our minimum cable size to improve efficiency.	
ENHANCED **Output:** Reduce emissions by replacing mobile generators wherever possible with lower carbon alternatives or by using alternative lower carbon fuel types by 2028	**Stakeholders said** Stakeholders recognise that diesel embedded generation and the management of our mobile generation fleet require a solution beyond ED2. **Our response**  We committed to producing a Diesel Strategy to transition away from carbon-intensive fuels at standby generation sites on the Scottish Islands while continuing to transition away from diesel mobile generation during ED2. Engineering studies indicate that eliminating diesel generation completely in the short term would be cost prohibitive, involving significant investment in subsea cables.	**Stakeholders said** Engagement with stakeholders is essential on strategies to decommission diesel to get it right on maintaining reliability, removing constraints for local and progress towards net zero. **Our response** Our Diesel Strategy includes engagement to ensure solutions are reflective of stakeholder and community needs on our islands, as we transition away from embedded diesel generators.	86%
ENHANCED **Output:** Reduce reliance on diesel back-up generation, exploring local solutions and flexibility opportunities from the start of ED2	-	**Stakeholders said** Reducing emissions from mobile diesel generation on the islands is particularly important, and the criteria for replacing diesel should go beyond costs. A tailored approach to improving the resilience of each of the Islands including local solutions and flexibility to help solve the issue	Not tested

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
		Our response Our Diesel strategy sets out how we will explore solutions, and that there is no one fix – we have presented a portfolio of solutions to include this thinking. We have also refined our Innovation Strategy to include innovation projects to investigate new ways and technologies which can be deployed in the future to contribute to decarbonisation on the Scottish Islands.	
ENHANCED **Output**: Plant 2,000 hectares of native woodland and restore 1,200 hectares of peatland in our licence areas, which are expected to remove up to 300,000 tonnes of CO_2 by 2045, and provide 3000 biodiversity units by 2045.	**Stakeholders said** Stakeholders want us to meet net zero and be as ambitious as possible, recognising that SBTs are only part of the solution; where we can't abate carbon we need to remove it. They support doing this through natural capital and biodiversity investment. **Our response**  We will target natural capital and biodiversity investment within the communities we serve, providing local air quality and habitat improvements. This is a transformational and longer-term approach for net zero, that provides a legitimate and transparent record of carbon abatement.	**Stakeholders said** Planting trees in landscapes which previously didn't have trees is not value for money and restoration of peatland and native woodland is preferable. **Our response** We have amended our approach to restore native woodlands and also peatland restoration as a result of this feedback.	79%
NEW **Output**: Remove all PCB-contaminated assets from our network by 31 December 2025	-	**Stakeholders said** Go ***beyond regulations on PCBs*** and identify alternative processes. **Our response** We have brought PCB work into our baseline and we will continue to work closely with industry groups for efficient resolutions.	Not tested

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
REFINED **Output**: Replace 72km of fluid-filled cables on our network and reduce oil leakages by 20% relative to 2019/20	**Stakeholders said** Stakeholders want to see us reduce the environmental impact of what we do to prevent pollution risk from our assets and operations. **Our response** We have increased our ambition for replacing fluid filled cables as a direct result of this feedback	**Stakeholders said** Stakeholders urged more ambition to reduce the environmental impact of operations to prevent pollution risk. **Our response** We reviewed our intervention selection criteria increase the weighting of assets closer to water courses and amended our proposal to suit.	Not tested
REFINED **Output**: Complete works at c.73 sites across our network in line with ETR138	-	-	Not tested
REFINED **Output**: Sign up 80% of our supply chain (by value) by 2028 to our Sustainable Supplier Code	**Stakeholders said** Supply chain stakeholders told us that they have ambition to achieve net zero themselves and that they want to collaborate with us to tackle our Scope 3 emissions. **Our response** We have launched a Supply Chain Sustainability School to help them to understand SBTs and other aspects of sustainability to assist them on their net zero journey by committing to these themselves. We are confident that a high proportion of our supply chain will sign up to this during ED2.	**Stakeholders said** Further ambition was urged to sign up 100% of our supply chain by 2028. **Our response** We have set a stretch target of 90% of our supply chain to have signed up to our supplier code, and we will work closely with all suppliers to drive this as far as possible based on what is feasible. In additional we have set a voluntary SBT that 35% of our supply chain will have set their own SBT's by 2026.	76%

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
REFINED **Output:** Electrify 80% of our core vehicle fleet by 2028, reduce our average road mileage by 15% (from pre-covid levels) and limit air travel where possible	**Stakeholders said** All consumer segments indicated a medium willingness to pay to increase the proportion of our vehicle fleet that is electric from 80% to 100% by the end of ED2. **Our response** We have signed up to the EV100 initiative; 80% of our less than 3.5 tonne vehicle fleet will be EV by 2028 (and 100% by 2030).	**Stakeholders said** The majority of customers thought this was a high to medium priority and some stakeholders called for more ambition including a 100% electric vehicle target or alternative fuel vehicles. **Our response** Our target is in line with our EV100 target to transition the whole fleet to EVs by 2030. We have decided to stick with this timeframe as it minimises the cost to customers because it enables us to complete the terms of existing leases.	75%
REFINED **Output:** Complete undergrounding of up to 83km of lines	**Stakeholders said** Continue the success of ED1 by improving visual especially areas where there are sensitive landscapes. Engage communities on priorities. **Our response** We will continue to underground overhead lines to restore natural beauty through visual amenity.	**Stakeholders said** How to address risk of flooding with underground lines which is likely to increase due to climate change. **Our response** Our projects will now undergo a climate change assessment as part of our design process to ensure we deal with climate related risk. Full details are in our Climate Resilience Strategy	Not tested

Table 1: Summary of the EAP and outputs

2. DELIVERING SUSTAINABILITY IN SSEN

Delivering a Sustainable Business is core to SSE Group values. Sustainability is everything that we do and how we do it. Our task was to create a sustainability approach that had ambition, building upon and drawing that green thread through our current operations with a strategic approach centred around the UN SDGs and targets accredited by the Science Based Target initiative (SBTi). We are proud of how we have developed our strategy together with our stakeholders and our wider business. An extract of our overall five sustainability themes can be seen below in **Figure 2**. The full document **Delivering Sustainability in SSEN** was out for consultation with our stakeholders which closed in late-July 2021 and has now been further refined and launched on our website.[3] it can be read in full in our ***Sustainability Strategy (Annex 13.2)*.**

We recognise that embedding sustainable solutions throughout our operations is impactful and meaningful. We are committed to pushing our business forward to achieve our sustainability goals and net zero transition. Our Sustainability Strategy will help shape our company to become purpose-led, leading the way with innovative solutions to the world's problems. We have set out a clear vision to 'accelerate' net zero for our electricity network. Our work will support Government's net zero targets and enable our customers and stakeholders to start this journey. Our sustainability ambitions aim to create a fair and just decarbonised electricity network for the future, which will bring societal value during RIIO-ED2. **Our Sustainability theme 3. Enhancing our local environment, is where our EAP sits.**

2.1 THE GREEN THREAD

Delivering an environmentally sustainable network cannot be delivered in isolation and we understand that the success of this plan rests with the execution of the complete plan. Policy direction in this area is only going in one direction and our impact will be a result of everyone's ability to make evidenced based, informed sustainable, conscious decisions. Figure 3 demonstrates how our EAP, and our investments proposed through this plan relate to other areas. However, our contribution to the environment doesn't rest solely in our EAP. The rest of our plan works hard to deliver on our ambitions, In order to illustrate how we are embedding this across our plan we are calling out our green thread across other chapters and annexes. We will also include a record of all the environmental benefits (as well as capturing them within our Investment Decision Packs), including carbon avoidance and losses management estimated for delivery in RIIO-ED2 from across our plan, with our Load and Non-Load areas contribution being the most significant.

Tree-cutting - We are also very conscious of the impact we have throughout tree cutting operations, whilst this is a legal obligation to ensure safety in our communities, we must work harder to understand our impact and do what we can to mitigate this. We are working with our tree cutting and innovation teams to understand how we can get more out of LIDAR and local data; we want to be able to estimate cut back volumes from this work – so we can determine our impact (as detailed in our ***Safety and Resilience (Annex 7.1)***). We are reviewing our LIDAR data – with a view to improve the outputs to enable us to identify species types, so we can build a robust biodiversity data bank, and help to inform future investment decisions based on rate of tree growth and sequestration potential.

[3] https://www.ssen.co.uk/sustainability/

Figure 2 - Our five sustainability themes

We want to be able to build on our local knowledge to help determine site specific issues and local growth rates. In addition, we will review how we manage our tree cutting, to ensure we go as far as possible to do this in a considerate way – including what we do with the "cuttings". Instead of mulching or chipping them – we could work with landowners to consider "eco encouraging stacking" arranging branches etc in ways that encourage local habitats to flourish and creating biodiversity enhancements. This will also reduce the need for mulching machinery and with a move towards electric powered saws to carry out the work we are ensuring our lifecycle carbon is being considered.

Where we are looking to invest circa £25m on reforestation, and peat bed restoration to help us deliver a credible Net Zero. The investment will be targeted at both of our license areas. By replanting in a controlled environment – we can choose an area that is away from our lines.

The EAP itself forms part of the non-load cost category, the more traditional elements will make a substantial contribution to the delivery of our wider sustainability ambitions, our commitment to resilience, and running CBAs through everything that we are proposing to ensure where it is viable, we tackle our carbon, whether through losses reduction technology selection, upsizing of cables to manage losses and connect LCT's. Our approach to asset management ensures a focus on ethical conscious decision making. The same principles will be applied across all of our plan from connections projects, load related expenditure right through to all operational activity. Our ***Innovation Strategy (Annex 14.1)*** will be a large part to be targeted at the delivery of net zero, and we are continuing to learn from our ED1 innovation portfolio and that of other DNO's. Our people are critical to the success of this, and our workforce resilience, in particular the training and diversity and inclusion policies are fundamental aspects of this plan.

Our overall deliverability will ensure that our projects are clustered in an efficient way – not only from a cost perspective but from an environmental perspective too, mobilisation disruption once, and ensuring that the smaller improvement projects are linked to larger projects.

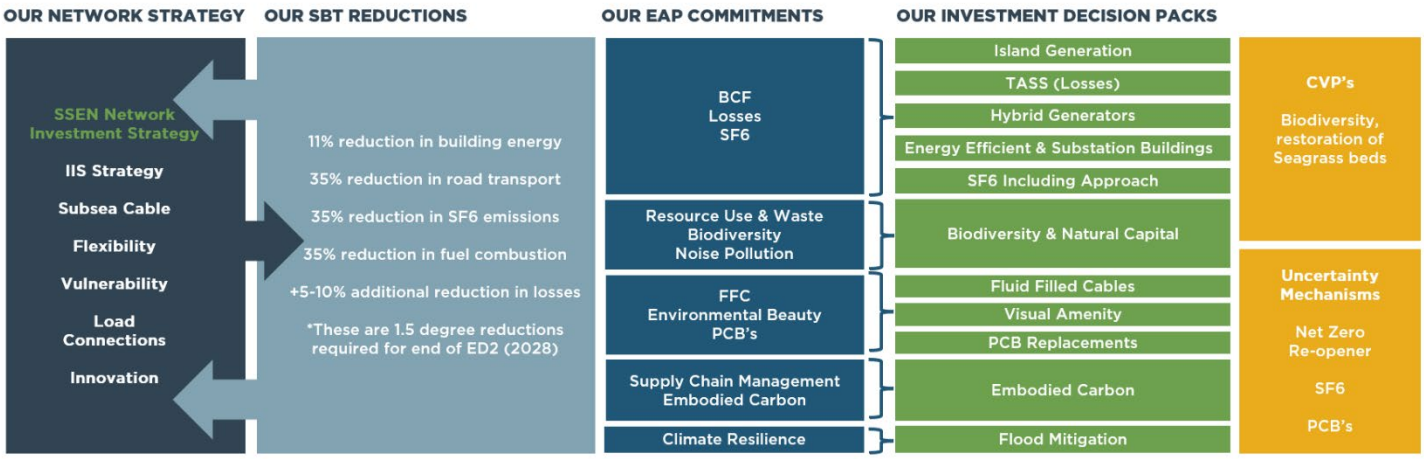


Figure 3 - Our EAP investment areas

2.2 SUSTAINABLE DEVELOPMENT GOALS

A Global framework Driving Local Change through Sustainable Development Goals (SDGs).

The United Nations Sustainable Development Goals (SDGs) are a collection of 17 global goals introduced by the United Nations in 2015 and are a global framework, aimed at policymakers to ensure a sustainable world. They target the three pillars of Sustainable Development - Economic, Social and Environmental issues. Expertly written to appeal to the masses they have been successful in getting credible support and affiliation with key actors across the globe. If we all align with this framework then we can collectively reduce and mitigate the impact of preventable climate change at a global level.

Our 8 Sustainable Development Goals (SDGs) have been selected after consultation with key stakeholders and outputs of workshops held over six events in September 2019 and March 2020. The stakeholders that attended this event varied from policy makers statutory authorities, industry, fuel poverty groups and consumer advocacy groups and technical experts and local authorities. Our Stakeholders were presented with the United Nations SDG's and identified the top goals that SSEN should focus on and outlined activities that SSEN should undertake to help achieve them. These activities are explained in more detail in our ***Sustainability Strategy (Annex 13.2).***

When stakeholders were asked to identify the top SDGs that SSEN should focus on 'Affordable and Clean Energy' and 'Industry, Innovation and Infrastructure' received the most support, accounting for 69% and 68% of the total vote respectively. These two/OT SDGs received support at all six of the events and across stakeholder types, with a similar proportion of stakeholders voting for them from each stakeholder type.

'Responsible Consumption and Production' came in as the third most important SDG with 51% of the vote, also drawing support from across the board, although it was slightly more popular among businesses and energy companies / utilities than with other stakeholder types.

Following the Coronavirus pandemic and our Synthesis report being released in March 2021, stakeholders noted that SDG 8 especially was more valued, as the way people are living/working has changed drastically over the last year and may do so on a permanent basis.

In our Sustainability Strategy we ensure SDG 8 is a key factor in our 'Serving the Public Interest' ambition, where we show our future desires for ensuring a safe and resilient network and working collaboratively to build trust and ensure legitimacy in everything that we do, for the greater good of our local communities and GB.

2.3 OUR SCIENCE BASED TARGET

A Science Based Target (SBT) is a set of targets that addresses the material carbon impacts that contribute to our BCF. The target is set against your most recent base year data and has to deliver within 5-15 years.

We have set the base year as **19/20**, because that is the most recent year that we have data for and we set the target year as 2033, which will coincide with the end of ED3 (assuming this is also a 5-year price control), and the NG Future Energy Scenarios predicted date of full grid decarbonisation. To be clear this is not a net zero by 2033 target – we shall meet net zero by latest 2045. Our accredited SBT is set out in Figure 4 below.

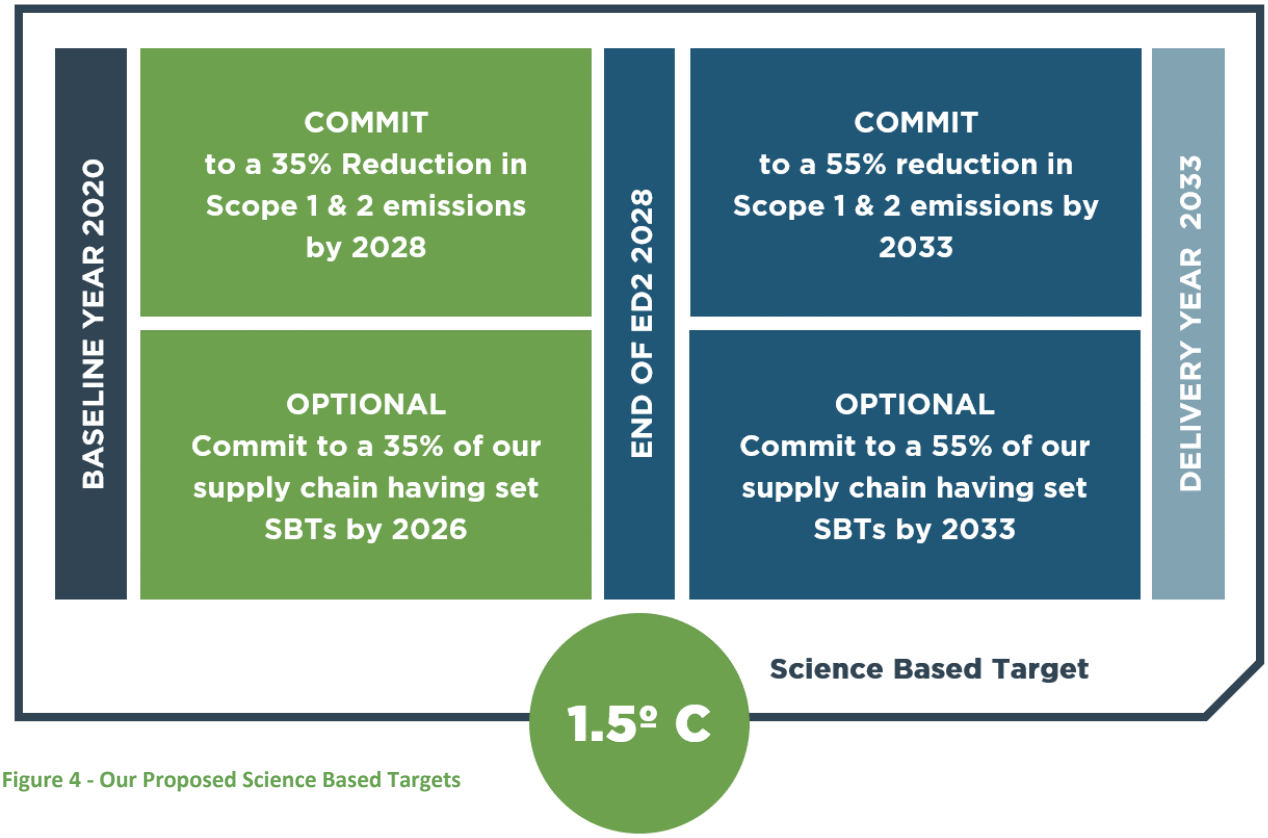


Figure 4 - Our Proposed Science Based Targets

Why science based?

This past year has highlighted the crucial importance of following and listening to the science. Key developments in the climate change evidence base, and political and public sentiment have highlighted the need for the upscaling and acceleration of far-reaching multilevel and cross-sectoral climate mitigation. Indeed, in 2019, the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050, with the Scottish Government adopting the same targets by 2045, five years earlier. To achieve this at UK level, GHG emissions must halve by 2030, and drop to net zero by 2050. This is now set out in law through the Climate Act 2019. The UK government are now proposing to change this to a 70% reduction by 2030.

Most notably, the Paris Agreement goal of limiting global warming to "well below" 2°C compared to pre-industrial levels has been bolstered by a 2018 **IPCC Special Report**,[4] finding that future climate-related risks are significantly larger if global warming exceeds 1.5°C than if global warming gradually stabilises at 1.5°C. This will include **long-lasting or irreversible impacts** - including but not limited to those set out below:

- **Species loss and extinction:** The risk of global terrestrial and area projected to undergo a transformation of ecosystems is 50% lower at 1.5°C than 2.0°C.
- **Drought and precipitation deficits:** Risks from droughts and precipitation deficits, heavy precipitation events, and tropical cyclones are lower at 1.5°C than 2.0°C.
- **Global sea level rise:** Sea level rise is projected to be around 0.1 metres lower with global warming of 1.5°C than 2.0°C.
- **Societal impacts:** Climate related risks to health, livelihoods, food security, water supply, human security and economic growth are projected to increase with global warming. Limiting global warming to 1.5°C compared to 2.0°C could reduce the number of people exposed to climate related risks and susceptible to poverty by up to several hundred million by 2050.

As part of our RIIO-ED2 engagement we have harnessed credible qualitative and quantitative stakeholder support for a 1.5°C target. With many stakeholders pushing us to be as ambitious as possible and follow the current policy. Furthermore, if we do nothing to decarbonise, we will feel the dangerous impact of human caused climate change much earlier, in some cases we are already feeling it – through warmer wetter winters and longer drier summers. The Committee for Climate Change most recent publication - Independent Assessment of UK Climate Risk[5] warns us that the UK has already fallen behind in preparing for, and adapting to, climate change; of particular note to energy companies the report identifies risks to people and the economy from climate-related failure of the power system as one of eight key risk areas the UK needs to address in the next two years. The report argues that costs related to addressing the impacts of climate change could triple by the 2080s if more isn't invested now into mitigation and adaptation.

Climate Equity and working with local communities

Climate change is expected, in general, to disproportionally affect low-income communities, those who are least responsible for climate change emissions. Yet these same communities could disproportionately benefit from strategies to address and adapt to climate change. In SSEN, we value our customers, and we seek to contribute to the communities we supply electricity to, and therefore we will seek to make investments that will contribute to the social value of the regions we serve. In addition, we will seek to develop our climate resilience policy so that it will enhance intergenerational (across generations) and intragenerational (within a generation) prosperity.

We will also reach out to our known low-income and vulnerable customers and identify those approaching need, to raise awareness of the climate risks associated with their communities, and work together with communities to co-operate on climate change adaptation, in light of our obligation to address human wellbeing, and in our view that equity is not always in tension with strong climate action or collective action. This is set out in our ***Climate Resilience Strategy (Annex 7.3).***

It is therefore critical that our business operations are synonymous with a 1.5°C Science Based Target. Setting a SBT accredited with the SBTi is now an Ofgem minimum requirement.

4 https://www.ipcc.ch/sr15/chapter/spm/
5 https://www.theccc.org.uk/wp-content/uploads/2021/07/Independent-Assessment-of-UK-Climate-Risk-Advice-to-Govt-for-CCRA3-CCC.pdf

Setting ambitious 1.5°C science-based targets

Our targets are in line with the level of decarbonisation required to meet the most ambitious goal of the Paris Agreement – to limit global warming to 1.5°C above pre-industrial levels.

Verified by the Science Based Targets initiative, we're cutting emissions further and faster by:

- Committing to reduce our combined Scope 1 and 2 emissions by 55% by 2033 from a 2020 baseline
- Setting a voluntary target and committing to working closely with our supply chain so that 35% of our suppliers will set science-based targets by 2026.

The current policy is clear, we must meet net zero and we are seeing increasing support from key stakeholders, consumers, and policy makers that any targets set must align with net zero and thus adopt a 1.5°C trajectory. In fact, policy makers are indicating that their expectations are that a 1.5°C target is now considered part of the new normal. Ofgem have since confirmed that their minimum requirements for ED2 is now 1.5 degrees, and the Science Based Target initiative are removing the well below two-degree option, as it will not deliver net zero.

Our targets include losses as a scope 2 emission in line with GHG protocol, we are serious about doing everything we can to address the issue of losses. We also want to be open, transparent, and held accountable on our other areas of material impact, to ensure they get the focus they deserve. For that reason, we will report on these areas separately where appropriate. But be assured that we have included losses in our short, and long-term targets. We have also set a voluntary target to target emissions from purchased goods and services and capital goods, this is our first step in our plan to reduce our embodied carbon. Following on from our supply chain engagement, we worked with them to establish what could be done in the short term, and we have set a target to have 35% of our supply chain also having set a science-based target by 2026.

We are proud to say we have prepared our plan to deliver on a 1.5°C trajectory, going beyond original minimum requirements and building further ambition into our base plan through our credible net zero pathway and proposed investment in nature.

2.4 HOW WE WILL ACHIEVE A CREDIBLE NET ZERO

Our target year for achieving net zero will be latest 2045. We have already committed to setting accredited science-based targets; however, they cannot get you to net zero alone, there must be additional investment targeted at carbon removal, **Figure 5** shows how they work together to create a credible net zero journey. We believe that setting a credible net zero target allows us to create a longer-term accountable solution that provides consequential benefits to our communities with benefits through air quality and habitat improvements. Our plan includes for targeted natural capital investment to achieve this over the RIIO-ED2 period.

The Science Based Target Initiative themselves have concluded a public consultation on net zero criteria and launched a new net zero standard in November 2021. The publications to date from the SBTi highlight that there are no silver bullets, and that any credible net zero journey starts with the avoidance and reduction of carbon emissions through an accredited 1.5°C SBT that sets an interim target and trajectory on the way to net zero, recognising that the SBT doesn't get us all the way there and we need to include

carbon "removal" as a piece of the jigsaw, but only once we have done everything else that we can – not as a substitute, and that is what our EAP sets out to do. 35% reduction in RIIO-ED2, 55% reduction by 2033 (SBT Target), beyond 2033 – we will set a further net zero target achieving this by latest 2045. So, to move forward we will develop an understanding of the net zero Standard published by the SBTi[6] with a view to have our own Net Zero Targets accredited. Part of the thinking is to review how we achieve Carbon Removals; we are proposing to do this through a nature-based solution and will also be reviewing the potential of setting Science Based Targets for nature[7].

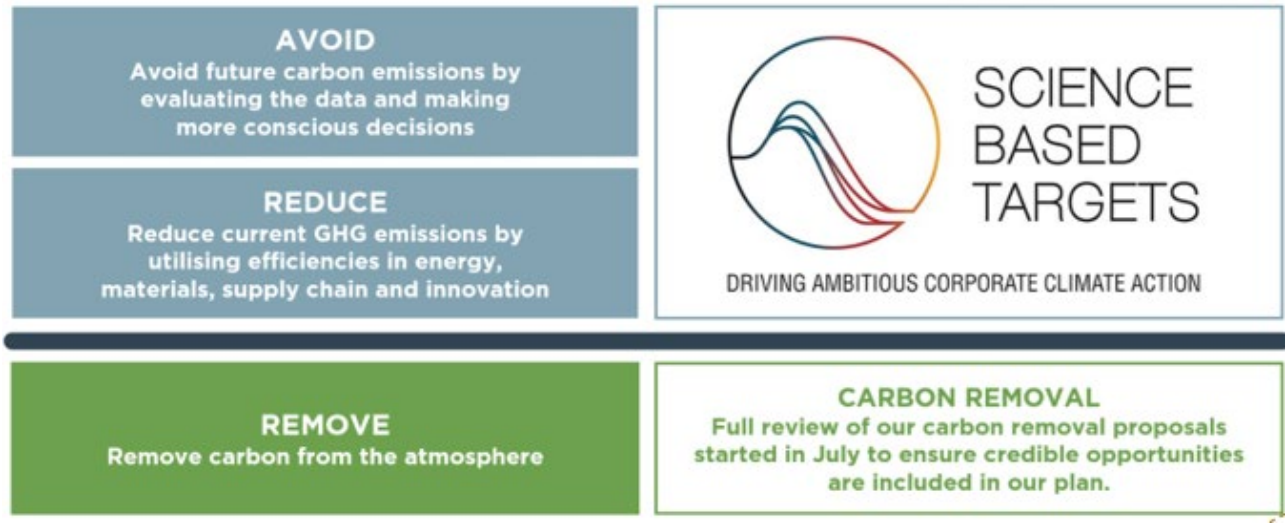


Figure 5 - Achieving Net Zero

2.5 SUSTAINABLE SOCIAL VALUE

We are committed to principles of a just transition which will support our shift out of a high carbon world and into a net zero world. Our work with the Centre for Sustainable Energy explores social justice in the future energy system and examines how the transition to a net zero energy system can be both smart and fair. This work has identified those who are likely to be unfairly disadvantaged, and the next phase will develop mitigation strategies to ensure a net zero transition that benefits everyone, meaning that we will design our system and services around all consumer needs to ensure we can all access the benefits of our future network offerings. This work is accounted for in our RIIO-ED2 plans and will feature in our longer-term targets to ensure that this continues to be a key priority in our thinking.

We have also introduced a shareholder financed £500,000 annual 'Powering Communities to Net Zero' fund to support LCT accessibility initiatives for those in vulnerable situations, and community led environmental and resilience schemes. Totalling £2.5m over the five years.

Through our ***Workforce Resilience Strategy (Annex 16.3)*** we will nurture our existing workforce, champion inclusion and diversity, and provide career opportunities for education leavers by creating roles in digital analytics, data development, operational field training and cyber security. This sets a foundation for a sustainable workforce that can meet the net zero challenge and provides a pipeline of skilled individuals for the societies we serve. As an infrastructure provider, reducing our Business Carbon Footprint (BCF) is a key

[6] SBTi launches world-first net zero corporate standard - Science Based Targets
[7] SBTN-initial-guidance-for-business.pdf (sciencebasedtargetsnetwork.org)

focus of our plans and we're developing this action plan which will govern how we protect, preserve, and restore the environment we operate in for future generations.

As well as addressing our BCF by a minimum of 35% in RIIO-ED2 - through reduced travel, fuel, and energy consumption, reducing losses and SF_6 leakage, our EAP also sets out our commitments for scope 3 emissions such as embodied carbon and supply chain management to ensure a circular economy emerges, biodiversity and investment in natural capital to enable carbon sequestration. We will improve environmental beauty through visual amenity investment, reduce the risk of pollution from our assets, and tackle our approach to resource use and waste. All of this together ensures that the environmental values added is sustainable in the long term and not dealt with in isolation. The delivery of all our plan will be driven by informed conscious decisions.

We'll also address Climate Adaptation in areas like flood resilience. Committing to set targets with the Science Based Targets initiative (SBTi) to ensure we play our part in limiting global warming to 1.5°C (or in line with current net zero legislation). We are committing to a reduction in business mileage and travel from pre covid levels, building a new working approach that allows colleagues to continue working flexibly where they can and learning from our pandemic delivery experience, we have proven that remote working can be done effectively, and we are harnessing that progress to ensure we achieve the right balance going forward.

Furthermore, as signatory of the Climate Group's EV100 commitment, it's our aim to make electric vehicles the new normal by 2030 so we're decarbonising our fleet and moving all company vehicles to be fully electric. More detail can be seen in section 8.21.

2.6 SUSTAINABLE ECONOMIC VALUE

As part of SSE plc, we've committed to fair and transparent tax practices supporting the services society needs to thrive. We were the first FTSE 100 company to receive the independent Fair Tax Mark and have been reaccredited every year since 2014.

We're proud to take a leading role in championing Fair Tax practices and want to work with our energy networks peers to ensure standards of transparency, like the Fair Tax Mark criteria are widely adopted across the industry.

We contributed £1,006m to the UK GDP over the 2019-2020 financial year and supported 9,710 jobs across the UK.

Over the past year, we've also actively committed to accelerating network investment to support a green economic recovery and the creation of jobs and skillsets to put us on the path to net zero. We play a fundamental role in the wider economy contributing £1,006m to the GDP economy annually and support 9,710 jobs across the UK in our wider supply chain and communities.

In November 2017, we committed to meeting the Task Force on Climate-related Financial Disclosures (TCFD) recommendations in full by March 2021. The TCFD was set up by the Financial Stability Board (FSB) to review how the financial sector can take account of climate-related issues and develop recommendations for more effective climate-related disclosures. This enables stakeholders to better understand the concentrations of carbon-related assets in the financial sector and the financial system's exposures to climate-related risks. For SSEN Distribution we report on risks to our network and business performance that are driven by climate change for example the increased risk of flooding, or the risks to our assets due to increased temperatures, including wildfires and droughts. We also review opportunities like Decarbonisation, and the electrification of heat and transport, and what that means to our business for the here and now and in the future.

3. DELIVERABILITY AND JUSTIFICATION

3.1 DELIVERING EFFICIENCIES AND VALUE TO CONSUMERS

Through our EAP we will ensure that innovations tested and proven in RIIO-ED1 are rolled-out effectively. This is demonstrated through our use of Transformer Auto Stop Start initiative (TASS), which will drive significant reductions in losses at a more efficient cost to customers compared to alternative solutions. Our whole systems strategy sets out how we will work with a broad range of stakeholders to explore whole systems solutions to address the challenges we face, in particular in delivering sustainable back-up generation alternatives that also provide security of supply. We are also transforming our commercial and supply chain strategy to meet the step-change in performance required to deliver ED2, with a focus on driving sustainability throughout our whole supply chain. Collectively these investments and strategic changes will allow us to deliver ongoing efficiencies throughout ED2 (of 0.7% per annum, as set out in ***Costs and Efficiency (Chapter 15)***), as well as efficiencies of over £14m through a reduction in unit rate of PCBs due to economies of scale. OBJ

3.1.1 DELIVERABILITY OF OUR PLAN

Our ambitious environmental targets will require a step change in performance to deliver the increase in volumes at efficient cost and to develop the new capabilities required to deliver RIIO-ED2. Of particular note is the level of work required to remove all PCB contaminants from our networks by December 2025, at a time when all DNOs are undertaking a similar programme of work. This could create supply chain issues and increase costs. We have set up a task force to review this programme of work and will ensure this is captured as part of our overall deliverability strategy. Biodiversity and investment in natural capital is a new area of investment for us, and we are beginning our learning now to ensure we are ready for RIIO-ED2. Our ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)*** describes our approach to evidencing the deliverability of our overall plan and activities in key individual areas. We are working with our supply chain to test and refine our ongoing contracting strategy to deliver RIIO-ED2 most efficiently and to ensure both our internal and contractor workforce have the skills and scope to deliver our plan (as detailed further in our supply chain and workforce strategies). All our supporting Engineering Justification Papers (EJPs) which underpin our investment plan have explicitly considered deliverability in their options assessment.

Through our commercial strategy we have also identified opportunities to optimise and streamline our delivery approach across different investment drivers and the requirements of our workforce and supply chain, as well as reducing disruption for consumers. We have full confidence that we are able to deliver our EAP within the delivery of the overall Business Plan.

3.2 IF WE TAKE NO ACTION

Ofgem has asked for DNOs to consider the impact on the environment by not undertaking any interventions. We have presented in our Business Plan Data Tables modelled activity if no action was to be undertaken (Memo Table 23, table 2), but we do not believe that this is a credible approach, and it goes against all of our stakeholder feedback. Doing nothing means that all of our emissions go up, our diesel consumption rises, SF_6 leakage will continue, and we won't look for alternatives, oil will leak into our watercourses, and we will continue to lose electricity through our network which will drive customer bills up. Biodiversity of our local areas will decline, and we will not met net zero. Doing nothing detracts from our step change approach that we are proposing in RIIO-ED2 – to move improve performance from ED1. We do accept and acknowledge that actions undertaken elsewhere within the energy system, and beyond, will help to reduce the environmental impacts as we collectively move towards net zero. For example, grid decarbonisation may bring positive consequences to our business carbon footprint through a reduction in the carbon value in losses, however we absolutely need to take accountability for our complete footprint. Our Business Plan and our actions outlined within our EAP are consistent with our internal direction of travel in support of this wider aim. We believe that a step change is required, moving beyond the activity implemented in RIIO-ED1 and therefore we are presenting ambitious plans across our business to reduce our environmental impacts as we transition to RIIO-ED2 and the journey to net zero. In addition, the do-nothing approach would mean that we were not delivering on Ofgem minimum requirements.

4. RIIO-ED1 PERFORMANCE

Our ***Track Record chapter (Chapter 2)*** provides more detail on our performance against key RIIO-ED1 performance metrics and incentives.

4.1 RIIO-ED1 HIGHLIGHTS

Taking a leadership position and improving transparency

In January 2021, we committed to setting accredited science-based targets (SBTs) with the Science Based Target initiative. SBTs are targets for greenhouse gas emission reduction. Using SBTs gives stakeholders and customer assurance that we are being transparent in our efforts to reduce our BCF, that we are making a valid contribution to minimise the risks associated with dangerous climate change, and that we are on a credible pathway towards achieving net zero.

Reducing our carbon emissions

Overall, we have improved our BCF reduction performance since the start of RIIO-ED1 and are making good progress towards our target of 15% reduction by the end of the period.

Electricity losses result in unnecessary emissions and cost to customers. In RIIO-ED1 we have focused on two areas responsible for electricity losses: theft and unregistered supplies, and technical losses from operating our assets. Combined, losses are responsible for 91% of our business carbon footprint (Scope 1 & 2). Our #NotWorthTheRisk campaign has been successful in deterring theft. We have also reduced technical losses across our network through our programme of upgrading cable sizes and network voltages. In RIIO-ED1 we have reduced losses by 32,097 MWh to date and forecast losses savings of 77,901 MWh to the end of RIIO-ED1. Our RIIO-ED1 losses strategy is available at on the SSEN website[8].

We continue to focus on addressing the environmental impact our assets, particularly Fluid Filled Cables (FFC) and SF_6 leakage. We no longer install FFC on our networks and we continue to tag our existing cables with a tracer oil to efficiently locate and repair leaks. Our strategy to minimise SF_6 leakage from our switchgear, implemented in 2019/20, focuses on using updated data to improve our understanding of our SF_6 assets. We had an ambitious ED1 target on both our networks to reduce SF_6 by 15% and although we are currently behind, we are seeing benefits from the strategy and expect continued improvement of our performance in the final years of this price control.

We have experienced several major subsea cable faults across RIIO-ED1 which has resulted in the use of diesel power stations as interim solutions to restoring power. Whilst this is a necessary step to ensuring our islands are supplied with electricity, it highlights the importance in RIIO-ED2 of finding greener alternatives as we seek to reduce the negative impact we have on our surrounding environment. We have produced a Diesel strategy and commit to implementing that strategy in ED2, this strategy can be found in Appendix D.

RIIO-ED1 learnings

We have learnt significant lessons in ED1, particularly the importance of the environment and sustainability as a key driver across the whole of our business:

- We are changing our approach in RIIO-ED2 and have already embedded a dedicated team tasked with achieving ISO14001 accreditation by the end of RIIO-ED1. This will underpin our Environmental Action Plan activities in RIIO-ED2.
- We are taking a strategic approach to key environmental issues across our plan, proposing PCDs in a number of areas to demonstrate our commitment to reducing our impact and delivering on stakeholder promises.
- The need to align with globally recognised frameworks - they provide a strong foundation and provide assurance to our stakeholders that we are on a credible pathway.

Our use of innovation in ED1 has provided valuable insight and learning:

- We will take the learning from network innovation projects and convert that learning into business as usual as evidenced by our Transformer Auto Stop Start (TASS) investment programme that targets loss reductions in our primary substations

[8] https://www.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=13590

We face specific challenges in the island communities we serve, where diesel generation still plays an important role in ensuring a reliable supply of electricity.

- ➔ We are committed to exploring alternative solutions through our RIIO-ED2 plan, with a strong focus on whole systems and innovation (see further details in ***Whole systems (Annex 12.1)*** and ***Innovation Strategy (Annex 14.1)***)

4.2 BENCHMARKING

On industry performance:

We have carried out benchmarking on our ED1 performance and we are currently (2019/20) ranked 14th and 8th for SSEH and SSES respectively. **A considerable step change** in our approach to the Environment is required if we are to contribute to and deliver on Climate Change legislation relating to Net Zero. A credible SBT will provide clarity on the task, which is significant, and assurance to our regulator and Ofgem that we are on a credible carbon reduction pathway.

Our RIIO-ED2 planning work has outlined the reasoning behind our performance and there are definite lessons we can take from ED1 as outlined above, particularly regarding high quality data, however, there are credible regional differences that need to be highlighted. Our diesel consumption for our fixed generation on our Scottish islands is the main contributor to this at 34.5% of our combined Scope 1 & 2 emissions (excluding losses[9]), with this consumption predicted to rise over the short term with Lerwick transitioning. The Shetland HVDC Transmission link will remediate that consumption increase if it goes ahead as planned and is a great example of whole system solutions in practice. These stations are used as back up generation on our islands due to the nature of our network. They are there to manage planned and unplanned outages to ensure security of supply to some of our most isolated and vulnerable customers. The failsafe solution is expensive network reinforcement like additional subsea cables; however, this comes at high cost. To protect the consumer from this cost we continue to utilise the standby generation system, meaning that this problem is not going away in the short term. There are also other subsea cable projects which again will help reduce the reliance on these generators in some areas. However, we need to accept and ensure that we make RIIO-ED2 a transition price control for our diesel consumption. We have been open with our stakeholders that this will remain an issue but understand that our customers want a stable security of supply. Additionally, we know that with the changes at Lerwick Power Station our diesel emissions will go up in the short term. Our Diesel Strategy can be found in Appendix D, includes a breakdown of our unique Diesel situation, and describes a pathway to target the issues through targeted innovations, exploration of alternative fuel types and new ways of working to proactively reduce emissions associated with Diesel. We also believe that the solution could lie in a whole system approach and flexibility service offerings. Meaning in ED3 we can implement solutions from this learning to transition away from dirty fuels and achieve our longer-term targets. Further details can be found in our ***Scottish Islands (Annex 8.1);*** our ***Whole System (Annex 12.1);*** and, our ***Uncertainty Mechanism (Annex 17.1).***

[9] Losses are a Scope 2 emission and make up 91% of our combined Scope 1 & 2 emissions. We will also report these separately to ensure our other material areas are also targeted.

Operational Transport is the next material contributor at 29% (excluding losses) and our EV100 commitment[10] will be key to the delivery of the SBT.

On wider performance, and examples of best practice:

We have looked externally, mainly to learn and extract examples of good practice and have been encouraged by progress across other industries, mainly biodiversity approaches from water companies which gave us the courage to include ambitious targets in our plan. Other regulators have been particularly interesting in their approach and have launched initiatives in this area. The initiative from OFWAT, proposed by Anglian Water in particular directly relates to our proposed Life Below Water CVP proposal, which can be seen in more detail in ***Consumer Value Propositions (Annex S 3).***

We have also looked at examples of islanded communities across the globe on how they are managing island networks for smaller communities, there are some useful examples, in particular the Greek islands - which have contributed to our learning for our Diesel Strategy (Appendix D).

DNO and Ofgem working groups are ongoing and together, we will develop an environmental scorecard for inclusion within the RIIO-ED2 framework. In order to set appropriate baselines and targets for the scorecard we will use our past performance, other DNOs performance, and performance of other industries where applicable, to justify and benchmark out targeted performance.

On data improvement:

As we digitalise, we have ambitions to improve and overhaul how we use our data. We have set up asset data taskforce workstreams, targeted at environmental issues like for example polychlorinated biphenyls (PCBs). We have undertaken a data maturity assessment, we are currently planning to undertake an external sustainability maturity benchmarking assessment, as part of our wider sustainability strategy work. This will help us to understand and plan what our data journey needs to be to improve reporting frequency to ensure we track progress closer to real time and ensure management interventions can happen in time to respond to any issues, ensuring performance against targets over the longer term.

On procurement and supply chain management:

During RIIO-ED2 we will be aligning with ISO 20400 Sustainable Procurement standard which provides guidance for any organisation of any size or type that needs to deliver sustainable outcomes through their supply chain. In March 2020 a gap analysis was completed to understand sustainability risks and opportunities within our supply chain and the result was a detailed category risk heat map. Moving through RIIO-ED2 we will ensure a 'golden thread' strategy is developed that aligns Sustainable Procurement to the SSE Group 2030 Goals. We will develop and embed appropriate sustainable measure(s) that link Corporate Sustainability to our supply chain and introduce a reporting system which collates supply chain data to track progress against our 2030 goals.

Lessons learnt are to improve our supplier code to expand and improve all aspects of Sustainability, we undertook this at group level and have now duplicated that at distribution level across both license areas

[10] EV100 Commitment, commits us to converting 100% of our operational fleet (<3.5t) by 2030.

and have a credible action plan to move this forward – full details can be seen in our ***Supply Chain Annex (Annex 16.2)*** The output of this work will be our Sustainable Procurement Charter.

Again, looking at best practice we have now collaborated with the Supply Chain Sustainability School to help us both assess our level of understanding and experience on critical elements, benchmarking us against industry levels, and then highlighting where we need to target training and skill enhancement.

This also allows our entire supply chain to access this service and build their own skill level up to ensure that we all move forward together, this will help us tackle our Scope 3 emissions.

5. OUR EAP ASSESSMENT METHODOLOGY

Our assessment methodology is founded from our companies Environmental Governance. Our policy statement and environmental strategy documents provide us with robust guidance to enable an extensive assessment of our business and the environmental impact it already has, and what is potentially a risk for the future. The output of this is SSEN Distribution environmental plan that is produced and approved by our business unit SHE and Executive Committee, these are reported against annually and published alongside our group annual accounting Sustainability Reports[11]. The strategy provides the business with a tool to communicate and drive key environmental goals forward that contribute to both our delivery of regulatory targets through the ED1 process, but also to the delivery of our wider company goals. We all pledge to share the key messages with our teams and colleagues to raise environmental awareness, discuss what the environmental strategy means for us and our teams in our business areas, and empowers us all to act by making conscious decisions to consider the environment and help SSE drive climate mitigation and adaptation to preserve the natural environment. These are reviewed on a quarterly basis and new concerns are logged and monitored for inclusion in our future plans.

We also have our own regulatory, compliance commitments, and past performance to look at when assessing our impacts, we currently report on our performance against our targets – including our ED1 regulatory commitments through our SSEN Environmental Annual Report[12] This report also contains our performance in Innovation.

Our business unit reporting records and tracks any environmental incident or complaint, this process is primarily for managing the incident however, from there we can assess cases individually and learn from any trends that are forming.

For RIIO-ED2 specifically we started by creating a carbon inventory and identifying the material risks, which we also undertook under the guidance of the SBTi – which gave us a great start. However, we wanted to make sure we took a fresh approach by carrying out an assessment of our network in its entirety to validate our thinking in a structured and systematic examination of all the network elements from grid supply point to meter, assessing the impact or risk of impact. We then followed a similar review of our operational activity. It is our intention to expand this further and build this into our integral processes going forward by undertaking this “bottom up” level of assessment more frequently.

[11] https://www.sse.com/sustainability/reporting/
[12] https://www.ssen.co.uk/DistributionPriceControlReview/ Environment Report 2020.

Again, to ensure we were not missing anything and learning from our colleagues and other industries we undertook a "top down" materiality assessment across all 17 SDG's, assessing each one in turn and recording the impact that we could have or contribution we could make to the deliverability of each SDG. We used our stakeholders to help validate the outcomes of this study, and we refined down to our eight SDG's as outlined in section 2.2 above.

The output of the sessions were pulled together, grouped where appropriate and reviewed to determine the materiality and potential consequences in the event of an incident. This produced our potential environmental action list, against each area we prepared options where appropriate (including engineering justifications and cost benefit analysis) we modelled the different options utilising Tableau software to see which proposed projects would deliver the most benefits. We used this information in our engagement with stakeholders to help us refine the resultant content of our EAPs, particularly in areas where we were proposing significant investment like fluid filled cables and overall business carbon footprint objectives, further explained in section 8.[13] **Figure 6** shows our top-down bottom approach.

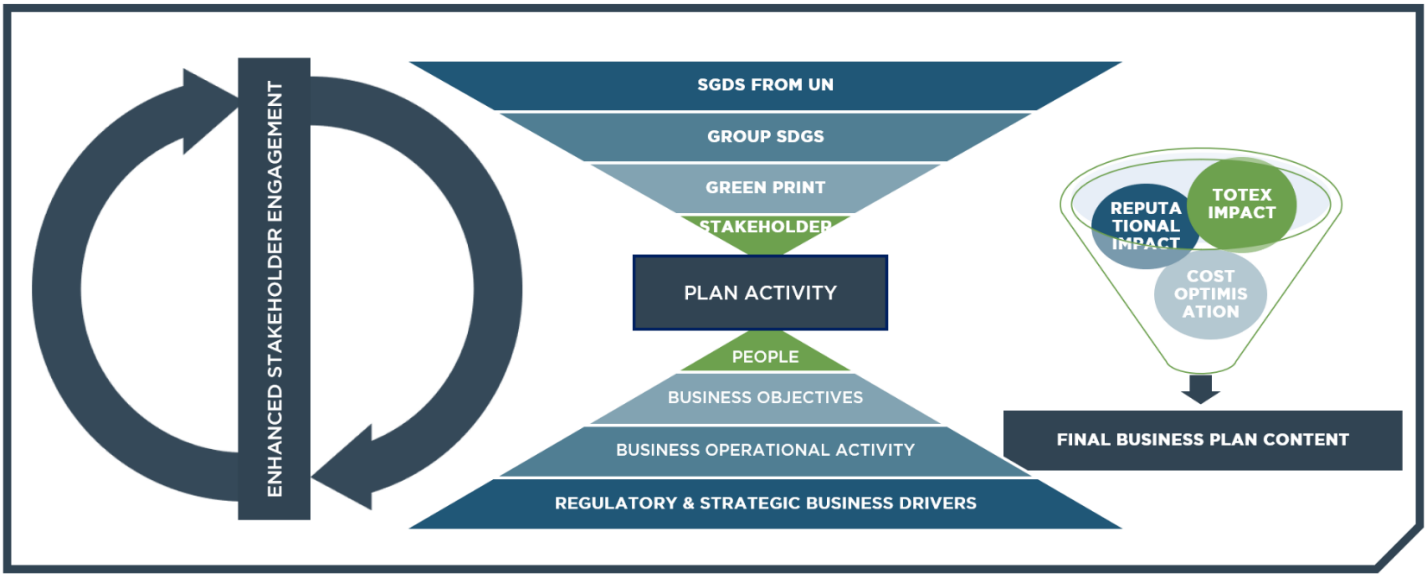


Figure 6 - Top down, bottom-up approach

Other workstream activity was used to inform our plans, for example network growth was modelled on our current view of the Distribution Future Energy Scenarios (DFES), allowing us to model our network carbon growth in a consistent way with the rest of the plan, and we could include this growth in our targets (see ***Forecasting and Scenarios (Chapter 9)*** for further details). We worked closely across other areas of our plan to communicate and test our proposals, to ensure we were highlighting areas of concern, alerting other workstream leads to consider in their plans particularly when we were trending particular issues with specifics that we need to avoid in future, but also to ensure that interventions we were proposing were not being identified anywhere else, so we would overlay all investment programmes and ensure the correct primary investment driver was identified and no double counting was occurring. This also allowed us to start clustering projects to ensure efficiencies and follow our ambition of "touch the network "efficiently" approach (see ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)*** for further details).

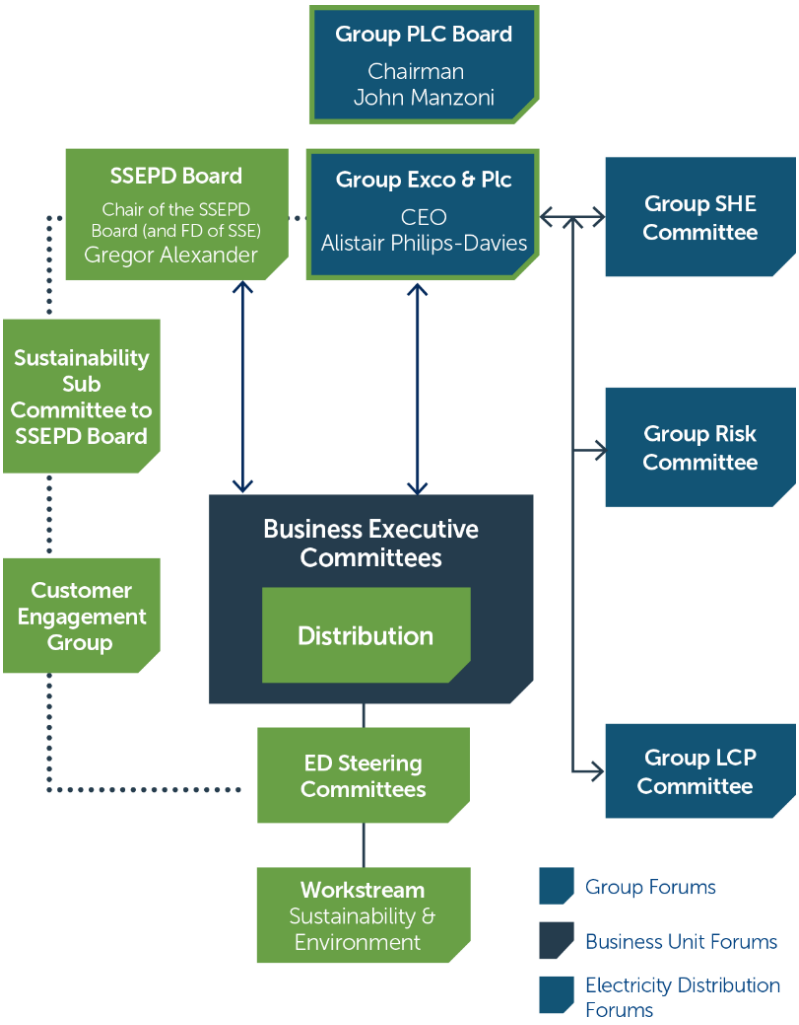
[13] The summary of this engagement can be seen further in Appendix A

Governance

All of this had robust governance wrapped around it, we have strong leadership and governance in place that not only helped create our EAP but also to drive our EAP forward. SSE places a heavy emphasis on driving sustainability performance from the 'Top Down', with sustainability performance metrics included in SSE Executive Directors' professional development goals.

As part of building our own Distribution Sustainability identity and our commitment to accountability we have developed a governance route to our Scottish & Southern Energy Power Distribution (SSEPD) Board. To ensure transparancy and develop trust, we will commit to public disclosure and reporting of progress related to climate action and environmental management. **As can be seen in Figure 7.**

Organisation and Action Planning A critical first step in embedding sustainable practices across SSEN Distribution is the need for simple and consistent management system approach. This includes a certified environmental management system (EMS) as well as clear and accountable internal management processes, underpinned by standards for sustainable procurement and future development. We are in the process of developing an ISO14001 EMS, to enable us to plan, implement, document, measure, and track progress against this Plan.



Monitoring and Reporting

To provide oversight and transparency on the progress during RIIO-ED2, a robust monitoring and reporting framework will be developed. SSEN Distribution will communicate progress through the RIIO-ED2 Function Team, to the Chief Sustainability Officer (CSO). The CSO is a Non-Executive Director on the Board of Scottish and Southern Energy Power Distribution (SSEPD), the subsidiary holding company for SSE's Distribution and Transmission businesses.

Figure 7 - Distribution within SSE Group PLC Corporate Structure

Disclosure and Reporting

SSEN Distribution supports SSE Group's commitment to disclosure, to support transparency of progress related to climate action and environmental management. We engage in annual reporting through external frameworks and partnerships. We believe it is important to report on our progress and to articulate the climate-related risks and opportunities of the business to its stakeholders. SSEN Distribution will report progress on this strategy through SSE's GRI focussed Annual Integrated Report and our own Environmental Report published on an annual basis. In 2020 we engaged in climate related financial disclosure utilising CDP and Task Force on Climate-Related Financial Disclosure (TCFD) and have continued to report on this platform on an annual basis.

In short it starts with an assessment of our current operations impact on the environment in line with our Environmental management procedures and company governance processes. We have a fully mapped out governance route to board level with robust assessment procedures. This allows us to review all our operations impact and assess the materiality of these and what we are doing about them. Information is taken and fed back through our workstreams in the lessons learnt process. We report annually to our stakeholders through our Environmental Report[14].

6. OUR EAP SCOPE AND OUTPUTS

The Environmental Action Plan has been formed as a result of the robust process laid out in section 5 above, and from Ofgem Minimum Requirements, legislation changes, built on by stakeholders and other activity across the plan and driven by our now required Science Based Targets. We went through a process to further understand our compliance areas, our track record and material impact areas, our stakeholder's preferences and what was causing the most harm. Our outputs table in section 6 outlines the deliverables, outputs, and environmental benefits that we intend to deliver from implementing the EAP. Section 8 goes through them in further detail.

Table 2 outlines our EAP commitments. At a cost of circa £172.3m, our EAP will deliver benefits from 15 targeted output areas, some of which will fall under the ODI-F Environmental Score Card, the rest are made up of Business Plan Commitments, PCDs, a UIOLI (Use it or lose it) allowance for Visual Amenity and targeted outputs to address substation Flood Mitigation works. We have a commitment to annually report our EAP progress under an ODI-R to our stakeholders. As a result of the interdependencies across the plan our EAP will also act as a reference point for all positive environmental impacts achieved elsewhere.

[14] https://www.ssen.co.uk/WorkArea/DownloadAsset.aspx?id=21231

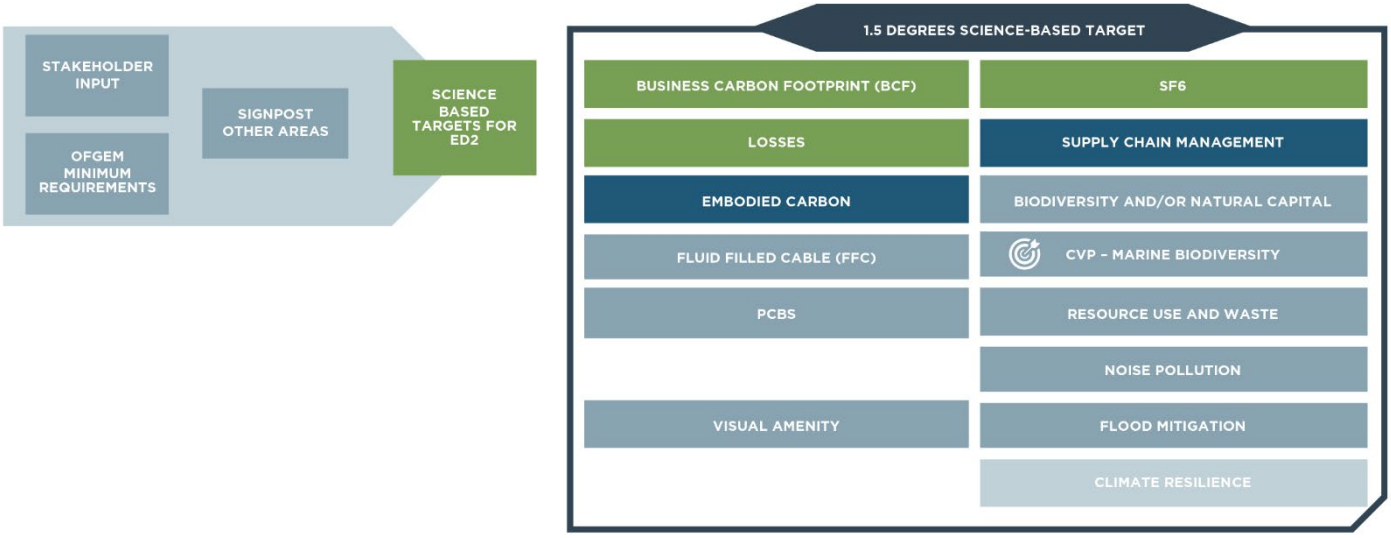


Table 2 - EAP Scope

Our EAP tackles two principal areas as a minimum:

1. Decarbonising the Network

2. Reducing the impact of our network on the environment

Our work to establish the critical material impact activities also through biodiversity and natural capital investment as a critical cog in the net zero wheel. These are explained further below.

Decarbonising the network

Our SBTs stipulate the targets in terms of carbon reduction, and key investment decisions are targeted at those. Our proposals have gone through a selection criteria and solution development including learning from Network Innovation Allowance (NIA) projects. Where the technology is not proven we are requesting investment to address the issues and to develop a solution. Environmental projects are difficult to prove in the Ofgem CBA tool, however where possible, we have assessed solutions through optioneering and CBAs. We have utilised other methods to assess societal benefits and looked to industry for guidance particularly with our biodiversity and natural capital investment proposals. In addition, the CBA tool uses 2018 BEIS prices, using more up to date carbon figures actually shows investment proposals more positively, like in the SF_6 case for example. We hope to continue to work with Ofgem to develop credible methods that recognise the wider benefits that these projects can deliver. In the case of the islands, we are reviewing the impacts of traditional reinforcement versus diesel replacements. These investments are reinforced by strategy directions for SF_6, Diesel and Losses.

Our SBTs

We are aligned with the latest climate science and public policy with a 1.5°C pathway. This translates into a 55% reduction in Scope 1 and 2 emissions by 2033, and a minimum 35% reduction by the end of RIIO-ED2. We are currently investigating our Scope 3 Science Based Targets, whilst not a requirement to have targets set against Scope 3 - we have voluntarily committed to a target in this area meaning we aim to have 35% of our supply chain having also set an accredited SBT by 2026, which will reduce our embodied carbon. Our diesel consumption makes us an outlier with the other DNO's due to our fixed generation in SHEPD. We will ensure our fault management, reliability and remote island generation strategies will reflect our reduced reliance on diesel.

The carbon value of losses will be greatly affected by the decarbonisation of the grid; however, decarbonisation does not resolve actual losses, and with our continued progression towards smarter grids and use of flexibility, actual losses are likely to increase further. By classifying losses as Scope 2 - make up 91% of our combined Scope 1 & 2 emissions, we are ensuring that they form part of our accredited targets and therefore we will do all that we can to tackle them going forward. That said we will report on our BCF both with and without losses – so that our stakeholders can see the other material impacts of our network. Our EAP tackles all areas of our BCF.

We also recognise that as we become more digitalised and adapt to new ways of working, there are other areas we want to understand better that will influence and contribute to our BCF, for example the use of data centres and how we capture the carbon impact of our at-home workers. We are committed to understanding this and will develop credible methodologies with the GHG Protocol and report on our progress in this area as part of our annual report. Our progress against our SBTs will be monitored via our ISO14001 management system.

Reducing the impact of our network on the environment

The preservation and restoration of our natural environment is critical if we are to have any chance in proactively managing and mitigating against dangerous climate change. It is important to us and to the communities we serve. Our plan will begin the journey to restore the impact our network has had on the environment - through the mitigation of oil leaks, the removal of contaminants, investment in our natural capital, implementation of circular economy principals right through to our supply chain, reducing noise, and being mindful on our resource use and waste.

Biodiversity and Natural Capital

Improving our natural capital across the communities we touch is not only import to our local eco systems and habitats but also critical to our wider net zero aspirations. We will do this by investing in our natural capital through strategic planting to counteract our tree cutting operations, by maintaining control of this ourselves or with trusted partners we can ensure the credibility of carbon secretion rates, and improved air quality for the longer term for us and our local communities. Acting now means we build a sustainable carbon sequestration resource in time for meeting climate legislation. In our engagement from draft to final our stakeholder support for this work has been strong, especially how this plays a part in the delivery of a credible net zero and this was a clear preferred approach over "carbon offsetting". The engagement has been rich and has fundamentally shifted our plans in this area, instead of blanket reforestation they were really keen to see a portfolio of investment to include other restoration – like peatland. They have

also voiced their preference to ensure our reforestation contains a blend of species types and tackles native woodland to ensure we restore considerately.

Stakeholder led investment

Stakeholder, customer, and community support for the environment has never been stronger, we have seen an increase in not only engagement, but also understanding and support for our environmental ambitions. We have also been encouraged to be fully accountable for our impact on our local environments and the delivery of any commitments made.

With this in mind our EAP will detail targeted projects and outputs to deliver against Ofgem and stakeholder requirements. We want to show where investment interventions contribute to achieving our environmental commitments in a fully transparent manner, meaning our reporting will be directly against these co created outputs providing clear visibility to business plan commitments.

Learning from previous price controls, our proposed investments through our EAP have been developed alongside other areas of the plan, for RIIO-ED2 investment programme we are absolutely clear on the principal investment driver – ensuring that when it comes to project planning and execution, we understand the benefits of completing the targeted work. Since this is a relatively new approach to take, and to demonstrate how committed we are to delivery we are proposing to volunteer for price control deliverables where appropriate, providing Ofgem and stakeholders with a route to ensure we are held accountable for delivery.

6.1 OUR COMMITMENTS TABLE

Our commitments table below details our business plan outputs and further environmental action plan commitments, all of which combined total up to our EAP costs of £172.3m. The additional commitments are marked with a leaf.

Commitments	Type	Target	Consumer benefit	Costs included in our baseline plan
S1. Environmental Action Plan	**LO/ ODI-F**	Produce and report annually on an Environmental Action Plan (EAP)	• Decarbonisation and improved environmental performance of our network and the wider community • Improved air quality, reduced carbon emissions and net zero	**£172.3m**(our EAP total)**
S2. Set Science-Based Targets, accredited with the SBTi	**Part of EAP**	Set an ambitious 1.5°C SBT (including losses) requiring at least a 35% reduction in our carbon footprint by 2028	• Reduced carbon emissions • Targeting embodied carbon through supply chain	Part of EAP
S2.1. Reduce travel-related emissions	**SSEN Aim / Part of EAP**	Electrify 80% of our core vehicle fleet by 2028, reduce our average road mileage by 15% (from pre-covid levels) and limit air travel where possible.	• £1.9m societal benefits delivered by reduction in carbon emissions	Incremental
S3. Reduce emissions from mobile diesel generation during interruptions	**SSEN Aim / Part of EAP**	Reduce emissions by replacing mobile generators wherever possible with lower carbon alternatives or by using alternative lower carbon fuel types by 2028	• £1.4m financial benefits delivered by reduced fuel costs • £1.5m societal benefits delivered by a reduction in carbon emissions and improved air quality	Part of EAP (£2.2m)

S4. Reduce reliance on back up embedded diesel generation on our islands	**SSEN Aim / Part of EAP**	Reduce reliance on diesel back-up generation, exploring local solutions and flexibility opportunities from the start of ED2	• £0.4m financial benefits from reduced fuel costs • £0.2m societal benefits from reduced carbon emissions	Part of EAP (£9.5m) Also captured in ***Scottish Islands (Annex 8.1)***
S5. Manage losses on our network	**Part of EAP**	Implement a strategy to efficiently manage losses on our network in the long-term: Re-classify losses as a Scope 2 emission and act to reduce actual losses	• Reduced transformer losses by up to 30% through our TASS project • Substation Energy Efficiency improvements • Manage significant losses incrementally across our network by applying loss reduction tech first • £36m societal benefits delivered by energy savings and lower carbon emissions as a result of reduced losses	Part of EAP (£4.9m) + Incremental costs across the plan
S6. Reduce SF_6 emissions from our assets	**PCD / Part of EAP**	Reduce emissions from our assets by a minimum of 35%, report on and begin reducing our holdings	• Reduction in the amount of toxic gas emitted by our assets, in line with our 1.5°C SBT. • £2.5m societal benefits delivered by reduction in carbon emissions	Part of EAP (£5.6m)
S7. Nature-based solutions for carbon removal	**PCD / Part of EAP**	Baseline and further Plant 2,000 hectares of native woodland and restore 1,200 hectares of peatland in our licence areas, which are expected to remove up to 300,000 tonnes of CO_2e by 2045, and provide 3,000 biodiversity units by 2045.	• Biodiversity baselining • A transformational and longer-term approach for net zero, that provides a legitimate and transparent record of carbon abatement. • Improved air quality and local habitats	Part of EAP (£26.4m)
S8. Reduce leakage from fluid-filled cables	**PCD / Part of EAP**	Replace 72km of fluid filled cable and reduce oil leakage by 20% relative to 2019/20	• £15m societal benefit delivered by reducing oil leakage	Part of EAP (£37.3m)
S9. Undergrounding in Areas of Outstanding Natural Beauty and National Parks	**UIOLI**	Complete undergrounding of up to 83km of lines	• Improved visual amenity of lines in National Parks and Areas of Outstanding Natural Beauty	Part of EAP (£11.0m)
S10. Complete flood-related activities in compliance with obligations	**PCD / LO / Part of EAP**	Complete works at c.73 sites across our network in line with ETR138	• Reduced impact of flooding on our network leading to improved resilience to climate change	Part of EAP (£24.2m)
S11. Sustainable Supplier Code	**SSEN Aim / Part of EAP**	Sign up 80% of our supply chain (by value) by 2028 to our Sustainable Supplier Code	• Contribution to lower emissions across multiple companies in our supply chain.	Incremental
S11.1 Environmental reporting	**Part EAP**	Create Environmental reporting to include Embodied Carbon and Biodiversity	• Reduce lifecycle emissions and embed circular economy principles to reduce waste • Create Biodiversity Baseline • Take efficient actions to reduce noise pollution and report on these actions	Part of EAP (£0.2m)
S12. Protecting marine biodiversity: Life below water	**CVP**	Explore opportunities to improve our marine environment	• Restoring ancient seagrass beds that have been destroyed by seabed activity provides carbon sequestration rates three times higher than on-land planting, • Improved natural habitats and protection against coastal erosion • £3.3m net benefit to the environment	£2.6m (not included in EAP total)
S13 Resource use and waste	**Part of EAP**	Commit to Zero Waste to Landfill (excluding compliance waste) by 2028	• Reduced waste from operations • Resource Use Standards in place by 2023	No additional costs
S14. Polychlorinated Biphenyl (PCB) compounds	**PCD / Part of EAP**	Remove of all PCB-contaminated assets from our network by 31 December 2025	• Compliance with new legislative requirement to remove PCB across all DNOs. • Transparency on the volume of PCB contaminated equipment on the network (through our Annual Environmental Report)	Part of EAP (£41.6m)
S15. Bunding	**Part of EAP**	We will construct bunding to bring assets in line with current Oil Storage Regulations with particular focus on assets that are in environmentally sensitive areas.	• Reduce the risk of pollution from un-bunded equipment in environmentally sensitive areas	Part of EAP (£9.5m)

LO: licence obligation; **PCD:** price control deliverable; **ODI:** output delivery incentive (**F:** Financial, **R:** Reputational), **CVP:** Consumer Value Proposition, **SSEN Aim:** company goal

Table 3 EAP Commitments

7. SUSTAINABLE ENGAGEMENT

7.1 SUSTAINABLE COMMUNICATIONS

Co-creating our EAP ambitions with our stakeholders over the past two years has proved invaluable. It has provided us with so much depth and excellent feedback to challenge and shape our thinking, resulting in an approach that covers all aspects of our business. We will continue with this approach to ensure we create a plan that resonates and delivers on stakeholder thinking, satisfies customer needs and meets consumer expectations.

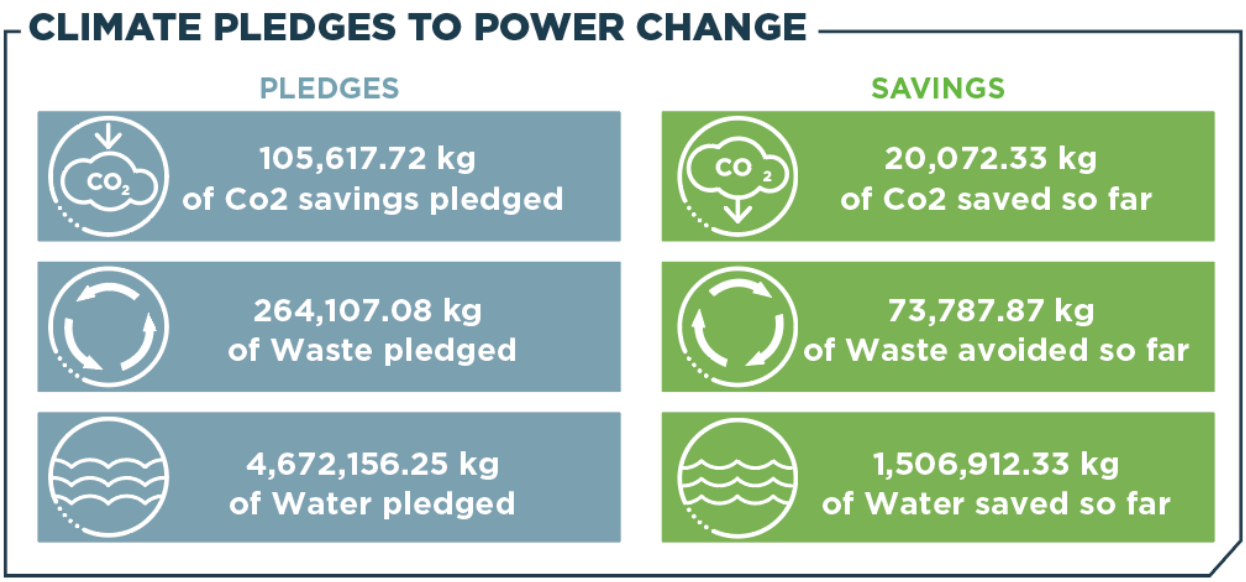
We have reviewed all feedback on our Draft Business Plan before our final submission, however given that this landscape is continuously moving, we are keeping out engagement channels open and continuously refining our approach. This past 18 months has proven that there is no "normal" and barriers that we thought existed are no longer there. We have discovered new ways of working and getting things done, we must continue to learn and evolve and challenge ourselves to overcome residual barriers as we all look to an effective and fair green recovery. So, our communications will also be sustainable and enduring to harness smart thinking and report on our commitments.

7.2 SUSTAINABLE PEOPLE

At SSEN we take pride in creating a culture fit for the future that encourages our staff to lead by example and think about the impact their actions have on the environment at work and at home.

- Supply Chain Sustainability School Membership – Our membership allows us to offer our staff, and our supply chain, the opportunity to upskill themselves by accessing a free learning environment with thousands of learning resources and CPD-accredited content with focus on 17 key sustainability topics.
- Climate Academy – We have launched the Climate Academy, a series of five online learning sessions introduced by our senior leaders and available to all colleagues. In partnership with the Supply Chain Sustainability School, the Climate Academy provides colleagues with a rich knowledge and understanding of climate change issues and what we can do, as individuals and as a company, to combat them. In line with the key themes of COP26, the sessions shared insight on safeguarding, protecting, and enhancing the environment, with an emphasis on education and awareness of climate change. Added to this was a strong focus on social inclusion, and creating a more fair, just, and inclusive society at local, national and international levels.

- Pledge to Power Change – At SSE Group level we have encouraged all staff to make climate pledges to power change to tackle our personal impact on the environment, these range from pledging to taking shorter showers and ditching disposable cups to donating old clothes and switching your car to EV. Results are below:



As you can see pledges against personal impact can make a massive contribution to managing climate change. So far SSEN Distribution have made 1276 pledges and have saved:

- 20,072.33 kg of CO_2 equivalent to 34 flights from London to New York
- 73,787.87 kg of Waste equivalent to 74 bin lorries
- 1,506,912.33 kg of Water equivalent to 6.4 million cups of tea

These initiatives were well underway but not called out specifically before, however at our Citizens Jury event we were challenged to think outside the box, and beyond our own business impact, and really think about the wider impact we could have. As a result, we could see the true value to society of looking beyond SSEN's impact as a business. By looking beyond, the business, and asking our staff as individuals to make changes in their day-to-day life through pledges we were able to make an even greater impact. As you can see these contributions are not insignificant and we will continue to run these programmes alongside our climate academy to raise continued awareness and to ensure each and every one of us understands the impact that we have and what we can do about it.

What else is coming?

- New Ways of Working – We are encouraging our staff to think about being **flexible, responsive, smart, and collaborative** when returning to work, each contributing to SSEN being a leading provider of energy and related services in a low carbon world. At SSEN, our people are empowered to be responsive to their lives, their workload, and the needs of their business area in a balanced way, fitting it all together, unfazed by any last-minute disruptions. With this

comes different challenges in terms of capturing our BCF, traditionally we would capture this in energy consumption in the way we use our offices however we are now looking at how to capture the carbon footprint of working from home through online activity.

- Be The Difference Days – At SSEN we are committed to being a responsible member of the communities in which we live, work, and serve, following the Coronavirus outbreak we hope to see the return of our Be the Difference days which encourage all staff to Be the Difference by volunteering whether in the form of skills-based assistance and fundraising or DIY and gardening, and school visits. We are hopeful this can link to the delivery of environmental initiatives and our CVP.

7.3 CITIZENS' JURY

Whilst we have had good engagement on our Environmental Plans, we wanted to ensure we were reaching as broad an audience as possible, particularly from our consumers with a wide range of views. As part of our continued engagement plan beyond draft submission we decided to engage with a Citizen's Jury in mid-July 2021, with the feedback incorporated into this final plan.

Citizen's Juries have been used in the UK since 1970s and are proven to be a very robust method of engagement. 36 members of our communities (18 North, 18 South) with no specific knowledge of our environmental plans were provided with evidence from subject matter experts in workshop format. This information allowed us to playback the results of our decision making to our customers to ensure we have gained their satisfaction and allowed them to get to the heart of what they really need in this area, moving away from what will help them personally, and having discussions on what will benefit society as a whole.

Environmental Feedback: Citizen's Jury participants were very supportive and interested in our plans: they feel it is incredibly important for SSEN to take action against environmental issues. Participants did raise the issue of affordability but were accepting that there may be an added cost to the consumer on the condition that vulnerable people would be protected from rising prices.

- Science Based Targets
  - Support & encouragement for plans to avoid, reduce, and remove carbon.
  - Happy to see clear plans around reducing diesel use and increasing the EV fleet.
- Supply Chain Sustainability Code
  - Impressed SSEN is 'leading by example' for other organisations looking to support sustainability through the value chain.
  - Particularly valued the support given to smaller companies.
- Climate Resilience Strategy,

  Most participants wanted to see investment for climate resilience now to:
  - Spread the cost over time.
  - Ensure affordable sustainable energy for future generations.
  - Improve public and environmental health.
  - Monitor if changes are effective; Encourage other companies/ countries to act.

Participants were very vocal on our companies' activities on peatlands on Shetland, and persistently brought this up throughout the discussions from the northern panel, they welcomed our proposals for Natural Capital but felt it should include peatland restoration to go some way in mitigating the impact of previous activity.

Participants encouraged SSEN to look beyond the energy industry – *we cannot ignore the wider impacts that we have on the planet, with a staff base like ours we could do much more*.

Participants want us to keep them in the loop transparently and encouraged continued research in climate change and its effects, advising the need for flexible funds as a 'buffer' to be able to act on unexpected environmental shocks that may occur.

8. OUR EAP DELIVERABLES IN DETAIL

8.1 ENVIRONMENTAL ACTION PLAN

Output reference: S1
Our proposed Output:
We will produce an EAP demonstrating how we are decarbonising the energy system, reducing network activity impacts on the environment, and addressing stakeholders' environmental priorities. We will monitor and report our progress externally through our Annual Environmental Report (AER) and update our EAP accordingly. Our total value withing our EAP is £172.3m which is the sum of all the EAP outputs.

8.2 BUSINESS CARBON FOOTPRINT (BCF)

Output reference: S2
Our Proposed Output:
Set ambitious Science Based Targets, accredited with the SBTi in line with a 1.5°C trajectory. We will report internally quarterly & externally on progress against these targets annually through our Annual Environmental Reporting (AER)

An accredited 1.5°C target means :

- ***55% reduction in Scope 1 & 2 emissions by 2033***
- ***At least a 35% in Scope 1 & 2 emissions by 2028***
- ***35% of our supply chain spend committed to SBTs by 2026.***

We are now committed to reducing our combined Scope 1 and 2 emissions by 55% by 2033 from a 2020 baseline and setting a voluntary target and committing to working closely with our supply chain so that 35% of our suppliers will set science-based targets by 2026. This equates to a combined reduction of approx. 200,000 t CO_2e (including losses). Our targets have been accredited by the SBTi.

Our EAP contains initiatives and outputs targeted to reduce our controllable BCF in RIIO-ED2, and our Scope three reductions targets. We will report progress against these annually, through our Annual Environmental Report (AER) & Regulatory Reporting - using a common DNO BCF methodology where possible. This is critical to the survival of the planet, the environmental benefits are clear, any reduction in BCF is good, but one aligned with science will help to prevent dangerous climate change.

A company's business carbon footprint is made up of their Scope 1, 2 and 3 emissions. These are defined by the GHG Protocol below:

Scope 1

Direct GHG emissions. Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc., emissions from chemical production in owned or controlled process equipment.

Scope 2

Electricity indirect GHG emissions. Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company.

Scope 3

Other indirect GHG emissions. Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Our total emission proportions can be seen in Figure 8 and our emission breakdown in t CO_2e can be seen in Table 4.

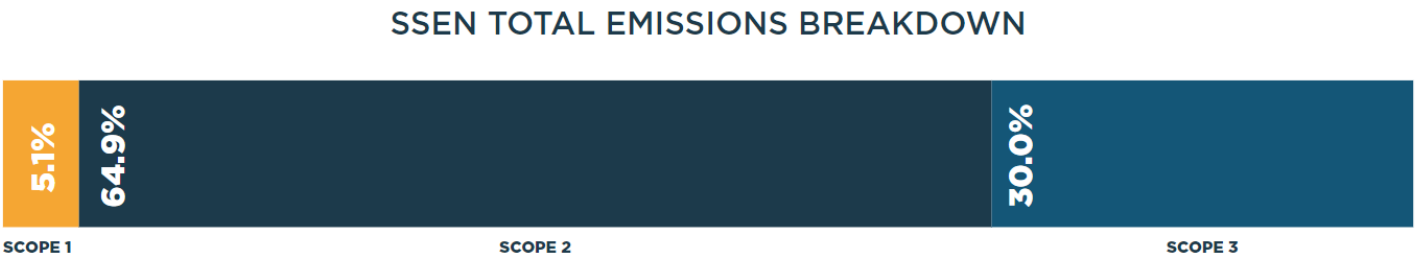


Figure 8 - Total emissions proportions

Emissions Scope	Total Footprint (t CO_2e)	Proportion of Total Emissions
Scope 1	42,556	5.1%
Scope 2	546,040	64.9%
Scope 3	252,145	30.0%
Total	**840,741**	-

Table 4 - Total emissions in tCO_2e (2019/20 figures)

The first step in any SBT process is to create a carbon inventory and identify your material risks, across all 3 scope categories. Losses are included as a Scope 2 emission and make up 91% of our combined Scope 1 & 2 emissions. The remaining 9% of our combined Scope 1 & 2 BCF is shown in Figure 9. Diesel consumption remains the largest contributor at 34.5% (excluding losses) and is mainly attributed to the consumption on the Scottish islands, which is predicted to rise over the short term with Lerwick transitioning.

The Shetland HVDC Transmission link will remediate that consumption increase if it goes ahead as planned and is a great example of Whole System solutions in practice. These stations are used as back up generation on our islands due to the nature of our network. They are there to manage planned and unplanned outages to ensure security of supply to some of our most isolated and vulnerable customers. The failsafe solution is expensive network reinforcement like additional subsea cables; however, this comes at high cost and never works through a cost benefit analysis. In the near term to protect the consumer from this cost, we will continue to utilise the standby generation system. There are also other subsea cable projects which again will help reduce the reliance on these generators in some areas. However, we need to accept and ensure that we make RIIO-ED2 a transition price control for our diesel consumption. We have prepared a Diesel Strategy (Appendix D) that will include targeted innovations, exploration of alternative fuel types and new ways of working to proactively reduce emissions associated with Diesel. Meaning in ED3 we can implement solutions from this learning to transition away from dirty fuels and achieve our longer-term targets (see our ***Scottish Islands Strategy (Annex 8.1)*** for further details).

Operational Transport is the next material contributor at 29% (excluding losses) and our EV100 commitment[15] will be key to the delivery of the SBTs. We are developing an EV strategy internally with an EV first approach to vehicle selection which will ensure the commitment is met.

[15] EV100 Commitment, commits us to converting 100% of our operational fleet (<3.5t) by 2030.

We have set ambitious targets and identified interventions against all other key material areas, Diesel, Road Transport, Substation & Buildings electricity use, other fuels and SF_6. These are all detailed in subsequent sections.

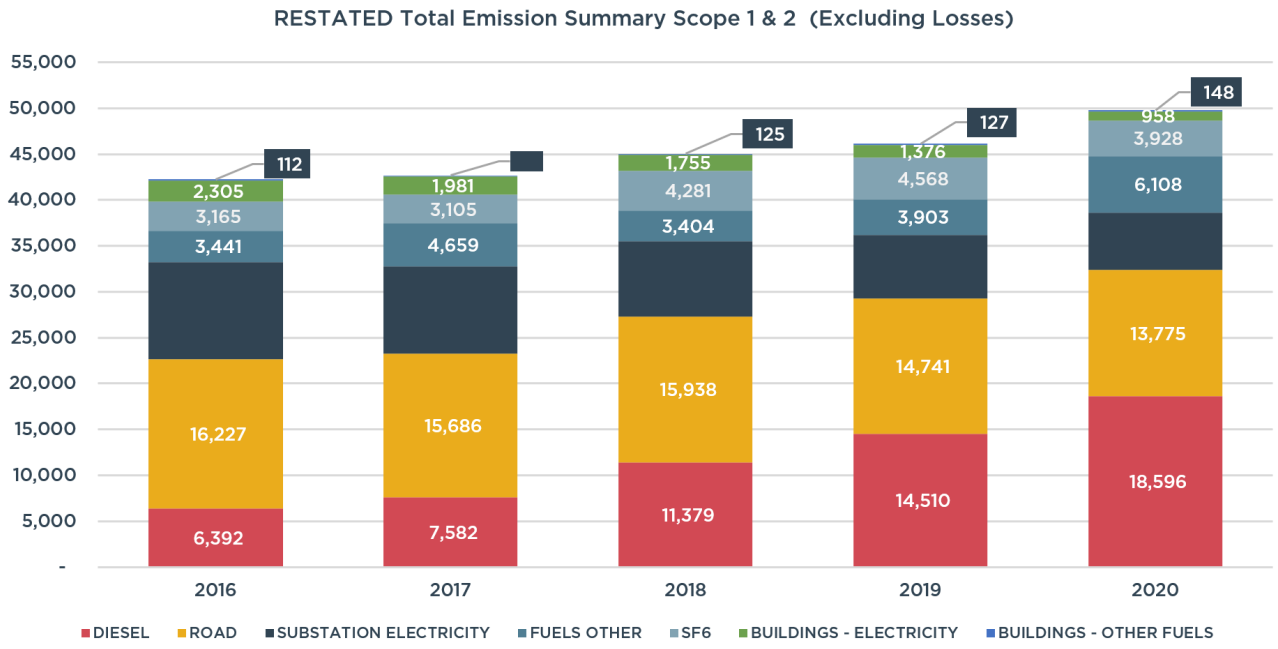


Figure 9 - SSEN Combined Business Carbon Footprint (Excluding losses)

Achieving ambitious targets will not be easy but they are achievable. We have modelled our proposed activity to 2050 as shown in Figure 10. Our network growth is based on NGFES Consumer Transformation for the first two years of RIIO-ED2, and System Transformation for the remaining 3 years. We have also modelled the interventions that we are proposing in our RIIO-ED2 EAP, and through other areas of the plan including innovation. As can be seen the model predicts that we can achieve a 1.5°C target pathway.

We have targeted projects against all material areas already costed in our RIIO-ED2 draft plan, but much of the target delivery depends on doing things differently, raising awareness to enable more conscious choices that will be driven and supported by our leaders across the business.

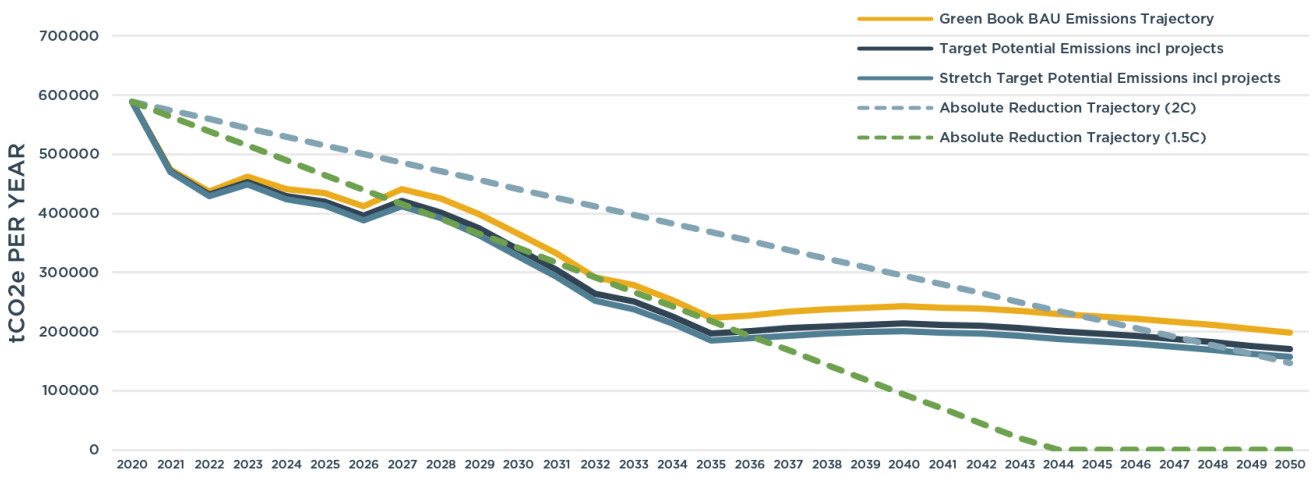


Figure 10 - Decarbonisation Model

Scope 3 emissions account for all embodied carbon and carbon associated in carrying out business activities, such as emissions due to fuel consumption by third parties, emissions associated with employees commuting to work, the embodied carbon in materials etc.

Scope 3 emissions are predominantly our supply chain. We have undertaken a complete screening of our scope 3 emissions as part of our SBTs preparation work. Since our Scope 3 emissions are below 40% of our total BCF, we do not need to set targets against these, however we have chosen to volunteer an additional target with the SBTi where 35% of our supply chain will also have set SBTs by 2026. Our primary target is a combined Scope 1 & 2 emissions reduction target, and our additional target will tackle Scope 3.

8.2.1 OPERATIONAL TRANSPORT/BUSINESS TRAVEL MILES

Output reference: S2.1

Our proposed output:

Transition our (<3.5t) fleet to 80% EV by the end of ED2 as part of EV100 commitment and reduce our average road mileage by 15% (from pre-covid levels), managing return flights to average 0.4 per employee per year.

In 2019, SSE joined the EV100 commitment which is managed by The Climate Group. By 2030 we are committed to our fleet transition to EV in the following areas:

- 100% of vehicles up to 3.5t by 2030 (80% by the end RIIO-ED2, where alternatives are available)
- 50% of vehicles between 3.5t and 7.5t (40% by the end RIIO-ED2, where alternatives are available and cost effective)

Based on research of our fleet holding, the transition of our fleet to EV will be done as and when lease periods come to an end, but only when and if that is appropriate for the work function required by the vehicle. We will also be implementing an EV First approach, meaning an EV must be explored and proven not appropriate rather than automatically opting for diesel. Our high-level assumption of traditional

company car conversion from diesel to EV company cars should either yield a saving, or break even - when assessing whole life costs (WLC) - including lease, BIK, fuel etc. Monthly cost comparisons for combustion versus EV equivalent further supports EV benefits. Vans are cost neutral therefor, cost is not a barrier, and we are not pushing undue costs to consumers earlier than needed.

One of the benefits of the pandemic is how we have learned to work across boundaries without the dependency of travel. We will continue to ensure we see a reduction in business miles from pre-COVID times by the utilisation of technology i.e. virtual meetings, negating the need for business travel. We will commit to reducing our BCF through reducing our average road mileage by 15% (from pre-covid levels) and managing return flights to average of 0.4 per employee, per year. Across our plan, as part of ***Our Network as a Net Zero Enabler Chapter (Chapter 10)*** and in line with stakeholder feedback we are proposing to invest a total of £510m in our network to enable the connection of c. 1.3m EVs, c. 800,000 heat pumps and 8GW of generation for our customers by 2028.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement BCF – Efficient and economic actions to address controllable BCF in RIIO-ED2 and achieve SBTi-verified Science-Based Target and net zero obligations in the long term	Bespoke metrics to track outcomes of implementing actions. Report on progress of BCF reduction using common methodology. Reporting will include Scope 1, 2 and 3 emissions	Annually from 2024
Report updates on EV100 commitment	Report on targets and measurements in AER	Annually from 2024

8.2.2 BUILDINGS ENERGY USAGE

An allowance of £5m for Low Carbon Technology (LCT) investment is proposed within the SSEPD buildings estate. Proposed investments include upgrading glazing, insulation, heating methods and lighting.

SSEN is committed to achieving a Net Zero operation by latest 2045 and therefore seeks to neutralize the impact of any sources of residual emissions and supply chain emissions ahead of this date. Carbon emissions from electricity and gas usage across SSEN's non-operational buildings were reported as 7,769 tCO_2 in 2020-2021. These emissions include a reported 974 tCO_2 due to energy consumption at the 57 depot and office sites fully or partially occupied by SSEN Power Distribution.

To support the overarching Net Zero target, SSE's Property Services has adopted an internal target to achieve Net Zero carbon emissions within its non-operational buildings by 2040. Actions to assist with the delivery of this target will focus on changing out older and inefficient building services plant such as electric and gas heating systems at end of plant life or if changing out is of economic benefit. Further proposed improvements will range from insulation measures for the building fabric, through improvements to heating systems and controls to other services such as lighting.

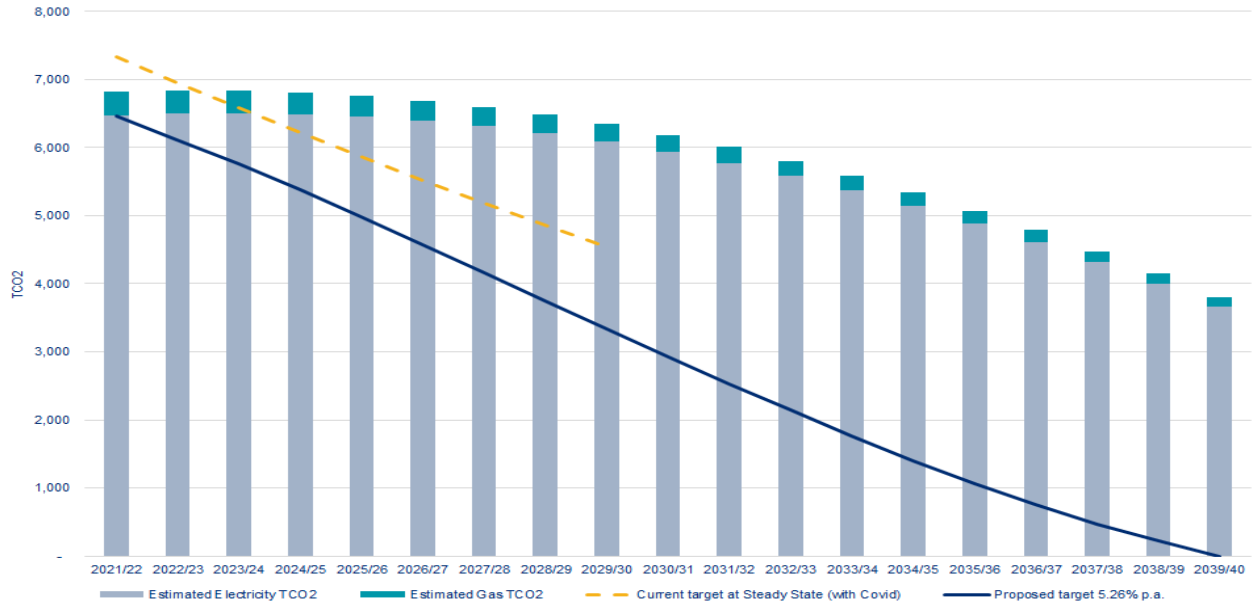


Figure 11: SSE Non-operation Buildings Predicted Carbon Emissions

To align with UK government strategies to improve the energy efficiency of our buildings, SSE will also end the use of fossil fuel heating systems within its SSE Power Distribution depot and office buildings and switch to low carbon sources.

COVID-19 has also highlighted the importance of good ventilation in buildings. Improving the energy performance of our buildings, whilst ensuring good ventilation, will ensure they are efficient and healthy environments.

SSE's estate decarbonization strategy will also seek to ensure best use of natural ventilation, and increase mechanical ventilation where feasible, to remove the need for new or increased use of air conditioning systems utilizing refrigerant F gases.

The use of Chartered Institution of Building Services Engineers (CIBSE) Technical Memorandum 44 (TM44) air conditioning inspections and their associated energy efficiency recommendations will also be instrumental in the determination of the investments in LCT proposed to reduce air conditioning and ventilation systems carbon emissions.

Key milestones adopted for the delivery of a Net Zero SSE Power Distribution buildings estate are:

- 2019 - SSE committed to the Climate Group Energy Productivity (EP100) scheme target to double energy productivity by 2030 (2010/11 baseline).
- 2021 - 100% renewable electricity supply to all non-operational buildings
- 2021 - New carbon emissions target proposed: Net Zero buildings by 2040
- 2021 - New 'towards Net Zero' buildings development strategy proposed.
- 2022 - Revised CO_2 emissions target of a 5.26% annual reduction to be introduced to align with the ambition of reaching a Net Zero SSE Power Distribution buildings estate by 2040.

- 2030 non-domestic private rented property minimum standards change (new build and existing leased offices and depots must have EPC B rating).

To align with the net zero buildings strategy the remaining SSE buildings estate that is not yet categorized with an EPC rating will be proposed to be surveyed to provide a full list of ratings. EPC recommendation reports for cost-effective improvements to buildings will be utilised when deciding low carbon technology investment and improvements.

To ensure the investment strategy is good value and appropriate a set of investment rules will also be applied. SSE investment in LCT and energy efficiency will follow Salix1 best practice and business case guidance. This guidance requires targets for different technologies to meet target criteria of return on investment and investment cost per tonne CO_2 saved each year over the plant, technology, or equipment life span.

SSE also plans to install electric vehicle (EV) charging at a range of key office and depot sites for the purpose of charging operational electric vehicles. The low carbon technology investment plan will also seek to offset the introduced carbon emissions and network demand with the installation of solar PV canopies, battery storage and demand controls.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Implement building efficiency measures to reduce our building BCF emissions by min 5%	Upgrading glazing, insulation, heating methods etc	From 2024
Report our Buildings Energy Use BCF	RRP	Annually from 2024
Measure and report our progress in reducing our buildings BCF, by utilising external assurance and certification where appropriate	Report on targets and measurements in AER	Annually from 2024

8.2.3 MOBILE/HYBRID GENERATORS

£2.2m (£1.3m SHEPD, £0.9m SEPD) (CV table 6)
EJP Reference – 10/SSEPD/ENV/BCF_GENERATION
Output reference S3
Our proposed Output:
Mobile Generators: Reduce emissions by replacing mobile generators wherever possible with lower carbon alternatives or by using alternative lower carbon fuel types by 2028

In RIIO-ED2 we aim to significantly reduce the emissions from our diesel generators by replacing the 30KVa sets with a hybrid alternative. As part of our EAP we commit to reducing our Business Carbon Footprint (BCF) from fuel consumption by a minimum of 35% and our hybrid alternative will help support this. The new hybrid generators will contribute towards a reduction in CO_2, air and noise pollution and have reduced running costs compared to our diesel generators.

We will also investigate alternative fuel types in conjunction with our supply chain and explore operational methods to reduce our reliance on mobile generators, such as our DSO flexibility products (see ***DSO Strategy (Annex 11.1)***). Not only will this reduce our BCF but it will also reduce local air pollution, and noise

disruption. We will also look to learn from other DNOs' work in innovative projects like Silent Power projects.[16]

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement BCF – Efficient and economic actions to address controllable BCF in RIIO-ED2 and achieve SBTi-verified Science-Based Target and net zero obligations in the long term	Bespoke metrics to track outcomes of implementing actions Report on progress of BCF reduction using common methodology. Reporting will include Scope 1, 2 and 3 emissions	Annually from 2024
Report updates on hybrid mobile generator replacement programme.	Report on targets and measurements in AER	Annually from 2024
Replacement of mobile diesel generators is included in our Diesel Strategy	Diesel Strategy	2024

8.2.4 OUR APPROACH TO DIESEL

Output Reference: S4

We will produce a Diesel Strategy and report on this annually as part of our AER.

As one of our minimum requirements, our BCF is high on our priorities to tackle in RIIO-ED2. As part of our ambitions to reduce our BCF we will be focusing on our approach to diesel and will be concentrating on three main areas:

- Island Generation
- Transport
- Mobile Generation

To achieve our SBTs reduction of a minimum of 35% in our Scope 1 and 2 emissions in RIIO-ED2 we will need to reduce our diesel usage in these areas. As part of our business plan we are looking at the following projects to ensure this target is met:

- We have prepared a Diesel Strategy, included in Appendix D. We plan to implement this ahead of ED2
- Explore whole systems solutions on our Islands
- Installing new more efficient diesel generators at one of our power stations. These generators will be fitted with a Selective Catalytic Reduction (SCR) which will reduce air pollution (NOx and Particulate Matter). The new generators will burn less fuel and therefore emit less CO^2 at the same time.
- Swap out our 30kVA diesel generators for hybrid alternatives. The hybrids will contribute towards a reduction in air and noise pollution as well as using less fuel than our current diesel generators.
- Ensure our EV100 commitment is promoted throughout the business and more awareness sessions are carried out locally to ensure staff are aware of the EV alternatives available.

[16] Innovation Projects - Silent Power – Hybrid EV Generator (NIA_NPG_016) | Northern Powergrid

As part of our ***Supporting Our Remote Communities (Chapter 8)*** we show an overview of our RIIO-ED2 proposals and consumer benefits. We commit to investing £329m to address the needs arising from specific regional factors unique to Scottish Islands. This includes investments of £64m in subsea cables, including intervention via replacement or augmentation of 15 cables with the greatest needs case of proactive work to avoid faults. Further, three cables totalling £84m: Skye to Uist (x2) and Pentland Firth West to Orkney are also proposed for intervention or augmentation and are critical components of our proposed Whole System approach during RIIO-ED2. Finally, £37m is also proposed as ancillary costs for cables.

£45m of the £329m is proposed for maintaining and operating standby diesel generation for island communities at seven sites. Within this expenditure we will replace the engines at Battery Point on the Isle of Lewis to improve its environmental impact and uprate the capacity of Bowmore Power Station on Islay. We expect our whole system uncertainty proposal to have significant role in this area as we seek to identify best value, integrated solutions that will allow us to deliver a 1.5-degree carbon reduction pathway in line with our Science Based Target commitments.

The third area of specific regional factor investment is £100m for Shetland. This will cover ongoing maintenance of Lerwick Power Station which will ensure reliability of supplies until the new transmission link is constructed and the transmission and distribution networks are connected; plus, the development of a new fault ride-through system to operate with this link; and thirdly the continued maintenance of Lerwick Power Station post link commissioning ensuring operational life as a standby generator.

Additionally, as part of our ***Uncertainty Mechanisms (Annex 17.1)***, we discuss how this works with subsea cables. This UM covers uncertain costs associated with subsea cables: (a) reactive replacement; (b) backup generation; and (c) cable decommissioning. Why do we need it? The UM will provide an efficient funding route to replace vital cables post unforeseeable failure events, along with the costs of additional backup power to restore interim supply. The cable decommissioning UM covers a potential future need to remove end-of-life cables which could be imposed by Marine Scotland during RIIO-ED2. Why is an UM in consumers' interests? Our UM provides the flexibility needed for reactive works in RIIO-ED2 recognising their unpredictability, whilst strongly incentivising cost efficiency through our broader RIIO-ED2 approach, which emphasises more cost-effective proactive works. Our UM also ensures customers will only fund additional costs (e.g. decommissioning costs) where they are truly needed.

How has our proposal been shaped by stakeholders? Stakeholders challenged why costs cannot be captured entirely in the baseline plan. In response we have refined our UM scope, limiting the reactive works element to replacement costs, and we have also articulated how our RIIO-ED2 strategy emphasises proactive works as the preferred fault management approach. Improving cost effectiveness and reducing reactive works. Estimated cost uncertainty range: £0 to +£76m.

We have also added our Hebrides and Orkney Whole System Uncertainty Mechanism (HOWS) to enable us to leverage baseline totex and achieve greater customer value.

This proposal recognises that a significant proportion of our baseline expenditure will be in close proximity to, and concurrent with, other potentially material energy investment decisions[3]. In our RIIO-ED1 Shetland whole system solution, we realised over £100m of customer value. We believe similar material value is possible during RIIO-ED2 for stakeholders if we can develop integrated whole system energy solutions in parallel with the needs of other vectors.

Reducing our reliance on diesel will significantly reduce our BCF, and importantly improve air quality local to our stations on our Scottish islands, where renewable energy is created and distributed to much of the UK.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement BCF – Efficient and economic actions to address controllable BCF in RIIO-ED2 and achieve SBTi-verified Science-Based Target and net zero obligations in the long term	Bespoke metrics to track outcomes of implementing actions Report on progress of BCF reduction using common methodology. Reporting will include Scope 1, 2 and 3 emissions	Annually from 2024
Diesel Strategy. Develop this further and implement this strategy by the start of ED2	We will aim to reduce our use of diesel in our transport, mobile generation and our island generation sites	Annually from 2024

8.2.5 ISLAND GENERATION - BATTERY POINT

EJP Reference – 345/SHEPD/REGIONAL/BATTERYPOINT
Battery Point £9m - SHEPD
Bowmore £0.5m SHEPD
Costs in CV15 – QoS & North of Scotland
Output reference S4

Our Proposed Output:
Fixed Island Generation – We will reduce the reliance on our back up fixed embedded generation by exploring alternative fuel types, replacement of ageing diesel assets over the RIIO-ED2 period, whilst also exploring local solutions and flexibility opportunities to provide a longer-term low carbon solution in our longer-term Diesel Strategy.

In RIIO-ED2 we aim to replace 4 existing Mirrlees KVSS Generators (oldest and least reliable engines 1 & 2) with 2 new, larger 5MW Diesel Generators. The new generators will be fitted with a Selective Catalytic Reduction (SCR) system which will reduce air pollution (NOx and Particulate Matter) as well as reduce carbon emissions due to them being more efficient.

On the 16th October 2020, the subsea cable supplying Lewis and Harris suffered a fault. While the cable is out of service, Battery Point (Stornoway Power Station) which is normally a stand-by station, is required to operate full time to maintain security of supply, supported by an additional 6MW of mobile generation temporarily in-place. Notification of a change in operation was made to SEPA under Regulation 45 of the Pollution Prevention and Control (Scotland) Regulations 2012, and in response, SEPA requested a BAT assessment considering all options available to minimise emissions from the station during the operational period. The results of the BAT assessment showed that the optimal operating arrangement available to maximise thermal efficiency is in place for the site for the duration of the cable repair.

The CO_2 output in 2020 was 16,929 tonnes compared to just 3,400 tonnes in 2019, due to the increased use of the generators resulting from the cable fault. Therefore, we are considering additional options to reduce CO_2 emissions for the Battery Point site. The existing Mirrlees KVSS Generators being replaced will also be kept for use as spares where appropriate and used to repair the remaining existing generators where possible. Full Details can be seen in our ***Scottish Islands (Annex 8.1)***).

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement BCF – Efficient and economic actions to address controllable BCF in RIIO-ED2 and achieve SBTi-verified Science-Based Target and net zero obligations in the long term	Bespoke metrics to track outcomes of implementing actions Report on progress of BCF reduction using common methodology. Reporting will include Scope 1, 2 and 3 emissions	Annually from 2024
Report updates on new diesel generator performance following installation	Report on targets and measurements in AER	Annually from 2024
Installation of new diesel generator is included in our Diesel Strategy	Diesel Strategy	In RIIO-ED2 phasing

8.3 LOSSES

£4.9m from TASS (£2.2m) and Substation Efficiencies (£2.7m) - £1.5m for SHEPD and £3.4m for SEPD
Output reference: S5

Our proposed output:

We will include losses as a Scope 2 emission and therefore address them as part of our SBTs. We will act to reduce actual losses over the RIIO-ED2 period. We will contribute to the evidence base on the proportion of losses that network companies can influence and/or control, addressing the affordability element of losses in addition to the carbon value reduction that will occur through grid decarbonisation.

We will implement our Losses Strategy in RIIO-ED2 which focuses its attention at reducing actual losses on the network and not simply relying on grid decarbonisation to decrease our losses. Initiatives that we are looking to implement in RIIO-ED2 that will reduce losses include the use of On-Load Tap Changing (OLTC) technology in transformers, continuing the replacement of historical transformers, setting a minimum cable size of 300mm^2 in LV, 11kV and 33kV networks, prohibiting cable tapering in new installations on LV and 11kv networks. We also intend to deploy monitors on the LV network which will allow us to monitor power factor and intervene where necessary. Further details can be found in specific EJPs and our Network Visibility Strategy (***DSO Strategy (Annex 11.1)***).

Losses are an inherent consequence of operating a distribution network. They are unavoidable and will directly be affected by the amount and type of generation connected to the network, however it is important that losses are minimised where possible to reduce the associated carbon emissions and the bill impact for consumers. Losses are categorised in two main elements, technical and non-technical losses[17] and make up 91% of SSEN Distribution's business carbon footprint (Scope 1 & 2).

Technical losses account for the majority of losses at 5% of the total electricity generated, which are primarily variable losses (heat due to energy flowing through cables and overhead lines) however fixed losses (dielectric and iron) are not insignificant and arguably more within our control.

Non-technical losses contribute another 1%, which can be due to theft or measurement errors.

Although, losses occur across the entire network, studies have shown that the low voltage network is the largest contributor[18]. The losses reported on our network are simply the difference in the energy metered entering the system and those metered leaving the system. Losses account for 1-2% of the overall GB Business Carbon Footprint and cost consumers £1bn per annum.

Distribution losses are currently reported as Scope 2 at Group level and, whilst in Distribution we traditionally have not assigned a scope to losses, the Ofgem Regulatory Instructions and Guidance (RIGs)[19] and the GHG Protocol[20] dictate that they should be Scope 2.

Distribution losses refer to the electricity lost from our Distribution network either as a function of the electricity travelling through our equipment or through measurement inaccuracies and theft. Either way, this lost electricity presents a cost to both customers and the environment and we are compelled to manage this so that distribution losses are as low as reasonably practicable. There are measures that we can take to reduce this loss, and this is primarily demonstrated through:

- The choice of network assets we install; and
- The improvements we make to our processes to reduce measurement errors and theft.

Understandably, this cannot be at any cost and we must balance the measures taken with the costs and benefits of implementing them.

[17] Technical Losses are further categorised into Fixed and Variable losses; Fixed losses – energy required to energise transformers etc; Variable losses – heat due to energy flowing through cables, overhead lines - I^2R. Non-Technical Losses, Inaccurate metering and billing and energy theft
[18] ENA Technical Losses Working Group - CEP023 TECHNICAL LOSSES MECHANISM STUDY
[19] Regulatory Instruction for Guidance for RIIO-ED1 (version 6.0) Appendix J
[20] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

Despite a reduction in the amount of electricity distributed through our network in 2020-21, as a result of the Covid-19 pandemic, the general drive is towards greater demand for electricity and steps to ensure that the existing electricity infrastructure is used as efficiently as possible (as shown in our DFES, ***Forecasting and Scenarios (Chapter 9)***. This is most evident through the following initiatives:

- The decarbonisation of transport and heat and the resulting increase in demand for electric options.
- Whole System thinking – where network owners and operators must consider the wider impacts of their system development and decision-making.
- Ofgem's review of how customers are charged for access to the network and what rights they have. This is about understanding spare capacity on the network and, where possible, potentially making this available to others.
- New obligations and commitments around the procurement and use of flexibility services where this is an economic alternative to investment in traditional network assets. These mechanisms generally result in an increased overall utilisation of existing assets, which has an incremental relationship to losses. Again, this seeks to make better use of the existing network.

By increasing the amount of electricity passing through our assets, and working our existing assets harder, all the above will cause losses to increase in the absence of counteracting measures. As a result, our ability to reduce the losses on our network is increasingly at risk. Our ED2 Losses strategy is included in Appendix C, this details how we will tackle technical and non-technical losses on our network, specific actions we will take and our performance metrics. Most of our Losses management will be through the incremental efforts across all our plan so are not called out as specific projects, our strategy sets minimal cable sizes, and pushes for low loss technology selection as a first consideration on investment decisions. The utilisation and penetration of On-Load Tap Changing (OLTC) technology during RIIO-ED2 is being reviewed. We are exploring the benefits of replacing HV transformers with versions which include OLTC technology to conserve voltage. We estimate that all measures will help us avoid losses across our network in ED2, the investment figures are not captured in our EAP as they are recorded in the respective load or non-load sections, and have undergone CBA assessments to inform our thinking, the output of these CBA's indicate that there has been justified selection of low loss equipment given the amount of benefits that are delivered. We also have smaller targeted projects that are building on proven innovation projects and converting them to BAU – like the TASS project and building energy efficiencies in our substations.

As part of our ***Innovation Chapter (Chapter 14)***, we use innovation to deliver improved outcomes for our customers today and to support the transition to net zero. We are proposing to invest £115.5m on load related innovation projects, £19m on non-load projects and £4.7m through this Environmental Action Plan. The roll out of Project LEAN (TASS) which is discussed more below, reduces costly network losses by switching off lightly loaded transformers during periods of low demand.

As part of our Losses Strategy we are also committed to understanding and building on the evidence base of controllable losses, where and how losses occur on our network, this is critical to achieving a reduction in actual losses, our aim is to understand where the losses occur, and how this may change as we transition to net zero, we are in the process of commissioning a study to help us understand this, we hope that the outcome of the work will assist us in being able to identify where losses are likely to occur and therefore

help inform investment and network operations decisions. We will report on our progress annually through our AER. 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 the transition to DSO will have on losses. That said our strategy builds in capacity and options to allow us to balance this through our minimal cable sizes. We will also see a replacement of older copper cables being replaced with larger aluminium cables – we have upsized the cables in this situation to balance the benefits. This programme of work will be monitored carefully to ensure we are doing all that we can across the board. In addition to the work all across the plan we have some targeted projects that are outlined below.

8.3.1 TASS

£2.2m (£1.0m SHEPD, £1.2m SEPD)
EJP Reference – 5/SSEPD/ENV/LOSSES/TASS
Output reference: S5
CV table: CV21

Our proposed commitment:
In RIIO-ED2 we will commit to installing Transformer Auto Stop Start (TASS) technology to reduce our substation losses.
In 2019 SSEN concluded the Low Energy Automated Networks (LEAN) project, which focussed on reducing losses at 33/11kV primary substations. This LCNF (Low Carbon Networks Fund) innovation project successfully developed, implemented, and demonstrated 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 a number of transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer.

TASS technology has been operating on the SEPD network since June 2018, and over the course of the LEAN project (to December 2019) achieved losses savings of over 100 MWh from two primary substations, providing carbon savings of over 38 tCO_2e. Full operation of TASS reduces transformer losses by ~25-30% at each site. No impacts on asset health due to TASS operation were identified through the suite of testing and monitoring techniques applied.

For RIIO-ED2 we propose to install TASS wall boxes at sites which have been identified as suitable to have TASS technology implemented. Deploying TASS will provide significant losses reduction over a 30-year period. The carbon savings for this option are estimated to be **595.41 tCO_2e**. Importantly this reduces actual losses – which means we are tackling the affordability element of losses too.

RIIO-ED2 SHEPD	Total
No. of Tass wall boxes to be installed	**59**
RIIO-ED2 SEPD	**Total**
No. of Tass wall boxes to be installed	**74**

Table 5: Number of TASS wall boxes to be installed in SHEPD and SEPD

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement – Implement a strategy to efficiently manage losses, both technical and non-technical, on the network over the long term. Contribute to the evidence base on the proportion of losses that network companies can influence/control	Reporting on the progress of implementing the losses strategy and associated performance measures	Annually from 2024
Installation of TASS technology in substations identified for TASS implementation	TASS technology implementation	2024-2028
Report on losses avoided and any reductions made in RIIO-ED2	Report on targets and measurements in AER	Annually from 2024

8.3.2 SUBSTATION EFFICIENCIES

£2.7m (£0.5m SHEPD, £2.2m SEPD)
EJP Reference – 6/SSEPD/ENV/LOSSES/SUBSTATIONBUILDINGIMPROVEMENTS
Output reference: S5
CV table: CV5

In RIIO-ED2 we plan to undertake refurbishment works to at least 44 existing substations ranging from 33kV to 132kV in our SHEPD and SEPD areas. The upgrade works include a variety of measures to improve the asset health and reduce on site electricity consumption, such as better control of lighting and room heating, reducing internal/external lighting levels, improvement of building fabric thermal performance and replacing the glazing. The substations chosen for refurbishment have been selected due to the high footfall at the sites. The assets have a mixture of welfare rooms, manned offices and other facilities.

The impact of this work will be closely monitored for effectiveness before roll-out to other substations in future investment periods. We will also target substation buildings where work is being carried out due to other primary drivers.

In substations, uncontrolled energy is typically consumed for heating and lighting, dehumidification and cooling equipment, 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, while still contributing to network losses.

We have been working with Strathclyde University to determine a model for a reduction in our losses from substations. The approach adopted was to develop a set of archetype substation building models, simulate their annual energy performance to quantify the potential for energy savings, and extrapolate these results to the wider substation stock, totalling over 10,000m^2 of floor area. The models were created using data from a wide variety of sources and the performance of the models was simulated on the well-validated ESP-r building simulation platform.

The models developed included a base case and variants, which represented a range of different energy efficiency measures: double glazing, external roof insulation, external wall insulation, draught stripping, combined insulation measures, heater control and replacement of existing heating with air-air heat pumps. The energy savings were quantified by comparing the results from the variants to the base case. The simulations produced data on the annual heating energy use and were run using climate datasets that were representative of SSEN's areas of operation – Scotland and Southern England, but the results indicated similar effectiveness of measures regardless of climate.

Annual savings in $kgCO_2$ and notional costs savings were derived from the simulation results. Additionally, indicative costs were calculated for the different energy efficiency measures. The full Strathclyde report can be found in Appendix E.

Reducing substation electricity consumption will reduce actual network losses and therefore associated CO_2 emissions and associated consumer costs. This is key in contributing towards SSEN's Science-Based Target of 35% reduction in scope 1 and 2 emissions by 2028 in order to be in line with the 1.5°C climate science pathway. In addition, many of the substations have not had works carried out on them since they were constructed so these improvements will also contribute towards the asset health.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Refurbishment works undertaken at 44 substations to improve asset health and reduce electricity consumption	Report on targets and measurements in AER	Annually from 2024
Report on electricity consumption	RRP	Annually from 2024

8.4 SULPHUR HEXAFLUORIDE (SF_6)

£5.6m (£0.2m SHEPD, £5.4m SEPD)
EJP Reference – 9/SSEPD/ENV/SF_6
Output Reference: S6
CV Table: CV22

Our proposed output:

We will develop an SF6 Strategy that aims to reduce our business carbon footprint impact from SF6 leakages by a minimum of 35% by 2028 from 2019/20 levels. Through targeted investments, improved leakage and repair operations, and deploying innovative technologies. Whilst reviewing our strategy annually to ensure we are updating our approach as required to reduce SF6 bank where economically viable.

The SF6 strategy will also:

- Commit to efficient and economic actions to reduce leakage rates and improve management of SF6 assets
- Adopt target(s) for SF6 leakage and/or SF6 asset management
- Commit to reporting on total SF_6 bank and leakage reduction rates using a common DNO methodology

8.4.1 INTRODUCTION TO SF_6

SF_6 is a manmade gas. It is a fluorinated greenhouse gas and emissions to the atmosphere contribute to global warming. It is extensively used in electrical switchgear providing excellent electrical insulation and arc quenching properties as well as enabling compact design at efficient, effective lifetime costs.

SF_6 has been used as an effective electrical insulator and arc suppressant since the early 1970s, mostly installed within electrical switchgear such as circuit breakers and switches, but also in Current and Voltage transformers. It has been used across the full range of electricity distribution and transmission voltages and we have a significant number of assets employed on our SEPD and SHEPD networks containing this greenhouse gas.

The earliest SF_6 equipment is now over 40 years old although the peak periods of SF_6 introduction was in the 1970s and 1980s. It has become apparent in recent years that the rate of SF_6 leakage from the ageing asset base installed across all GB Distribution Network Operators (DNOs) has been increasing. Therefore, it has been necessary for all DNOs, to develop and implement SF_6 leakage mitigation strategies and to introduce targets to reduce SF_6 leakage.

Increased environmental awareness of the impact of SF_6 gas released now merits enhanced leakage mitigation measures and it is anticipated that new environmental legislation will restrict the future use of such equipment. We have therefore developed a programme to target replacement of our SF_6 equipment with the highest leakage rates employed on our networks. We are proposing to explore alternatives to SF_6 and will install alternatives where solutions are available. We are also committed to better management of our leakage rates and are currently exploring improved technology to stop leakage at source.

Business Plan Output S6 demonstrates our commitment to reduce our GHG emissions associated with SF_6. We propose to deliver this through a Price Control Deliverable to provide assurance to Ofgem and Consumers on deliverability.

8.4.2 IMPACT OF SF_6

Sulphur Hexafluoride (SF_6) is an extremely potent and persistent greenhouse gas with a CO_2 equivalence factor of x22,800. SF_6 has been used as an effective electrical insulator and arc suppressant since the early 1970s, mostly installed within electrical switchgear such as circuit breakers and switches, but also in Current and Voltage transformers. It has been used across the full range of electricity distribution and transmission voltages and we have a significant number of assets employed on our SEPD and SHEPD networks containing this greenhouse gas.

SF_6 Legislation is being reviewed by the EU as part of the F-Gas Legislation with a view to achieving the EU (and UK) net zero targets. The legislation is expected to be updated around Spring 2023. The ENA have worked with the member companies to develop a report for the European Commission (Re: Review of the F-gas Regulation 517/2014). We have indication the UK will likely enact the legislation as defined by the EU and expected in 2023 or be more stringent. We expect several possible legislative scenarios ranging from a ban on new SF_6 equipment at voltage levels from a defined future date to a full ban including replacement of all existing SF_6 equipment by a particular date. The report and work done at the ENA included analysis to understand the alternatives to SF_6 that are available on the market. For the UK these are currently very limited and the DNOs will need to work with the supply chain to develop and supply plug and play alternatives that work on the UK network and standard substation designs. The report also analysed costs and potential developments of SF_6 alternatives from manufacturers to develop a matrix of the most effective action by voltage level to reduce SF_6 emissions from equipment.

In summary the higher voltages (132kv and above) have a much better payback for £ per kg of SF_6 emissions saved. We have used the ENA work to help with our stakeholder engagement, our RIIO-ED2 plan and our long-term strategy. Our full SF_6 Strategy & Approach can be found in Appendix B, however, see extract below. We are actively working collaboratively with other DNO's through the ENA as the chair to this group which will help to develop a common reporting methodology. We continue to work with the supply chain to push for alternatives. Our SF_6 Approach will continue to be agile in nature to allow it to take account of this work as it develops.

8.4.3 OUR RIIO-ED2 APPROACH TO SF_6

Our RIIO-ED2 investment strategy is to reduce SF_6 emissions from our current asset base. We will implement an enhanced leakage reduction strategy for the RIIO-ED2 period in response to increasingly ambitious environmental drivers and stakeholder expectations, which will significantly reduce SF_6 emissions, particularly in the SEPD network area and will also align our leakage performance with other DNOs in the GB electricity distribution sector.

We are proposing investments targeted at reducing the amount of SF_6 leakage on our networks by 47replacing assets that are leaking SF_6 but whose condition would not otherwise merit accelerated replacement. A secondary investment driver and benefit will be to improve our overall asset health of equipment containing SF_6 as a result of defective equipment being replaced with new modern assets.

We have chosen to implement an ambitious asset intervention strategy to replace the Severe and Poor Leaking SF_6 switchgear on our Networks to deliver the greatest absolute reduction in SF_6 emissions. This asset intervention strategy has been based on the need to significantly reduce SF_6 leakage rates (particularly in SEPD) to meet Ofgem's minimum requirements of an accredited Science Based Target (SBT) combined with increasing government ambitions on the horizon and our stakeholder expectations. This significant reduction will help enable us to meet our SBTs. This RIIO-ED2 SF_6 Strategy aims to reduce the amount of gas lost through leakages and reduce our BCF impact from the leakages by a minimum of 35%.

We are proposing to invest £ 5.57m over 5 years, replacing 45 units, our unit costs in the later years in the price control include an allowance to enable us to explore and select alternative technologies for replacement.

The proposed investments will reduce our SF_6 bank and improve the detection of leakage and repair of equipment. The SF_6 strategy will also:

- Commit to efficient and economic actions to reduce leakage rates and improve management of SF_6 assets; We will do this through continuing to manage our leakages and working with innovation and industry.

- Adopt target(s) for SF_6 leakage and/or SF_6 asset management; we have done this in line with our SBTs, and our proposals are supported by our worked up in our SF_6 Engineering Justification Paper.

- Commit to reporting on total SF_6 bank and leakage reduction rates using a common DNO methodology. We will do this through continued collaboration with the joint DNO, ENA SF_6 Strategy Group, and by reporting on our performance in our Annual Environmental Report.

Planned interventions will include like-for-like asset replacements in the early years of the RIIO-ED2 period, followed by the introduction of new technologies in the latter year as technology readiness levels improve.

8.4.4 OUR MOBILISATION PLAN FOR ED2

We are currently improving our complete SF_6 strategy, as we understand more of what the potential legislation scenarios may be and are actively learning from live innovations looking at both leak, prevention, detection, and repair – and alternatives to the F gas. We will demonstrate how we have done this in efficient and economic ways, including our approach to SF_6 asset reduction. We have included in our plans a transition to other technologies for both replacement and leak detection and management. However we still have further ambition and have developed a strategic approach to evaluating the life-time costs and benefits of asset replacement, plus clear long-term plans for cost-efficient identification, containment and eventual safe-disposal of small, sealed equipment items that contain SF_6, as well as modelling and identifying our assets that have the highest leakage rates (severe and poor leakers) we have modelled our asset age profile over the longer term, further work is ongoing to match this profile to when new technologies will become available for switch out and the assessment of the value to consumers to making that switch out early, as opposed to waiting until the end of the asset life.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement – Efficient and economic actions to reduce the leakage rates and improve the management of SF_6 assets. Implement a strategy to efficiently manage SF_6 assets.	Leakage reduction target. Report on total SF_6 bank and reduction rates using a common DNO methodology	Annually from ED2 start
Replace severe and poor leaking SF_6 assets with like for like replacement and with alternative	EAP	Annually from ED2 start
Demonstrate progress and target measurements from our SF_6 Strategy commitments	Report on targets and measurements in AER	Annually from ED2 Start

8.5 BIODIVERSITY AND NATURAL CAPITAL INVESTMENT

Nature based solutions for carbon removal - £12.5m SHEPD and £13.2m SEPD
Biodiversity Baselining - £0.1 SHEPD and £0.6 SEPD
Output reference: S7
Table CV22
Our proposed combined output:

Part 1 - Developing a tool to baseline and monitor our biodiversity and enable cultural change required to enhance biodiversity

Part 2 - We will deliver 2,000 ha of woodland restoration and 1200 ha of peatland restoration which is expected to remove over 300, 000 t CO_2e by 2045, and provide 3000 biodiversity units by 2045.

ED2 values are lower at around 10,000 t CO_2e and 1500 Biodiversity Units, however this also sets us on a pathway to achieve removals of £1m t CO_2e over 100years.

We have a regulatory obligation to meet net zero, we fundamentally believe that after targeted carbon emission reduction, natural capital investment plays an important role to get there. Our plan proposes significant investment in Natural Capital to achieve the carbon removal required to meet our credible net zero target. We could choose to "offset" but feel that nature-based solutions provide more value and will deliver better longer-term benefits for our consumers. This is the option most supported by our stakeholders. So, in summary, this natural capital investment will not only ensure that we are mitigating our impact on nature itself but also be part of our net zero journey, vastly improving biodiversity as a consequence. Our investments in this area are split into two: We must first baseline and then secondly, invest. The detail for these can be seen in section 8.5.1 and 8.5.2 respectively.

In ED2 we will have a tool developed to baseline our existing natural capital portfolio and to monitor the provision of ecosystem services from our sites. We will work collaboratively with other DNOs and TOs to develop this tool. This will provide us with a baseline where we can ensure the impact of future projects are mitigated.

It is our understanding that addressing the biodiversity crises also provides benefits that can mitigate against human caused climate change. They are both so inextricably linked that we must work to solve both issues; one without the other is just not enough, and the IPCC AR6 report in 2021 tells us that we are running out of time[21]. We have known for a long time that the catastrophic consequences of climate change are coming and our lack of action in previous years now means that drastic, emergency action is needed. Furthermore, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), produced a report stating that "The overwhelming evidence of the IPBES Global Assessment, from a wide range of different fields of knowledge, presents an ominous picture……The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide."[22]

On 14 June 2021, the government in England committed to delivering a "nature positive future[23]" in its response to the Treasury-sponsored Dasgupta Review on the Economics of Biodiversity. After introducing a new legally binding target for species abundance for 2030 in the Environment Bill[24], it is to table a new amendment that expands the biodiversity net gain requirement to all new nationally significant infrastructure projects – now set at 10% net gain. Scotland has failed to meet international targets on biodiversity, including those on extinctions[25]. Habitat loss, invasive non-native species and climate change are all a major threat to native species such as red squirrel, wild cat, Atlantic salmon, the capercaillie and the freshwater pearl mussel. The Scottish government plan to publish a new Biodiversity Strategy after COP10, scheduled to conclude in May 2022[26] to address these changes and in support of their Climate Change Plan "Securing a Green Recovery on a Path to Net Zero[27].

8.5.1 TIMING & SCALE OF THE INVESTMENT

We fundamentally believe that we need to act now to ensure that we meet our obligations and targets aligned with UK and global commitments. Habitat creation will take time to establish, taking 5-10 years to achieve any carbon sequestration. In addition, driven by biodiversity net gain legislation changes and net zero targets the market value for land for carbon reduction and biodiversity offsetting is increasing. By delaying this investment, the ask and the costs will continue to rise, pushing the ever-increasing burden onto the future consumer.

Why us? Our network is needed to enable the strategic delivery of net zero – we need it as a society. A consequence of building and operating our network is that we disturb nature. We have a responsibility to mitigate against that disturbance. If not us, then who?

The scale of the investment is driven by our predicted carbon footprint levels over time, we recognise that we cannot abate everything and therefore need to provide some form of carbon removal. Carbon sequestration rates from nature-based solutions build up over time and whilst our maximum sequestration potential could exceed requirements in the very long term, we need this level of investment to achieve the removals required in time with the legislation. Improving our natural capital will not only ensure we meet our biodiversity targets but will also be critical to our wider net zero aspirations. We will invest significantly

[21] **Sixth Assessment Report (ipcc.ch)**
[22] https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf
[23] https://www.gov.uk/government/news/government-commits-to-nature-positive-future-in-response-to-dasgupta-review
[24] **This is now passed into law as the Environment Act 2021**
[25] https://www.nature.scot/scotlands-biodiversity-progress-2020-aichi-targets-conserving-genetic-diversity-development-national
[26] https://www.gov.scot/publications/scottish-biodiversity-strategy-post-2020-statement-intent/pages/6/
[27] https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/

to create a long-term solution to ensure a credible net zero and that biodiversity net gain is a reality by investing in targeted biodiversity and natural capital projects like afforestation and peat restoration projects across the network. By 2028 we will have nurtured afforestation ready to provide carbon sequestration from year 5 and which will mature to provide potential carbon sequestration rates of approximately 40,000 tCO2 by end of ED3 and building to achieve a potential of 1 million t CO_2 e removal over a 100-year term.

As part of our ***Safety and Compliance Chapter (Chapter 6)*** we propose to spend £198.5m on Tree Cutting during RIIO-ED2 to maintain the safety and integrity of the Overhead Line (OHL) network in line with applicable safety standards. Tree and vegetation growth represent a real risk to the safety, and reliability, of the electricity distribution network and must be managed effectively. We have over 60,000km of overhead line network across both our regions. Unmanaged tree and vegetation growth can result in significant damage to our OHL network and a serious safety risk to the public and our employees. As part of our biodiversity ambitions, we will ensure the tree cutting programme is managed to protect the local environment, at the same time as ensuring our network is safe and reliable. In addition to the delivery of a credible net zero and biodiversity improvements, this investment in natural capital will contribute to the mitigation of our tree cutting in a considerate way. As part of our wider plans, we are improving accuracy and use of our LIDAR data to be able to determine species information on our network corridors. This will allow us to tailor our operations to be mindful of the species. We are also reviewing our handling of the tree debris and foliage that is cut back to utilise them in a way that can enhance local habitats and eco systems – even after they have been cut.

We will create a tool that will help us manage our biodiversity and natural capital portfolio, particularly aimed at new projects in the first instance with the view to expand. This will include the provision to monitor ecosystem services from network sites. We will report on these annually through our AER.

In addition to minimum requirements, we will create a long-term solution to ensure a true net zero is a reality by investing in targeted biodiversity and natural capital projects like afforestation, and replanting initiatives across the network.

8.5.2 BIODIVERSITY BASELINING

£0.7m (£0.1m SHEPD, £0.6m SEPD)
Output reference: S7
CV22

Our proposed commitment:
Developing a tool to baseline and monitor our biodiversity and enable cultural change required to enhance biodiversity

Providing a baseline and raising awareness over the importance of this work is imperative so in RIIO-ED2 we are looking to achieve a Biodiversity Net Gain (BNG) approach which aims to leave the natural environment in a measurably better state than beforehand.

We currently have no targets in place for ED1 with regards to BNG and in order to embed this within RIIO-ED2 we are proposing the following options:

- **Earth Observation** - (EO) based biodiversity mapping. Satellite Earth observation enables the mapping and monitoring of a variety of aspects on habitat distribution, quality and change in different spatial and temporal scales, thereby helping to enable SSEN to better assess and monitor performance in our natural capital portfolio. Throughout RIIO-ED2 - introduce methods to establish a biodiversity baseline of our network and metrics (Biodiversity Units) and utilise existing GIS models to develop a Biodiversity heatmap

- **Learning Management System (LMS) Training Platform -** LMS can be used to ensure systems and processes needed to deliver BNG objectives are clearly defined and communicated to the relevant workforce, helping to ensure the BNG requirements are met, and training up Sustainability Champions across the business to ensure we are capturing all opportunities for biodiversity improvements on permitted development schemes. Including biodiversity assessments in our inspection and maintenance checks.
- Developing a **Biodiversity Net Gain Specification** and a Habitat Creation Specification for suppliers and project managers to ensure that construction and maintenance projects are delivered with No Net Loss and enhance Biodiversity Net Gain

- **Land** - Where possible taking actions to increase our environmental value on our land and implement actions where appropriate to achieve new ways to achieve biodiversity 'No Net Loss' on new projects in RIIO-ED2. We will complete a review to our land assembly approach to include a focus on any biodiversity opportunities where safe and appropriate to do so.

- **Staff initiatives - Bee bomb seed mix -** 97% of natural bee and butterfly habitat has been lost in the UK since World War 2. Bee bomb mixes can help to restore lost wildlife habitat and contribute to the biodiversity. These contain a mix of 18 native wildflower seeds and can be scattered onto cleared ground on selected SSEN portfolio to create a wildflower meadow and thereby create a suitable habitat for bees.

In addition to the measures above biodiversity can also result in an improvement in air quality by trapping toxic particulate matter. Particulate matter is a problem in urban areas throughout the world, and these tiny particles are proven to impact on respiratory health negatively. BNG if achieved can therefore improve air quality and habitats around our installations, particularly ones located in urban areas or areas with existing poor air quality.

We are continuing to fully develop this area and are working to develop a tool to assess net changes in natural capital for new connections and network projects and to adopt a system to monitor the provision of ecosystem services from network sites.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement - Appropriate tool adopted to assess net changes in natural capital from different options for new connections and network projects. Appropriate tool adopted to monitor the provision of ecosystem services from network sites and commit to reporting annually	Targets against actions to increase environmental value	Annually from 2024
Aim to achieve a Biodiversity Net Gain (BNG) approach	RRP	Annually from 2024

8.5.3 NATURE-BASED SOLUTIONS FOR CARBON REMOVAL

£12.5m SHEPD, £13.2m SEPD
EJP Reference – 347/SSEPD/ENV/NATUREBASEDSOLUTIONS
Output Reference: S7
Our proposed output:

We will deliver 2,000 ha of woodland restoration and 1200 ha of peatland restoration which is expected to remove over 300, 000 t CO_2e by 2045, and provide 3000 biodiversity units by 2045.

As part of our net zero journey, we need to allow a form of Carbon Removals in our plans, net zero is not a possibility without carbon removals. There are several ways to achieve this, and the carbon trading market is currently not as transparent as we would like it be, we believe there is still work to be done to demonstrate legitimacy in the area to ensure no further risk is placed on the consumer.

While the delivery of carbon reductions via Nature-based Solutions (NbS) has uncertainty factors (discussed further in our EJP) there are a range of wider environmental benefits that can be delivered. Namely the enhancement of natural capital and delivery of multiple ecosystem services. It is largely agreed that well designed NbS can make an important contribution to reaching net zero emissions, if combined with dramatic cuts in greenhouse gas emissions (e.g., by burning less fossil fuel)[28]. Natural capital can be defined as the "**world's stocks of natural assets** which include geology, soil, air, water and all living things"[29]. It is these natural capital assets that deliver a flow of significant benefits, often called ecosystem services, which make human life possible.

[28] https://www.naturebasedsolutionsinitiative.org/news/on-the-misuse-of-nature-based-carbon-offsets/
[29] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/909202/ncc-terminology.pdf

Ecosystem services are defined by the Common International Classification of Ecosystem Services[30] (CICES) as:

- **Provisioning services:** food, fresh water, wood, medicinal products, etc.
- **Regulatory and maintenance services:** purification of air and water, climate regulation, pollination, carbon sequestration, natural pest control etc.; and
- **Social and cultural services:** tourism and recreation, cultural heritage, and educational opportunities and a sense of wellbeing.

Historically, negative impacts of development on the environment have been a source of reputational risk, more recently however, attention is focusing on how ecosystems provide critical benefits that improve quality of life and benefits to business. The recognition of the importance natural capital has increased with the introduction of natural capital accounting and initiatives that attempt to make environmental benefits more visible. This has also increased the perception and understanding of the range of environmental risks. Figure 12 shows the relationship between, biodiversity, ecosystems, and value.

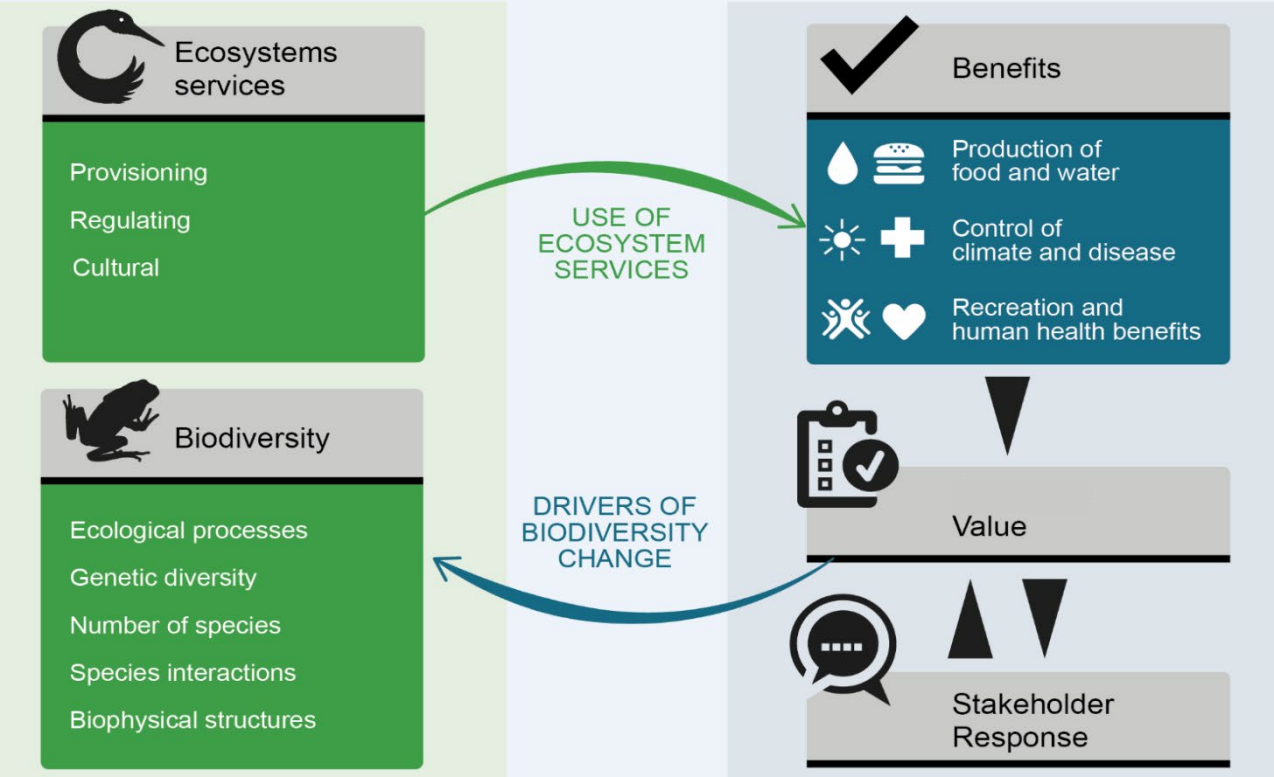


Figure 12: The benefits approach (from Business and Biodiversity Risk JNCC[31]

There are several means of quantifying benefits which are explored further in the EJP. Following a sensitivity analysis of potential assessment mechanisms, the following sources were chosen for quantification and monetisation:

[30] https://cices.eu/
[31] Biodiversity Risk - Integrating Business and Biodiversity in the Tertiary Sector 2018 https://hub.jncc.gov.uk/assets/7cac352f-1b21-420e-9e0a-c0860f4da556

- **The Office of National Statistics (ONS)** provides national accounts separated for Scotland, N. Ireland, England and Wales for a range of ecosystem services, where possible ONS data were used[32].
- **Woodland Carbon Code** provides an accredited quantification of declarable carbon
- **Peatland Carbon Code** provides an accredited quantification of declarable carbon
- **Willingness to Pay** a bespoke survey result was used
- **Government advice on valuation of greenhouse gasses** values[33]
- **Ofgem CBA carbon values**

The government guidance on Enabling a Natural Capital Approach (ENCA)[34] has also been followed.

There is an emerging market for biodiversity units. Natural England's Biodiversity Metric 3.0 is being used to calculate the units required to deliver the soon to be mandatory 10% Biodiversity Net Gain for new developments in England. This in turn has resulted in a trading market for biodiversity units. While Scotland has not yet adopted NE's BNG metric and model it has been used as a proxy for measurement in England and Scotland. Latest industry figures for the market value of biodiversity have been used for monetisation in our wider assessment beyond the ED2 CBA template.

This is a required significant change from previous price controls, we cannot keep depleting natural capital – often removing wildland to build renewable energy infrastructure - we need to find a balance it shouldn't be one at the sacrifice of the other. We know the cost of carbon will rise - investing organically like we are proposing is arguably the only way to ensure longer term cost certainty for our consumers, as we have noted before this investment takes time, it is not instant or a quick fix, however once developed will deliver richly over a 100-year span and beyond. The initial investment needed rises dramatically the faster you need the result, that is why we need to invest now, so that it can mature when we need it for net zero targets and so that costs can be controlled. Nature can bounce back, but it needs to be now.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement - Appropriate tool adopted to assess net changes in natural capital from different options for new connections and network projects. Appropriate tool adopted to monitor the provision of ecosystem services from network sites and commit to reporting annually	Targets against actions to increase environmental value	Annually from 2024
Establishment of Natural Capital Investment	RRP and annually through AER	Annually from 2024

[32] **https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/woodlandnaturalcapitalaccountsuk/ecosystemservicesforenglandscotlandwalesandnorthernireland2020**

[33] https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation

[34] **https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca**

8.6 FLUID-FILLED CABLES (FFC)

FFC Replacement - £4.7m SHEPD, £28.9m SEPD
Tagging - £ 0.2 SHEPD, £3.6 SEPD
EJP Reference – 8/SSEPD/ENV/CABLE/FFC
Output Reference: S8

Our proposed output:

We will remove 72km of oil-filled cables on our network by 2028 and reduce leakages by a minimum of 20% and continue to "tag" our worst performing circuits on an annual basis for future improvement opportunity.

FFCs represent an ageing population of legacy assets and therefore have increased maintenance and intervention costs. The leakage of oil from fluid filled cables (FFC) represents a national challenge for all DNOs, and leakage rates are reported annually. There are significant differences in leakage rates across DNOs with our SHEPD network having one the lowest leakage rates, whereas the SEPD network has one of the highest. Although a memorandum of understanding with the Environment Agency acknowledges this problem, we plan to implement a proactive cable oil leakage reduction programme during the RIIO-ED2 period, comprising increased replacement of FFC with solid cable. This strategy has been endorsed by key external stakeholders who have expressed concern and provided letters supporting investment.

With an ageing asset base and against a net zero backdrop of increasing electricity demand, it can be expected that the FFC failure rate will increase in future without proactive replacement interventions, thus increasing quality of service risks for customers. Therefore, we have developed an intervention programme for the RIIO-ED2 period, focused mainly in SEPD. This programme provides a balance between FFC oil leakage reduction, cost and deliverability and will align our FFC leakage performance targets with sector benchmarks and meet stakeholder expectations.

During the RIIO-ED2 period we aim to replace a total of 72km of FFC. A risk model was calculated over our FFC asset database that used a regression model which factors in: Historical weather, soil type, age of asset, estimated leakage rates based on top ups, cable voltage, cable pressure, soil shrink/swell and the time of year. The results provided us with risk scores 0 to 100 (0 best the lowest risk, 100 the highest) for all our FFC.

We will be replacing all FFC with a risk score between 75 and 100. We have also included cables with a Health Index score of 5 (HI5) which indicates the cable is at ‘end of life’ and cables in close proximity to the Source Protection Zone (SPZ1) for Portsmouth Waters.

The volume breakdown for each area selected is shown below:

- Risk score between 75 and 100 - 38.08km
- HI5 – 12.86KM
- Portsmouth Water SPZ1 - 20.9Km

Our target for reducing oil used for top ups is 20% in RIIO-ED2, we will report on this annually through our AER. This investment is also mapped to our NLRE, all underground oil filled cable investment is included here.

Fluid Filled Cables Tagging

Alongside our FFC replacement plan, 125 cables have also been identified to 'tag' on our worst performing circuits. These circuits are all located in SSES as the cables in SSEH fell outside of the highest scoring cables. A risk-based weighting criteria has been used to identify these circuits, with environment being the highest weighting.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement – Efficient management of Fluid Filled Cables	Adopt a target for reductions in the volume of leakage from fluid-filled cables	Annually from 2024
Replace 72km of Fluid Filled Cables (FFC) and continue to tag	RRP	Annually from 2024
Report updates on our FFC replacement programme	Report on targets and measurements in AER	Annually from 2024

8.7 VISUAL AMENITY

£4.0m SHEPD & £7.0m SEPD
EJP Reference – 16/SSEPD/ENV/VISUAL_AMENITY
Output Reference: S9
CV 20
Our proposed output:
Restores natural beauty and visual amenity in Areas of Outstanding Natural Beauty (AONBs) and National Parks (NPs) by undergrounding up to £83km of overhead lines

We will continue with undergrounding schemes in areas of outstanding natural beauty and national parks that are supported by stakeholders up to the values of 30km in north and 40km in the south throughout RIIO-ED2.

For the RIIO-ED2 period, we are requesting £4m to underground 30 Km in our SHEPD region which equates to £0.8m per year. The proposed rate is £133,000 per km. (£4m / 30km).

For SEPD, £7m is being requested to underground 40 Km which equates to £1.4m per year. The proposed rate for RIIO-ED2 in the South is £175,000 per km. (£7m / 40km).

For both SHEPD and SEPD, we have worked with BAU to establish the above unit rates based on previous completed schemes.

Visual Amenity is a Stakeholder led scheme with minimal engagement being carried out in RIIO-ED1 on Visual Amenity in the North and no engagement in the South. For the RIIO-ED2 period, we aim for engagement to be stepped up to ensure all our stakeholders are aware of the options to underground local network where applicable. We are reviewing the role of our Stakeholder Advisory Panel (SAP) and enduring role of our RIIO-ED2 Customer Engagement Group (CEG), this could be an avenue we explore for Visual Amenity proposals. The output of stakeholder engagement in the ED2 period will inform the location of investment from the Use it Or Lose It Allowance (UIOLI) set by Ofgem.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Underground 30Km of overhead network in our SHEPD region and 40Km of overhead network in our SEPD region	RRP	Annually from 2024
Report updates on our visual amenity programme	Report on targets and measurements in AER	Annually from 2024

8.8 FLOOD MITIGATION

£24.2m (£0.5m SHEPD, £23.7m SEPD)
EJP Reference – 7/SSEPD/ENV/FLOODMITIGATION
Output Reference: S10
CV 16

Our proposed output:

We will continue to carry our flood defences to substations using ETR138 defence policies. Complete flood mitigation works by end of RIIO-ED2 to circa 47 sites in SEPD and circa 14 sites in SHEPD. Our plans will be reviewed annually using ongoing survey information conducted throughout RIIO-ED2 period.

In RIIO-ED2 we have developed a programme of work to implement flood mitigation measures, highlighting the requirement to follow a systematic approach to ensure the resilience of grid and primary substations from flooding. The primary driver for flood mitigation investment is to ensure measures put in place meet the recommended specifications of Engineering Technical Report 138 Issue 3 2018 (ETR 138). The work programme has been clustered with other work where appropriate to ensure work programme efficiencies.

Substations can be particularly vulnerable if water reaches certain critical depths. During flooding incidents, the impact on society can be severe due to the combination of the flooding and loss of electricity supplies to a large community, especially if this also affects other critical infrastructure such as water, gas, sewage or telecommunications.

Severe historical flood events have demonstrated the need to understand and improve the resilience of substations to flooding and led to the publication of Engineering Technical Report 138– Resilience to Flooding of Grid and Primary Substations (ETR 138). ETR 138 addresses the risk management of flooding at grid and primary substations in England, Scotland and Wales. It outlines a systematic approach and requirement to protect against coastal, river and surface water flooding.

ETR 138 applies to all DNOs and is covered by Licence Condition 24 Distribution System Planning Standard and Quality of Performance Reporting, which states we must adhere to a standard no less than set out in P2/7 or any subsequent Engineering Recommendation (which includes ETRs).

Furthermore, flood mitigation is a strategic objective for Distribution. We have developed a Climate Resilience Strategy (CRS), as part of our Sustainability Strategy, which emphasises the need to improve the flood resilience of assets. Flooding is scored as the highest risk in 2020 and through to 2050 with the maximum scores for both likelihood and impact compared to other risks. The strategy emphasises the need to defend and future proof the network.

For RIIO-ED2 we have identified 30 sites in SHEPD to have flood risk surveys carried out and estimate that from these surveys 14 sites will require flood defence measures implemented.

In SEPD 47 sites have been identified as requiring potential flood mitigation work. Flood risk surveys will be undertaken on these sites to evaluate and confirm flood defences for the sites. Additionally, in SEPD four sites have had further investigation and surveys undertaken to establish the flood mitigation work required, these works will be undertaken in RIIO-ED2.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Carry out flood mitigation surveys for our SHEPD and SEPD licence areas.	Surveys undertaken	2024-2025
Flood defence works implemented for SHEPD and SEPD licence areas	Flood mitigation works on substations	2024-2028
Report updates on our flood mitigation work programme	Report on targets and measurements in AER	Annually from 2024
Report on flood costs and volumes	RRP	Annually from 2024

8.9 SUPPLY CHAIN MANAGEMENT

Output Reference: S11

Our proposed Output:

Implement a Sustainable Supplier Code and have 80% of our supply chain (by value) signed up by end of RIIO-ED2; whilst on an ongoing basis working collaboratively with the supply* chain with *the aspiration to achieve 90% of our supply chain (by value) signed up by end of RIIO-ED2. We report annually through our AER. As part of our SBTs commit to having 35% of our supply chain also having set SBTs by 2026.

Ahead of RIIO-ED2 we will be aligning with ISO 20400 Sustainable Procurement standard which provides guidance for any organisation of any size or type that needs to deliver sustainable outcomes through their

supply chain. In March 2020 a gap analysis was completed to understand sustainability risks and opportunities within our supply chain and the result was a detailed category risk heat map. Moving towards RIIO-ED2 we will ensure a 'green thread' strategy is developed that aligns Sustainable Procurement to our RIIO-ED2 and 2033 Goals, this will also contribute to our wider group's goals. We will develop and embed appropriate sustainable measure(s) that link Corporate Sustainability to our supply chain and introduce a reporting system which collates supply chain data to track progress against our goals.

Lessons learnt through this process were to improve our supplier code to expand and improve all aspects of Sustainability. At group level we have launched our new supplier code, and have now duplicated that at distribution level across both license areas and have a credible action plan to move this forward – full details can be seen in our ***Supply Chain Annex (Annex 16.2)***

We have set a voluntary SBT to have 35% of our supply chain (by spend) signed up to SBTs themselves by 2026 – this voluntary target was formed following engagement with our supply chain.

We are now working with the Supply Chain Sustainability School, and we are already utilising the school to improve our supply chain management. They are an industry led initiative whose mission is to be a world class organisation to enable a sustainably built environment. The School will work with us to provide targeted support for our staff and supply chain and cover 17 sustainability topics ranging from wellbeing, slavery, ethics, through to the standard carbon emissions, air quality etc.

SSEN will be able to take advantage of the following areas:

- Dashboard for our suppliers to track sustainability activity
- Set bespoke learning pathways for supply chain & internal colleagues
- Supply chain sustainability tool that monitors embodied carbon
- E-learning modules fitted into our LMS system for internal staff training
- 5 CPD training sessions for our staff and wider workforce covering all areas of sustainability through our Climate Academy.

Supply chain stakeholders told us that they have ambition to achieve net zero themselves and that they wished to support us and collaborate with us to tackle our Scope 3 emissions. This also allows all of our supply chain to access this service and build their own skill level up to ensure that we all move forward together, this will help us tackle our Scope 3 emissions. Suppliers have said that the training the School offers has directly helped them to reduce their carbon emissions and waste.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Min Req – High standards of environmental management adopted in supplier code, including requirements for public disclosure of metrics and cascading code to their suppliers that are material to the company's input	Adopt target of more than 80% of suppliers (by value) meeting supplier code in RIIO-ED2. Report on actual percentage of suppliers (by value) meeting code	Annually from 2024
35% of our supply chain (by spend) signed up to SBTs by 2026	AER	Annually from 2024

8.10 EMBODIED CARBON

£0.2m SHEPD & SEPD
EJP Reference – 13/SSEPD/ENV/CARBON
Output Reference: S11.1
CV 4
Our proposed output:

Creation and implementation of an Environmental Reporting tool report and to calculate our embodied carbon from manufacture to implementation for projects which commence in RIIO-ED2 and beyond.

We are also proposing to commit to:

- ***Monitoring and reporting on embodied carbon in new projects***
- ***Collaborating with DNO's supply chain on addressing challenges to reduce embodied carbon in the network***
- ***Establishing baseline and a target to reduce embodied carbon on new projects during RIIO-ED2.***

Implementing an embodied carbon methodology and reporting tool by 2025. Creation of embodied carbon standards for new network projects by 2024.

Our voluntary SBT regarding our supply chain is aimed to reduce our embodied carbon, by setting science-based targets themselves will mean they will reduce their own emissions resulting in a reduction in our embodied carbon, Scope 3.

During RIIO-ED2 we will be working with Action Sustainability (owned by the Sustainability School who we are working with on our supply chain management) to develop an embodied carbon reporting tool. This tool means we can manage our data in a more efficient system where the data is displayed in a way that we require. We will request data from our suppliers that covers a variety of topics (company travel, electricity, fuel consumption, fugitive emissions, waste, water and how they promote the natural environment).

The development of a tool to calculate and report the embodied carbon of our products and services will help to identify the embodied carbon footprint within the supply chain, enabling benchmarking and opportunities to reduce it. Reduction in embodied carbon is required to help us meet our Environmental

Action Plan commitments and contribute to our Science Based Targets (SBTs), whilst also delivering stakeholder desires of taking actions to accelerate net zero. We need to act now to enable the embodied carbon reporting tool to become embedded within their processes and allow time for supply chain training and upskilling.

The output at the end of RIIO-ED2 will be the provision of accurate embodied carbon data of our existing network where possible and from within our supply chain, to enable baselining and reduction opportunities to be identified on new projects and undertaken. Again, we will be working with other DNO's to develop common solutions where appropriate.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement – Monitor embodied carbon in new projects. Collaboration with supply chain on addressing challenges to reduce embodied carbon in network	Within RIIO-ED2 establish baseline and a target to reduce embodied carbon on new projects during RIIO-ED2. Report on embodied carbon within new projects	Annually from 2024
Creation and implementation of tool to calculate our embodied carbon for projects commencing in RIIO-ED2	RRP	Annually from 2024
Report on embodied carbon in new projects	Report on targets and measurements in AER	Annually from 2024

8.11 NOISE POLLUTION

Output reference: S1.1

Our proposed Output:

Take efficient actions to reduce noise pollution, and report on these actions. Implement a Noise Pollution strategy and trend analysis of complaints by 2024 and monitor throughout RIIO-ED2.

In RIIO-ED2 we will be taking measures to reduce noise pollution and commit to minimising any disruption caused by our equipment within substations. We will investigate all noise complaints ensuring that they are within permitted noise range levels, and report on these actions. We will also continue to consider the noise risk from our actions.

Noise impacts on residential properties are a material consideration in our planning process and we will aim to demonstrate no adverse impact for noise levels in our substations.

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirement Noise Pollution - Efficient actions to reduce noise pollution	We will report noise complaints in our annual RRP	Annually from 2024
Minimum Requirement Noise Pollution - Efficient actions to reduce noise pollution	Implement a noise pollution strategy and trend analysis of complaints	Annually from 2024

In RIIO-ED1 to date we have received the following numbers of complaints regarding noise complaints across SEPD and SHEPD.

Year	SEPD # Received	SHEPD # Received
2015-16	0	0
2016-17	12	4
2017-18	10	4
2018-19	6	1
2019-20	6	2
Total to date	**34**	**11**

Table 6: Noise complaints received to date across SHEPD and SEPD.

Complaints and enquiries were humming, buzzing and vibrations from substations. Our equipment selection criteria will consider noise pollution when selecting and procuring equipment.

8.12 RESOURCE USE AND WASTE

Output Reference: S12
Our proposed commitment:

Commit to zero waste to landfill (excluding compliance waste) by 2028.

- ***Achieve a recycling, recovery and re-use rate of ≥90% across our waste streams by 2028. Including an Interim target to divert 80% of waste from landfill by 2024.***
- ***Report on actual waste to landfill, recycling and reuse as a % of total.***
- ***We will update our sustainable procurement processes to embed circular economy principles to enable a Zero Waste philosophy.***
- ***Creation of resource use and waste standards and reporting for our network including offices and depots by 2023.***

We already gather monthly reports on waste from our offices and large substations (where we have waste collection points). Our reports show the tonnage of waste per month and is broken down into categories which show how much waste has gone to landfill / recycled. To ensure we are capturing all waste correctly and have a clear strategy for the future, a Waste Action Group has been set up which started in Summer

2021. Our RIIO-ED2 Sustainable Procurement Model will feature heavily in our waste strategy to guarantee that circular economy principles are embedded and that our supply chain is on the same path as SSEN.

Our Waste Targets:

- Achieve zero waste to landfill (excluding compliance waste) by 2028 (the end of the RIIO-ED2 period).
- Achieve a recycling, recovery and re-use rate of ≥90% across our waste streams by 2028. Our interim target would to be to divert 80% of waste from landfill by 2024. Whilst we already divert 79% of our waste based on 2020/21 data, we recognise that the closure of offices as a result of COVID-19 will have had an impact on the total waste produced. We expect to continue operating flexible working so whilst we will return to offices, and buildings will be occupied more regularly, overall the use of buildings is likely to differ to pre-pandemic times therefore we believe that a target of 80% by 2024 is ambitious but achievable.
- In the 2020/21 Financial Year, 47% of waste was treated via EFW (recovered) and 21% was sent to landfill. We commit to working with our suppliers to reduce actual waste in the cycle. Whilst EFW is diverting waste from landfill, we recognise the need to push this 47% up the waste hierarchy to prioritise recycling and reuse and commit to reviewing this in RIIO-ED2.
- Report on actual waste to landfill, recycling and reuse as a % of total.
- We will update our sustainable procurement processes to embed circular economy principles.
- Ensure sustainable procurement charter (supplier code) forces supply chains to consider waste management and provides a route to monitor and manage.
- Ensure our disposal management of carcinogenic (bitumous) tarmac is of a high standard and meets any legislation.
- Creation of resource use and waste standards and reporting for our network including offices and depots by 2023.

We are also in the process of reviewing our hazardous waste processes and are involved in the Street Works UK working group that was set up to investigate the amendment to existing legislation that is due to come into effect in June 2022. We will be working with this group to refine our processes in line with any new guidance.

Should there be a change in our allowance requirements as a result of this change we have included funding recovery proposals through the Street works Uncertainty Mechanism. ***See Uncertainty Mechanism (Annex 17.1)*** for further details

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Minimum Requirements – Procurement process updated to embed Circular Economy principles	Target for zero waste to landfill by 2028 Achieve a recycling, recovery and re-use rate of ≥90% across our waste streams by 2028. Report on actual waste to landfill, recycling and reuse as a percentage of total	Annually from 2024
Embed circular economy principles to reduce our resource use and waste	RRP	Annually from 2024
Report on actual waste to landfill, recycling and reuse as a % of total	Report on targets and measurements in AER	Annually from 2024

8.13 BUNDING

£0.2m SHEPD £4m & SEPD £5.5m
EJP Reference – 448/SSEN/ENV/BUNDING
Output Reference: S15
CV 22
Our proposed commitment:

We will construct bunding to bring assets in line with current Oil Storage Regulations with particular focus on assets that are in environmentally sensitive areas. In line with The Oil Storage Regulations, bunding should be carried out on existing assets containing more than 200 litres of oil where this poses significant risk (i.e. less than 10m away from any inland freshwater or coastal waters, or less than 50m away from a well or borehole otherwise known as a Source Protection Zones). Oil bunding is becoming more necessary as higher volumes of old critical infrastructure are in operation. We have identified 189 assets that are within environmentally sensitive areas, containing large amounts of oil (>200 litres) which have been identified for bunding improvement plans during RIIO-ED2.Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
Bunding to be carried out on existing assets containing more than 200 litres of oil & where it poses a significant risk	RRP	Annually from 2024
Report on volume of bunding applied	Report on targets and measurements in AER	Annually from 2024

8.14 REMOVAL OF POLYCHLORINATED BIPHENYL COMPOUND

£41.55m (£13.19m SHEPD, £28.36m SEPD)
EJP Reference – 11/SSEPD/ENV/PCB Legislation
Output Reference: S14
CV 22
Proposed Output:
Remove all PCB-contaminated assets from our network by 31 December 2025
We will also commit to reporting on the volume of PCB-contaminated equipment on the network

Polychlorinated Biphenyl Compound (PCBs) are classified as Persistent Organic Pollutants (POP). In general, POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. POPs bioaccumulate with potential adverse impacts on human health and the environment. Production of certain types of chemical, including Polychlorinated Biphenyls (PCBs) have been banned by the Stockholm Convention on Persistent Organic Pollutants.

In the past, PCBs were used as a coolant and dielectric oil in transformers and other electrical equipment. Use of these chemicals in newly manufactured electrical equipment ceased in 1985, but there are still many items of electrical equipment deployed within electricity distribution networks that pre-date 1985 and may contain PCBs.

In 2014, the Environmental Agency required all Network Operators to place all transformers on an EA PCB register. UK legislation previously allowed transformers to remain in service until end of operational life but there is now a change in the legislation.

The revisions to the Persistent Organic Pollutant Regulations now require that all EU Member States shall identify and remove from use, equipment (e.g., transformers, capacitors or other receptacles containing liquid stocks) containing more than 50 ppm PCBs and volumes greater than 50 ml as soon as possible but no later than 31st of December 2025. This revision came across into UK law as part of the Brexit process and is now also in place in Scotland as part of Scottish law.

As the POP deadline falls within the RIIO-ED2 period, the planned investment programme for the RIIO-ED2 period only contains expenditure in the 2023/24, 2024/25 and 2025/26 (Q1, Q2 & Q3) financial years.

These transformers are not normally included in routine oil sampling and testing, hence the selection of a statistical approach to identify cohorts of transformers with PCB contamination. The cohort model used for PMTs has been developed and agreed across all GB DNOs working in conjunction with the ENA. This model provides a reliable basis for scheduling our programme of contaminated transformer replacements. The delivery of this extensive programme of work represents a considerable challenge for all electricity DNOs in terms of supply chain capability and managing reliable supplies to customers.

Ground Mounted (GMT) and Pole Mounted (PMT) transformers are the main equipment types containing PCB contaminated insulating oils in our asset base. The planned intervention strategy is based on identification and replacement of contaminated units and the removal of all PCB contaminated assets from our network by the end of 2025.

PCBs have been identified as a combination of baseline funding and an uncertainty mechanism (UM) and as part of our ***Uncertainty Mechanisms Chapter (Chapter 17***), we discuss Polychlorinated Biphenyls. For PMTs the cohorts that have been statistically proven to be contaminated using the ENA Cohort model (Reds) and the PMTs where a year of manufacture cannot be identified (Red+) are in the baseline funding as they are known to require replacement prior to end 2025. Also, in the baseline are the PMTs whose cohorts have been specifically assigned from the ENA Cohort model for us to test. We will test these units on behalf of the DNO community to provide the PCB contamination ppm (Ambers) to determine the status of the PMTs in those cohorts. For GMTs we have put the testing programme and associated anticipated oil changes in baseline funding. The UM provides flexibility to fund the replacement of assets containing Polychlorinated Biphenyls (PCBs), based on volume uncertainty. The UM provides flexibility to remove additional assets once better information is available on PCB volumes. For PMTs this is the undetermined Cohorts that may become statistically proven to be contaminated. For GMTs this would be those whose PCB contamination is over 50ppm after the test, drain and refill intervention. The results of the statistically significant sample from Spring 2021 have informed the volumes in the UM for GMTs. The UM ensures the funding is based on the most accurate data, rather than a speculative large baseline with consumers over-paying. The issues around funding PCB removal have been discussed at length through Ofgem Working Groups and in the Energy Network Association (ENA).

	SHEPD		
	ED2 Baseline	ED2 UM	Total
PMT Red (#)	1,359	-	1,359
PMT Red+ (#)	668	-	668
PMT Amber (#)	1,002	3,670	4,672
Total (#)	**3,029**	**3,670**	**6,699**
Sub - Total Cost (£m)	**£12.89**	**£16.09**	**£28.98**
	SHEPD		
	ED2 Baseline	ED2 UM	Total
GMT (Testing) (#)	-	-	-
GMT (Oil Change) (#)	59	-	59
GMT Replacement (#)	5	112	117
Sub - Total Cost (£m)	**£0.31**	**£4.08**	**£4.38**
GMT + PMT Total Cost (£m)	**£13.19**	**£20.17**	**£33.36**

	SEPD		
	ED2 Baseline	ED2 UM	Total
PMT Red (#)	1,599	-	1,599
PMT Red+ (#)	2,353	-	2,353
PMT Amber (#)	1,215	1,535	2,749
Total (#)	**5,167**	**1,535**	**6,701**
Sub - Total Cost (£m)	**£25.89**	**£7.72**	**£33.61**
	SEPD		
	ED2 Baseline	ED2 UM	Total
GMT (Testing) (#)	9,552	-	9,552
GMT (Oil Change) (#)	242	-	242
GMT Replacement (#)	4	221	225
Sub - Total Cost (£m)	**£2.47**	**£8.63**	**£11.10**
GMT + PMT Total Cost (£m)	**£28.36**	**£16.35**	**£44.71**

Table 7: GMT and PMT costs including ED2 baseline and UM

Implementation Timeline

Action	Performance Measures and Reporting Commitments	Timeline
	RRP	Annually from 2024
Remove all PCB-contaminated assets from our network by 31 December 2025 Commit to reporting on PCB contaminated equipment on our network	Report on targets and measurements in AER	Annually from 2024

9. OUR ROLE IN THE ENERGY TRANSITION TO LOW CARBON TECHNOLOGY (LCT)

During the next decade our electricity network will undergo its most significant structural change since the formation of the National Grid. UK Government has committed to reaching net zero by 2050 and accepted the advice of its independent Climate Change Committee (CCC) to reduce emissions by 78% by 2035 compared with a 1990 baseline. The Scottish Government has committed to reaching net zero by 2045 and reduce emissions by 75% by 2030 compared with a 1990 baseline. This requires a total transformation of the way we use electricity in our everyday lives. The Climate Change Committee forecasts that the mass uptake of low carbon technologies such as renewables, electric vehicles, batteries, and heat pumps, will more than double electricity demand by 2050, creating significant new supply and demand patterns for our part of the energy ecosystem.

We're already rising to the challenge of helping our communities reach their own net zero ambitions and are working with them to enable their net zero transition: we're doing this by delivering upgrades to network infrastructure, facilitating the connection of low carbon technologies, and taking the first steps towards implementing innovative and flexible approaches to investment and network connections. We're especially committed to protecting customers in vulnerable circumstances and adapt our service provisions to ensure that no one is left behind.

Our customers and communities will have access to new and innovative products and services. As we transition to DSO, we will need to coordinate and balance regional grids; maintain and manage new connections; procure demand-side management flexibility, create new markets with maximum participation from innovators and community groups; capture, process and share network data while maintaining cyber-security. As part of our ***IT and Digitalisation chapter (Chapter 5)*** we discuss our priority for RIIO-ED2 is to continue building on ED1 improvements to provide a service that is trusted and valued by all our customers.

Our role as an energy network operator puts us at the heart of the transformation to deliver net zero. Our customers' needs and expectations are changing as we come to rely even more on a constant supply of electricity in our day-to-day lives. Our services must continue to evolve and support our communities in achieving their net zero ambitions. Additionally, ***DSO (Chapter 11)*** highlights DSO (distribution system operator) roles and responsibilities which will enable us to play a full role in the transition to net zero and better support our communities in delivering their net zero ambitions.

Within ***Whole Systems Chapter (Chapter 12),*** we discuss the energy sector playing a crucial role in enabling the UK and Scottish Government net zero targets in 2050 and 2045 to be met. The transition to a net zero energy supply will blur the boundaries between different sectors (such as electricity, gas and transport) and create interdependencies that necessitate a coordinated or 'whole systems' approach. To deliver a Whole Systems approach we need to continuously collaborate with local communities and authorities, alongside organisations in the energy, transport, telecoms, water and other sectors. For example, the decarbonisation of heat, with a range of alternative solutions (hydrogen, electric heat pumps and district heating) requires cross-sector collaboration and Whole Systems thinking to optimise costs and investment while meeting environmental commitments.

As part of our ***Trusted and Valued Service (Chapter 4),*** in RIIO-ED2 we commit to partnering and delivering education on LCTs to the most vulnerable and hard to reach as part of our ***Vulnerability Strategy (Annex 4.2).*** Through this strategy we will meet all our customers' needs, in line with our obligation to treat everyone fairly. Our data-driven approach will help target our activities and register more customers who will benefit from our services. One of our company initiatives will be that we will provide annual LCT accessibility funds for those in vulnerable circumstances and community-led environmental resilience schemes; providing a £500,000 annual fund (shareholder financed). We are committed to ensure everyone can benefit from the net zero transition. Our fund will support customers who need it the most.

However, there's still much more to do and we are leading by example by becoming the first UK DNO to commit to setting Science Based Targets demonstrating that we are serious about driving down our own carbon impact whilst enabling others to reach theirs. There are huge opportunities to build a sustainable, green electricity network that works for everyone, and by listening to our stakeholders to understand local and regional needs we can ensure efficient investment happens at the scale and pace required to meet the challenge.

10. OUR LONG-TERM TARGETS & OBJECTIVES

As part of our wider sustainability and environmental strategic approach we have set longer term targets, which the SBTi guides you to do. According to the SBTi, setting a net zero target implies 2 conditions:

(i) To achieve a scale of value-chain emission reductions consistent with the depth of abatement achieved in pathways that limit warming to 1.5°C with no or limited overshoot and;

(ii) To neutralise the impact of any source of residual emissions that remains unfeasible to be eliminated by permanently removing an equivalent amount of atmospheric carbon dioxide.

Companies may reach a balance between emissions and removals before they reach the depth of decarbonisation required to limit warming to 1.5°C. In other words, emissions are reduced as much as possible through engineering solutions with remaining "residual" emissions addressed through carbon removals. These could be achieved via a certified offsetting framework. The guidance around this is still in development and the criteria for eligible carbon removals is not yet defined. For this reason, we want to have control over our "carbon removal" provision and have included for this in our plan. In the future where emissions cannot be eliminated, we will have the natural capital at a mature enough level to provide our "offset". This may enable an earlier net zero target year; however, this option would only be used once all other carbon reduction measure options have been exhausted, offsetting or any removal should not be used where a better solution to avoid emissions is available. This may mean a net zero year later, but it will be a legitimate target.

To meet net zero, we must set longer term targets beyond 2033 (Our SBTs target year). We have set a net zero target for 2045 and have included a natural capital investment to provide the carbon removal that we will need in the longer term. Beyond 2033 it is expected that we will at least remain on a 1.5°C trajectory, however policy in this area is only moving in one direction and it is likely that the targets will be even more ambitious to prevent dangerous climate change.

We will remain committed and continue to pursue measures to reduce emissions further, and as time goes on, new low-carbon technologies may become more available which will aid progress; however, we must remain vigilant and ensure consequences are well managed.

10.1 SCIENCE BASED TARGETS (SBTS)

Through the 2015 Paris Agreement, world governments committed to curbing global temperature rise to well-below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C. In 2018, the Intergovernmental Panel on Climate Change warned that global warming must not exceed 1.5°C to avoid the catastrophic impacts of climate change. To achieve this, GHG emissions must halve by 2030, and drop to net zero by 2050.

In Autumn 2021 we had our SBTs accredited by SBTi, making us the first UK DNO to set SBTs in line with a 1.5°C pathway. We have also voluntarily set a target in which we commit that 35% of our suppliers by spend covering purchased goods and services and capital goods, will set SBTs by 2026. During the RIIO-ED2 programme we will continue developing and embedding the process and we will regularly communicate

progress to our stakeholders. Progress against our SBTs will be monitored via our ISO14001 management system.

Part of the net zero journey includes our approach to all emissions, including those from Losses, SF_6, and Diesel. Recognising that these are critical elements that we need to tackle to meet our SBTs, we are developing individual strategies to outline how we will deliver them. However complete carbon abatement won't be achieved in time for net zero legislation, and therefore carbon removal will be required. We are therefore developing what that looks like – we are committed to ensuring this is done in a legitimate and transparent way. Our transformational approach to natural capital investment is our proposal to do so.

10.2 MANAGING OUR ENVIRONMENTAL IMPACT

We are committed to causing no further damage to the communities in which we operate. We will act in RIIO-ED2 to reduce the risk of pollution from our assets and are developing a longer view for assets that have the potential to cause harm, specifically fluid filled cables and specific transformer types. We will be setting longer term targets to transition away from these in a sensible fair way during, this information will be developed throughout RIIO-ED2 in conjunction with our stakeholders and innovation learning.

10.3 EMERGING POLICY DIRECTION

We know that environmental policy – or lack thereof is a global problem, we also know that it is only going in one direction and companies will have stricter and tighter legislation coming in the future. We welcome the awareness COP26 has brought to policy, and we expect to see further legislation as a result. We continue to scan the horizon for anything that may impact us and our network, the new SF_6 legislation is one. The Committee for Climate Change has recently announced furthermore progressive legislation is required to manage Climate Resilience, there is discussion around a 1.5°C target, now being the minimum standard for companies to adhere to and there will be others. Ofgem also recognise this and have included Environmental Re-openers for this purpose. We will continue to work closely with our stakeholders to make sure we are managing this as efficiently as possible.

11. ENVIRONMENTAL RE-OPENER / UNCERTAINTY MECHANISMS

During RIIO-ED1 so far, significant environmental developments have occurred which are reflected in the need for proposed changes for RIIO-ED2. In addition to net zero targets, there were new requirements on persistent organic pollutants, accelerated Polychlorinated Biphenyls (PCB) removal and the introduction of Ultra Low Emissions Zone. There has also been increasing awareness of the impact of business activity on the environment and the climate in public discourse. This is evident in many local authorities declaring 'climate emergencies' through the course of 2019.

It is likely that there may be changes in the environmental policy legislation throughout RIIO-ED2. The immediate relevance relates to upcoming SF_6 legislation. The European Commission (EUC) has an ongoing review of the F-gas Regulation 517/2014, which is considering alternatives to SF_6-filled medium-voltage switchgear. The ENA have been coordinating a response to the EUC's review with a view to ensuring that any F-gas Regulation amendment is sensible and practical for UK impacted companies and a representative

of this process has been feeding into the RIIO-ED2 working group to ensure any implications are accommodated.

Ofgem propose to implement a re-opener mechanism to respond to environmental legislation that would require any material change in the approach to our EAP. In the case of national legislation, Ofgem expect DNOs to work together to show what these material changes would be and the approach required to implement the changes.

12. REPUTATIONAL INCENTIVES AND REPORTING REQUIREMENTS

12.1 ENVIRONMENTAL SCORECARD ODI-F

Ofgem are proposing a financial incentive across our EAP, this has still to be refined with Ofgem and the DNO's and Ofgem have programmed this negotiation for the first quarter of 2022. To date Ofgem and the other DNO's have been working on developing this measure. We have highlighted the areas we feel could be considered under this investment with Ofgem and the other DNO's, but nothing has been agreed so we haven't speculated on the regulatory outcome of this incentive and look forward to concluding discussions in 2022.

12.2 ANNUAL ENVIRONMENTAL REPORT

Ofgem are proposing a new licence obligation to deliver an Annual Environmental Report (AER) yearly. The AER will detail progress of EAP commitments and report metrics against targets set. Ofgem consider the AER process would be a reputational incentive and working with RIIO-ED2 work group to establish a common approach for annual reporting and metrics for inclusion within a reputational incentive.

We already publish annual environmental reports, and this will continue but expand to include all categories included in our EAP. The AER will be stakeholder facing and will used to report progress to stakeholders on co-created initiatives.

12.3 ANNUAL RRP SUBMISSION

We are required to submit annually, in July, our Regulatory Reporting Pack (RRP) to Ofgem for both SHEPD and SEPD. As part of the RRP we are mandated to report on our environmental activities as proposed in our ED2 Business Plan Data Tables (BPDTs):

- CV16 Flood Mitigation
- CV20 Visual Amenity
- CV21 Losses
- CV22 Environmental Reporting
- M1 Flood Mitigation (site)
- M23 Environmental Action Plan

- M24 Losses

13. PRICE CONTROL DELIVERABLES (PCD)

Ofgem have issued further guidance on the use of Price Control Deliverables for RIIO-ED2. Ofgem defines PCDs as follows:

"In RIIO-2, we will use PCDs to capture those outputs that are directly funded through the price control and where the funding provided is not transferrable to a different output or project. The purpose of a PCD will be to ensure the conditions attached to the funding are clear up-front."

Ofgem are proposing a new threshold for PCDs which they are proposing to set at £15m. This means that activities under that threshold cannot be classified as PCDs, and we can only propose PCDs for activities worth £15m or more.

For our EAP we aim to demonstrate a leadership position by setting up PCDs for some of our Environmental projects.

14. CONSUMER VALUE PROPOSITION (CVP)

Alongside this EAP, we propose to offer a CVP to explore opportunities to restore seagrass beds in our licence areas which have not already been addressed by existing marine conservation initiatives. Full details can be found in our ***Consumer Value Proposition (Annex S 3)*****, an extract of which is below.**

We own and operate 113 subsea cables (to Scottish islands and the Isle of Wight), providing electricity to our islands. Our subsea activities cause some disturbance to the seabed, and we are looking through this CVP to reverse the negative impact we may be having on our environment. Our CVP can help with climate adaptation pathways by providing protection from coastal erosion, and provide carbon sequestration, as an alternative to offsetting and to mitigate the impact of climate change, in line with our 1.5-degree SBT.

We all have a responsibility to mitigate against climate change. Looking out at other sectors many utilities are following similar paths, and recently OFWAT have released innovation funding for this type of initiative. We are fortunate in that we have the potential to invest in natural capital that our customers will see the benefits of, due to the areas in which our networks are located. As an example, the planting of seagrass off the Scottish, and South English coast would not only sequester carbon but as a result, encourage more wildlife including fish and seabirds into the area. Customers that reside in these areas would potentially be able to see the physical benefit of our investments.

We have identified an opportunity in the biodiversity activity that DNOs undertake and have been challenged to address it by our stakeholders. Current legislation calls for a net gain on terrestrial projects at above ground assets, but there is a gap in legislation for below ground assets meaning we only do what is required through the planning process, no net gain below water means that we are deprioritising our impact on water courses and our oceans where the potential consequential benefits often exceed the

benefits of on land investment – hence why our stakeholders were keen to understand why we as an industry are ignoring this opportunity to build back much greener. Through this CVP we can put this right, not only by the work we do, but also by the awareness that it will raise within our industry and beyond should it be successful. The value of doing this as part of the framework will escalate the societal benefit and strengthen the profile and importance of this type of work in our journey to address climate change.

Our proposal is that in RIIO-ED2 we replant lost seagrass meadows in the area surrounding both our licence areas, as we seek to leave the ocean healthier than we found it. We are proposing to undertake a significant seagrass planting project during RIIO-ED2, that will unlock benefits for customers and communities for many years to come. This will add balance to our environmental proposals, ensuring we treat our above ground and below water activities on an equal basis. We want to ensure that biodiversity, no matter where it is found, is improved in our licence areas during RIIO-ED2 and beyond. This is above and beyond what we are required to do, but our stakeholders are pressing us to consider new ways to deliver environmental benefits and this is an exciting area of activity where we can explore real ambition.

We want to address the decreasing biodiversity and quality of our coastal waters through an ambitious seagrass planting programme at selected locations around our coastal networks. We will, in partnership with delivery specialists and local community organisations, undertake a significant and ground-breaking programme of activity around our coastal networks with the aim of replanting up to 17 hectares of seagrass meadows over the ED2 period, but understand that this is a long-term investment that will deliver benefits well beyond ED2.

This CVP seeks to align with our corporate commitment to doing the right thing, but also respond to stakeholders and communities in delivering additional environmental benefits, out with that of the typical responses from a DNO, that will take proactive action to reverse climate change impacts. We understand taking action now takes time to deliver benefits but waiting is not an option. These delicate ecosystems take time to recover and grow, so acting now will secure benefits sooner. Biodiversity needs time and consideration – it cannot be sped up or rushed by spending more later. We are passionate about doing the right thing, and this CVP explores the opportunity and value that could be delivered through targeted seagrass replanting.

Seagrasses, a functional group of marine flowering plants rooted in the world's coastal oceans, support marine food webs and provide essential habitat for many coastal species, playing a critical role in the equilibrium of coastal ecosystems. Despite their importance, seagrasses are disappearing from threats such as pollution, decreased water clarity, and physical disturbance. Over the last century, 92% of the UK's seagrass has disappeared. We recognise that our impact on the marine environment could have played a role in this depletion.

There is no international legislation for protecting seagrasses, and so protection typically occurs by local and regional agencies. In the UK, **Project Seagrass** is a marine conservation charity dedicated to ensuring that seagrass meadows are protected globally, working with a range of partners to do so. A number of seagrass restoration and monitoring projects have been run across the nation - notably North Wales, West Wales, and the Isles of Scilly. However, we have identified a gap in replanting lost seagrass meadows in the area surrounding both our licence areas. Following a mapping of the benefits through our Social Return on Investments model, has driven the amount of restoration we propose. The value of this CVP is lower than our other proposals but actually returns more societal benefits, we hope that through an award of this

CVP, that the publication of its success will greatly raise the awareness and importance of this work and that others will follow suit, resulting in us collaboratively restoring our planet. Please see our **Consumer *Value Proposition*** (***Annex S 3)*** for more details.

APPENDIX A: ENHANCED ENGAGEMENT

- Overview: **Addressing the environmental impact of our operations and improving environmental outcomes for the communities we serve**
- Total cost in baseline plan: **£172.3m (EAP including BCF)**
- Contribution to annual customer bills**: £4.34 (South), £5.31 (North)**
- Consumer benefit: **Decarbonisation and improved environmental performance of our network and the wider community. Improved air quality, reduced carbon emissions and net zero.**

RIIO-ED1 context

Overall, we have improved our BCF reduction performance since the start of RIIO-ED1 and are making good progress towards our target of 15% reduction by the end of the period.

Electricity losses result in unnecessary emissions and cost to customers. In RIIO-ED1 we have focused on two areas responsible for electricity losses: theft and unregistered supplies, and technical losses from operating our assets. Combined, losses are responsible for 91% of our business carbon footprint (Scope 1 & 2). Our #NotWorthTheRisk campaign has been successful in deterring theft. We have also reduced technical losses across our network through our programme of upgrading cable sizes and network voltages. In RIIO-ED1 we have reduced losses by 32,097 MWh to date and forecast losses savings of 77,901 MWh to the end of RIIO-ED1. Our RIIO-ED1 losses strategy is available at ssen.co.uk/losses strategy.

We continue to focus on addressing the environmental impact our assets, particularly Fluid Filled Cables (FFC) and SF_6 leakage. We no longer install FFC on our networks and we continue to tag our existing cables with a tracer oil to efficiently locate and repair leaks. Our strategy to minimise SF_6 leakage from our switchgear, implemented in 2019/20, focuses on using updated data to improve our understanding of our SF_6 assets. We had an ambitious ED1 target on both our networks to reduce SF_6 by 15% and although we are currently behind, we are seeing benefits from the strategy and expect continued improvement of our performance in the final years of this price control.

By 2019/20 we had delivered almost 50% of our ED1 target to replace 21km of fluid-filled cable in our northern license area network (10.9km achieved) and 55km (23.9km achieved) in the south. We will continue with our strategy of cable tagging and replacement throughout the rest of the price control period.

Stakeholder evidence

Engagement details	Insights derived
Fuel-poor customers, Future customers, Vulnerable customers, Business customers We tested our ***EAP strategy, outputs and costs*** through qualitative focus groups involving ***fuel poor, future and vulnerable customers and business customers*** to get insights into the acceptability and affordability of our Draft Business Plan.	• **Fuel poor participants** supported the ambition of the EAP outputs, in both regions even urging more ambition for carbon footprint reduction given the urgent need to address climate change. They were also concerned about the cost of the EAP to bills. [E156] • **Customers in vulnerable situations** were generally supportive and positive about the EAP and would like more transparency and accountability about how SSEN is meeting the targets. [E156] • **Business customers** agreed that the EAP was a **high priority and** found the **cost broadly acceptable**, considering the prominence of net zero as an issue, but there wasn't enough comparable data to judge it. [E156] • **Future customers** were very ***supportive of the EAP outputs*** and urged more investment in this area – and some of this group felt it should be funded by the company, rather than customer bills. [E156] • A particular area for ***more ambition*** urged by **future customers** was a 100% electrification of vehicles target and alternatively-fuelled vehicles rather than purely electric vehicles where this was not practical eg vans the Highlands. [E156] • 60% of school aged participants ranked, "people should pay more for their electricity now to help pay for environmental benefits for future generations" third or higher out of a set of 8 statements related to the energy trilemma. [E158]
Domestic customers We engaged ***domestic consumers*** about the ***environmental action plan*** and innovation via a ***Citizens Jury*** and on our Draft Business Plan via an online survey	• ***Domestic customers*** were very ***supportive*** and impressed by SSEN's EAP. They said is incredibly important for SSEN to take action against environmental issues. Participants did raise the issue of ***affordability*** but were accepting that there may be an added cost to the consumer but wanted to be reassured that vulnerable people would be protected from rising prices. [E149] • Companies like SSEN have a greater responsibility to act on environmental targets than consumers. [E149] • ***Domestic customers*** discussed the importance of ongoing monitoring and evaluation and the need for accountability regarding our EAP and its innovation projects. [E149] • **Domestic customers** suggested ***further ambition*** for the ***EAP*** could include:

	• Assessing the impact of meat, seafood and food packing in staff canteens • buying from sustainable and ethical suppliers • Extending the supply chain sustainability code to include an assessment of a company's carbon footprint from food. [E149] • ***Domestic Customers*** were positive about building ***natural capital*** across the network, particularly where infrastructure works disrupts natural capital, and it is important to convince wider stakeholders of its value and SSEN investment plans. [E149] • Participants noted that a resilient EAP will rely on continual research on climate change. [E149]
Non-consumer stakeholders We engaged a broad range of ***non-consumer stakeholders*** to test their views on the ***outputs and costs*** in our Draft Business Plan – and the ***Environmental Action plan outputs and costs*** in particular – via an online consultation event and surveys	• ***Stakeholders*** overall were satisfied with the ambition of the EAP and thought implementation was key and the real ***challenge*** for SSEN is in the ***implementation and monitoring of its action plan***. [E151] Monitoring of targets was also echoed by the storage and renewable stakeholder segment [E167] • *'Does our package of output in this area represent a sufficient level of ambition*?' scored 3.00/5 for Environment and Sustainability. [E151] • *Does our package of outputs in this area represent good value for money for customers?*' scored 3.00/5 for Environment and Sustainability. [E151] • *'Is our package of outputs in this area comprehensive enough to meet the needs of our customers?'* scored 3.25/5 for Environment and Sustainability. [E151] • ***Storage and renewables stakeholder segment*** were satisfied with the EAP outputs and noted they go beyond network infrastructure to consider suppliers, transport, and biodiversity. The outputs associated with reducing emissions from mobile diesel generation on the islands is particularly important, and the EAP was not just treating this as a cost issue. [E155] • SSEN should work with water stakeholders to get best practice guidance on water quality. [E151] • ***Local authority stakeholders*** highlighted that the target to 'promote biodiversity net gain in the longer term' did not have a measurable target for example the 10% biodiversity net gains proposed in the Environment Bill. [E155] • The EAP required greater attention to removal, restoration and associated carbon footprint being factored into the lifecycle of projects requiring a changed business and procurement model. [E151] • National Government stakeholders urged SSEN to work ***beyond regulations on PCBs*** and identify alternative processes. [E151]

	• Planting trees in landscapes which previously didn't have trees is not value for money and restoration of peatland is preferable. [E151]
National Government We engaged MPs, MSPs and Government agency representatives about our Draft Business Plan via bilaterals and at an online consultation event	• We consulted MSPs for: Orkney Islands; Ochil and South Perthshire; Western Isles who were broadly satisfied with the EAP. [E166] • ***Scottish Government*** agency representative highlighted that the biodiversity element of the EAP didn't encapsulate all potential action that SSEN could do in this space. [E177]. More ambition on biodiversity was possible. [E151] • ***Scottish Government*** referenced the 'Peatland ACTION Project' involving private investment to restore 60%+ of the 20% of Scotland's land that is ***peatland*** for carbon storage and sought clarification of SSEN's role in this project. [E177] • SSEN was urged to investigate ***natural capital accounting methodologies*** and that the Scottish Government was developing a methodology which could be shared. [E177] • Scottish Government highlighted ***co-ordination with other infrastructure providers*** on waste and restoration. [E177 • Government suggested ***restoring woodlands*** would be preferable to tree planting and collaboration with the Woodland Trust was recommended. [E177]
Charities We engaged expert charity representatives about our Life below water CVP via bilaterals	**Life below Water** • The lack of data to quantify benefits was highlighted. Baseline methodologies around low-cost best practices had been applied at similar projects in Loch Arline (Mull) and Loch Broon (Wester Ross). [E177] • Successful schemes build in not only environmental benefits but align with strong community presence and activity – the key is stakeholder engagement. [E177] • Restoration of oyster beds and salt marshes play an important role in the ecosystem restoration in addition to seagrass. [E177]
Current and future employees We tested the outputs and costs in our Draft Business Plan with colleagues via surveys	• Annual/biannual reports on how SSEN is meeting its EAP targets is required. [E172]
Industry stakeholders We collaborated with a wide range of stakeholders via an	• Stakeholders urged us to aim beyond Ofgem's minimum requirements, as these are not seen as ambitious, and to work with partners such as LEPs [E071].

online workshop to co-create our EAP, Science-based Targets (SBTs) and sustainability/ net zero strategy	• Stakeholder ***priorities*** included: impact of investments (eg wind turbines) on bio-diversity; minimizing leakages from fluid filled cables; recovery of losses as there are "no excuses for losses"; and removal of SF_6. • A range of stakeholders highlighted waste-to-energy opportunities [**E008**][**E012**].
Community energy schemes We engaged with stakeholders via online workshops	• Stakeholders see us as having a leading role in meeting Government's 2050 net zero targets and the strong need to reduce losses in line with other countries [**E071**]. • We were encouraged to talk to the Woodland Trust and endorse their tree strategy for West Solent's solar farm [**E103**] • We were advised to be careful with the bee bombs strategy as meadows require poor soil [**E103**] • Stakeholders expressed desire for the New Forest to remain unspoiled [**E103**].
Charities/ NGOs We engaged with stakeholders via online workshops	• Stakeholders see a role for us beyond compliance and our own organizational boundaries and encourage a focus on: education and implementation of energy efficiency, including partnerships with schools and charities; research on green energy; wider carbon reductions; collaboration with climate focused organisations [**E071**]. • Stakeholders prioritised increased network capacity for renewables and low carbon generation accompanied by support mechanisms for lower income households to reduce impacts on bills [**E071**]. • A charity expressed a desire for partnering with us in a community engagement role to communicate projects to people in the local area [**E103**]
Developers/connections representatives We engaged with stakeholders via online workshops	• Stakeholders urged us to show ambition and debate/lobby Ofgem to remove restrictions which hinder sustainability projects [**E072**]. • They raised the need to train staff in maintenance/service of new techniques and technologies and to show the science behind potential increased costs to get people on board by framing messages correctly and improving communications [**E071**]. • They called for us to apply targets to our subcontractors and look at full lifecycle for suppliers to encourage industry change [**E071**]. • We were encouraged to push for biological net gain rather than no net loss, and commitments should be numbered to improve confidence [**E103**] • We were advised to consider RSPB's active management land under cables which encourages biodiversity [**E103**].

	• It was felt that there had been missed opportunities with electric storage heaters where people have been charged inflexibly to charge their heaters to meet the networks' needs. There could been alignment with charging and community energy project output - we should work with the National Grid to harness this potential link [**E103**] • One developer/connections representative found the term 'waste' difficult as it is a resource and was of the mindset that everything should be re-used if possible rather than disposing or recycling [**E103**]. • It was raised that there are a lot of cables in the South Downs National Park and we need to get out into communities rather than just involving a few self-selecting participants [**E103**].
Local authorities We engaged with stakeholders via online workshops	• Stakeholders identified environmental priorities to be: reduce SF_6 usage and oil leakage; reduce waste, ensure ethical/sustainable supply chain, electrifying fleet; reducing energy consumption; waste to energy opportunities (with local authorities) [**E010**][**E011**][**E012**][**E013**]. • Other priorities included education of consumers about climate change and climate change resilience [**E103**]. • These stakeholders were concerned about affordability for consumers and identified the importance of providing incentives for sustainable technologies for consumers, for example, insulation. Additionally, that increases in bills for climate action should be transparent to consumers [**E103**]. • We were advised to plant suitable trees rather types that would be cut down for timber at a later date [**E103**] • It was pointed out that the south has a lot of chalk and therefore poor-quality soil where bee bombs and meadow planting could be targeted [**E103**] • The point was made that reducing biodiversity loss should be the first priority, to protect mature trees [**E103**] • They also highlighted the need for management of land beneath power cables, such as where hedges have been cut down unnecessarily - expressed desire for wildlife corridors [**E103**] • Partnering with Wildlife Trust, councils, Plantlife etc was also advocated [**E103**] • Stakeholders said we could invest in R&D to explore new ecosystems and deploying biodiversity [**E103**] • We were advised to work on smaller-scale generation sites converting waste to electricity for use in district heating, and to start building the infrastructure for what will be used in 2050 [**E103**] • We were warned that there should not be a heavy reliance on waste for energy if the aim is to be 'zero waste' [**E103**] • They said target should be to avoid single use items and look to where they can be used elsewhere [**E103**]

	• It was voiced that we should keep cables underground where possible, pointing towards railways where cables could be kept [E103] • It was noted that archaeological areas of significance were missing [E103] • Success of improving visual amenity during ED1, especially areas outside of national parks where there are sensitive landscapes were mentioned- we were advised to speak to and engaging with local communities to see what they think [E103].
DNOs We engaged with stakeholders via online workshops	• Our responsibility to 'keep the lights on' is underpinning the need for a strong focusing on climate change resilience as a priority, particularly resilience against flooding [E072]. • Stakeholders voiced that investing heavily in reducing SF_6 leakages wasn't justified until an affordable alternative is available [E103].
Environmental community interest groups We engaged with stakeholders via online workshops	• Stakeholders also noted Ofgem's role is to set minimum targets and urged us to push further and supported the use of science-based targets [E072]. • These stakeholders also noted that we should be realistic about loss reduction and balance costs for consumers and that SF_6 leakages not high so we shouldn't prioritise this [E071]. • We need to move towards greening the network by facilitating consultations with land-owners about tree cutting and how it effects the local community [E010]. • Stakeholders encouraged distribution to do the same, as transmission and commit to biodiversity net gain where practical and cost efficient [E103]. • It was pointed out that there a is potential for local communities to be self-sufficient so stakeholders advocated for the idea of local generation solutions [E103]. • We were encouraged to come up with a sustainable procurement process to sit alongside their plans for resource use and waste which runs throughout the supply chain [E103] • They were pleased with how we considered pylon routes in rural areas and didn't personally think pylons are a priority issue [E103] • We were advised to consider potential loss of net biodiversity gain against visual amenity when laying underground cables. [E103]
Service partners (Infrastructure/ engineering) We engaged with stakeholders via online workshops	• Stakeholders supported science-based targets and also urged us to go beyond Ofgem's requirements and identified the risk in only meeting Ofgem requirements [E009][E010][E011][E012][E013]. • We were advised to move towards 'responsible consumption and production' by improving network efficiency through thicker cables with smaller losses

	• They thought we should educate customers and communities about energy efficiency and set examples eg use of plastic cups [E009][E010][E011][E012][E013] • We were urged to quantify value of addressing impacts from infrastructure (commitment to no further degradation) to convince Ofgem for funding • Plant/machinery/vehicles need to be electrified eg tipper trucks during construction to reduce pollution at our sites [E072] • They thought we needs to consider resilience against natural processes eg coastal erosion in Scotland and climate change eg increasing wildfires [E072] • They also need to consider joined-up thinking through all operations, use of equipment, vehicles etc [E071]. • Stakeholders were pleased with our work on science-based targets and hoped we continued to lead the way in getting science-based targets accredited [E103] • An infrastructure/engineering representative highlighted alternative to SF_6 for LV and MV, so it's down to DNOs and consumers. Stakeholders felt that as SF_6 needs to be tackled, however, we should make clear the costs and best way of achieving a carbon reduction [E103]

Consultants
 	
We conducted audience research via online workshops
	• We could support renewable generation through lobbying for subsidies, proactive reinforcement, funding innovation and research, connection capacity and simplifying connections process [E009] [E011][E012][E013].
	• We were encouraged to collaborate at government level to achieve 'affordable and clean energy' [E009] [E011][E012][E013].
	• Stakeholders thought we need to tackle fuel poverty and implement mental health initiatives to achieve 'good health and wellbeing' [E009] [E011][E012][E013].
	• We should be leading through support roll-out of EV/LCT, no new fossil fuel connections, focusing on sustainable connections and sustainable supply chain, and educating consumer/younger generation on climate emergency to achieve 'climate action'[E008][E009] [E010][E011][E012]
	• We should be working to reduce waste, ensure ethical/sustainable supply chain, electrifying fleet and reducing energy consumption of its offices to achieve 'responsible consumption and production' [E008][E009] [E010][E011][E012]
	• For 'industry, innovation and infrastructure', we need to:
	  ○ Enable commercial development
	  ○ Utilise innovative solutions such as DSR and battery storage
	  ○ Promote the use of low carbon technologies and EVs
	  ○ Increase capacity for renewables and invest in micro generation
	  ○ Look for energy to waste opportunities

	○ Collaborate with research associations and academic institutions for innovation ○ Invest in innovation and R&D ○ Ensure reliability by efficient asset management and maintenance ○ Provide incentives and support risk in innovation ○ Collaborate with other organisations, namely other utilities ○ Encourage the use of new technologies and automation • For 'life on land', we need to: [E008][E009] [E010][E011][E012] ○ Establish the impact of your assets ○ Take responsibility and avoid a 'box-ticking' approach ○ Ensure land is not contaminated because of our operations, including spillage from cars and generators and disposal of waste ○ Consider the environmental impact of infrastructure ○ Manage trees and woodlands with an environmental, not an economic mandate ○ Offset the negative impacts of running your business ○ Ensure sustainable best practice on new estates and developments ○ Educate consumers and engage with Wildlife trust • We should be support fuel poor/vulnerable customers, take advisory role in tackling fuel poverty through negotiation with suppliers, and focus on affordability and fairness to achieve 'no poverty' and 'reduce inequalities' [E011][E012] • We should have proactive role in local plans/new housing developments, supporting community energy and micro-generation, through closer collaboration with councils, developers, planners, utilities and communities to achieve 'sustainable cities and communities' [E008][E009] [E010][E011][E012] • We need to look at removing local constraints and simplifying connection process to accommodate renewables to achieve 'sustainable cities and communities' [E008][E009] [E010][E011][E012] • We should use community funds to promote sustainable transport eg installing bike racks. [E008][E009] [E010][E011][E012]
Domestic customers We conducted audience research via a survey to understand consumer sentiment on a range of topics	• We should support domestic renewable generation by simplifying the connection process and providing education about domestic generation [E008] • We should provide leaflets with information on home energy efficiency advice to customers [E008] • We should help customers with costs of insulation, which is the main barrier for large scale adoption [E007]

	• We should promote 'responsible consumption and production' through education of customers on efficiency, constraints, access and limitations [E010, E013]. • We should clearly communicate our EAP to the public as this might encourage other companies and individuals to act on environmental concerns - taking on a leadership role. [E149]
Consumers We tested domestic and non-domestic customers' priorities for 15 initiatives separately for the North and South Licence Areas via a robust Willingness to Pay study, which included a qualitative phase to understand the reasons for customers' choices	• Environmental initiatives as a whole were the highest enhancement priorities for consumers, ahead of network and customer service (with the exception of helping fuel-poor households, which was the top priority) [E126]. • This was supported by the qualitative phase which revealed a desire for more ambitious environmental outputs including ensuring the network is ready for a green future, although value for money remained important [E125] • Reducing our Business Carbon Footprint further from 28% lower than now to 42% lower than now by 2028 is a very high priority for all types of consumer in the south, and a high priority for all consumers in the North [E126]. • Increasing our ambition for replacing the length of oil-filled cables we will replace during ED2 from 52km to 92km is a very high priority for non-domestic customers in the South, and a high priority for domestic customers in both Licence Areas. Non-household customers in the North ranked this as a medium priority [E126]. • All consumer segments indicated a medium willingness to pay to increase the proportion of our vehicle fleet that is electric from 80% to 100% by the end of ED2 [E126].

Business/DG customers
 	
We conducted audience research via a survey to understand consumer sentiment on a range of topics
	• For 'life on land', stakeholder told us we need to: [E010]
	  ○ Establish the impact of your assets
	  ○ Take responsibility and avoid a 'box-ticking' approach
	  ○ Ensure land is not contaminated because of our operations, including spillage from cars and generators and disposal of waste
	  ○ Consider the environmental impact of infrastructure
	  ○ Manage trees and woodlands with an environmental, not an economic mandate
	  ○ Offset the negative impacts of running your business
	  ○ Ensure sustainable best practice on new estates and developments
	  ○ Educate consumers and engage with Wildlife trust
	• We should be educating customers about energy consumption and provide trainee programmes/apprenticeships in colleges to achieve 'quality education'. [E013]

Academic institutions We collaborated via expert roundtables	• We need to design the electricity distribution network strategically to minimize electricity losses in renewable generation. [**E014**] • We should increase building energy efficiency by introducing an 'upgrade scheme' for customers looking to upgrade their energy system eg boilers etc [**E014**].

Supply Chain
 	
Online stakeholder workshop to seek feedback from stakeholders on our Climate Resilience Strategy and Environmental Action Plan
	• A business representative highlighted opportunity where there are organisations involved in recycling locally [**E103**]
	• Reporting and external disclosure of climate action data is undertaken by larger organisation and setting requirements for public disclosure across the supply chain is likely to represent an unnecessary burden, in terms of both cost and time [**E093**]
	• Since ISO14001 accreditation does not directly measure an organisation's environmental performance we should ensure additional qualitative criteria are incorporated into future tender opportunities[**E093**]
	• There is clearly a need for us to positively engage with the SME community to address their concerns and build confidence in the affordability reaching the sustainability targets [**E093**]
	• 63% of respondents who participated in the sustainable procurement survey understood Sour ambitions but do not have a clear site of future sustainability targets [**E093**]
	• 79% of stakeholders do not have a clear view of the costs to deliver the sustainability targets. The remaining 21% represent those suppliers who have already adapted their business to deliver both sustainable solutions and targets [**E093**]
	• 72% of the responses are committed to deliver zero waste to landfill. However, 64% of responses have made little or no progress in developing an approach or setting targets. The latter is predominantly across the SME community – best practice waste reduction initiatives can be shared with the supply chain and targets incorporated into supplier management [**E093**]
	• Only 26% respondents were fully committed (majority large organisations) to the delivery of our future sustainability targets through increased investment – there is clearly a need for us to positively engage with the SME community to address their concerns and build confidence in the affordability of the strategy [**E093**]
	• The four main findings from interviewing our key suppliers to test the supply chain's readiness, appetite and alignment to our future sustainability targets, as well as to gain feedback and insights into what they need from us, are as follows [E093]:
	  ○ Embracing sustainability is seen as a source of future competitive advantage and as a means of reducing operating costs
	  ○ The tender process needs to place increased emphasis and weighting on sustainability. An overwhelming focus on price

	fails to incentivise the supply chain to invest in 'green' alternatives ○ SBTs are an aspiration. Sustainability language rarely extends beyond environmental teams and the leadership team ○ Improving demand forecasting and range rationalisation could support elimination of inefficiencies benefitting both us and wider industry.
Government Online stakeholder workshop to seek feedback from stakeholders on our Climate Resilience Strategy and Environmental Action Plan	• Opportunities for us to set targets in this sector and be as ambitious as possible, particularly from climate and business perspectives was highlighted by stakeholders [**E103**] • We could be more ambitious than seeking no net loss and move towards net gain, referencing the Dasgupta Review - actions could include avoiding ancient woodland when re-routing overhead lines, minimise loss at early planning stages, and improve management of wayleaves [**E103**]
Housing Association Online stakeholder workshop to seek feedback from stakeholders on our Climate Resilience Strategy and Environmental Action Plan	• Stakeholders advocated use of science-based targets and thought having more visibility about what that means is good [**E103**] • The whole supply chain isn't included in carbon footprint. Stakeholders raised the point that our supply chain is neither local nor British - materials come from China or Greece, workers come from Ireland [**E103**] • Concerns were raised over the use of battery backup on small islands surrounding short lifespan and high costs - considering using hydrogen instead, tied in with offshore wind [**E103**]
Research bodies, policy forums and think tanks We engaged with Sustainability First (SF) to understand their aspirations for DNOs and current key concerns	• SF's key concerns are: ○ All DNOs should adopt '1.5degrees' (increase in global temperatures) as a maximum increase. Offsetting should not count towards net zero. ○ Losses: they were unhappy that the incentives were removed and would like to see DNOs setting targets around these (and believe engineers are keen to do this) ○ DNOs should have clear plans for getting away from SF_6 ○ Energy efficiency: giving advice is a baseline; the latest thinking is that the next level is smart electric storage with energy efficiency advice to help vulnerable customer reduce their bills. Additional research needs an extra funding stream (not innovation). ○ Biodiversity ○ DSO/Flexibility/Partnership. • Climate adaptation is also an issue [**E137**].

Engagement statistics

ED2 ENGAGEMENT EVENTS

37

INSIGHTS

340

STAKEHOLDERS ENGAGED

9,475

Stakeholder segments engaged

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	LEPs	Emergency response	Healthcare	Community interest bodies		
WIDER INDUSTRY AND VALUE CHAIN	DNOs	Transmission	GDNs	Water	Telecoms	IDNOs	
	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 advisers	Trade unions

EVIDENCE ASSESSMENT

ENGAGEMENT SCORING KEY

The engagement score assigns a weight to each source accounting for the robustness of the engagement event and the relevance of the feedback to the topic.

Score	Description
1-1.66	Limited evidence of good event planning, methodology or data collection. Feedback provided is high level with tangential relevance to the topic.
1.67-2.33	Good evidence of engagement planning and discussion of data collection methods, but limited depth of feedback and range of opinions. Feedback not necessarily fully aligned to the topic and only provides a limited insight and thus moderately useful.
2.34-3	Well-conducted, trustworthy event with highly relevant feedback. Specific, clear and relevant information with clear link to the topic discussed and high value added.

Table 8: Engagement scoring key

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
Phase 4: Testing and Acceptability	Oct-21	E153	Employee Consultation Document Engagement on Draft Plan	Current and future employees	3	1.8
	Oct-21	E155	Stakeholder Consultation Document Engagement on Draft Plan	Community interest groups, storage and renewables suppliers, emergency response, healthcare and highways agencies	19	2.8
	Oct-21	E177	Sustainability strategy focused bilateral	National government and Charities	6	2.5
	Sep-21	E151	Consolidated Outputs and Costings Event	Contractors, Consultants, Local Authorities, National Government, Storage and Renewables suppliers, Supply Chain	106	3.0
	Sep-21	E152	Academic Panel	Academic Institutions	7	2.0
	Sep-21	E156	Draft Plan Qualitative Acceptability Testing Event	Domestic Customers	46	3.0

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
	Sep-21	E158	Future Consumers Event	Future Customers	26	3.0
	Sep-21	E170	Microsite survey on Costed outputs	Domestic Customers, Vulnerable Customers and Future Customers	1,298	2.2
	Sep-21	E175	Flexibility CVP Expert Event	Community Energy Schemes, Charities, Local Authorities,	31	2.0
	Sep-21	E176	Citizens Advice report on DNO Draft ED2 Business Plans	Consumer groups	1	2.0
	Aug-21	E166	Corporate Affairs General Bilateral	Government, Storage and renewables providers	25	2.0
	Jul-21	E149	Citizens' Jury	Domestic Customers	34	3.0
	Jul-21	E172	Customer Service and Consumer Vulnerability Internal Engagement	Current and future employees	74	2.0
	Jul-21	E167	Sustainability Strategy consultation	Vulnerable customer representative, A storage and renewables representative and Community Interest Group	4	2.5
Phase 3: Business Plan Refinement	May-21	E126	Willingness to Pay Quantitative report	Domestic customers, customers in vulnerable situations, next generation bill payers, SMEs	1,161	2.5
	May-21	E137	Sustainability Bilateral Sustainability First	Consultant	1	2.3
	Apr-21	E148	Corporate Affairs Bilats	Government, Consumer groups and Charity	6	1.3
	Mar-21	E125	Willingness to Pay Qualitative testing	Domestic customers, customers in vulnerable situations, next generation bill payers, SMEs	54	2.5
Phase 2: Co-creation	Mar-21	E103	Sustainability Workshop	Local authorities, consultants, contractors, distributed generation customers	27	2.5
	Feb-21	E095	Remote Island Communities workshop - Orkney	Local authorities, distributed generation customers, community energy schemes	18	2.0
	Jan-21	E093	Supply chain survey: sustainable procurement	Other supply chain	80	2.0
	Dec-20	E044	Customer service and LCT external Facebook survey	Domestic customers, current and future employees	90	1.2
	Dec-20	E087	Ecuity - SSEN Coronavirus Customer Survey (Dec 2020)	Domestic customers, customers in vulnerable situations	1,600	2.0
	Oct-20	E073	SSEN Stakeholder Advisory Panel	Business advisors	6	1.5

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
	Oct-20	E118	ED2 Customer Priorities Survey	Domestic customers, customers in vulnerable situations, next generation bill payers, SMEs	39	2.0
	Sep-20	E071	Annual Stakeholder Workshops - South	Local authorities, housing associations, water, vulnerable customer representatives	109	2.0
	Sep-20	E072	Annual Stakeholder Workshops - North	Local authorities, vulnerable customer representatives, housing associations	84	2.0
	May-20	E079	Employee engagement: Covid-19 employee Survey	Current and future employees	251	1.3
Phase 1: Open Discovery	Aug-20	E019	ED2 Customer Priorities Survey	Wider industry & value chain, ICPs, Supply chain	2,031	2.0
	Feb-20	E014	Energy Expert Roundtable	Local government, Vulnerable customer representatives, Emergency response	6	2.8
BAU Insights	Sep-19	E008	SSEN Distribution Stakeholders Workshops - Bournemouth	Local government, Community councils	17	2.5
	Sep-19	E009	SSEN Distribution Stakeholders Workshops - Dunblane	Wider industry & Value chain, Energy consultants	41	2.5
	Sep-19	E010	SSEN Distribution Stakeholders Workshops - Forres	Consumer groups	24	2.5
	Sep-19	E011	SSEN Distribution Stakeholders Workshops - Oxford	Wider industry & value chain, Consultants, ICPs	24	2.5
	Sep-19	E012	SSEN Distribution Stakeholders Workshops - Portsmouth	Builders & developers, DG customers	30	2.5
	Sep-19	E013	SSEN Distribution Stakeholders Workshops - Reading	Local government	27	2.5
	Aug-19	E007	Annual Distribution Survey of Domestic Customers	Domestic customers	2069	2.5

Table 9: Evidence assessment

MEASUREMENT OF SUCCESS

Output	Northern Target	Southern Target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Produce and report annually on an Environmental Action Plan (EAP)	EAP and annual reports produced	EAP and annual reports produced	New for ED2	£172.3m	Decarbonisation and improved environmental performance of our network and the wider community Improved air quality, reduced carbon emissions and net zero
Set an ambitious 1.5 degree SBT (including losses) requiring at least a 35% reduction in our carbon footprint by 2028.	Minimum 35% BCF reduction by 2028	Minimum 35% BCF reduction by 2028	New for ED2 15% BCF reduction		Reduced carbon emissions
Reduce SF_6 emissions from our assets by a minimum of 35%, and begin reducing our bank	Minimum 35% reduction	Minimum 35% reduction	15% reduction in SF_6 leakage as a % of installed bank, by the end of RIIO ED1 (2022/23),	£5.6m (part of £172.3m EAP)	Reduction in the amount of toxic gas emitted by our assets, in line with our 1.5°C SBT £2.5m societal benefits delivered by reduction in carbon emissions

Output	Northern Target	Southern Target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Implement a strategy to efficiently manage losses on our network in the long-term: re-classify losses as a Scope 2 emission and act to reduce actual losses	Actual losses avoided	Actual losses avoided	Reductions in electrical losses through best practice procurement strategies while using new sources of data to better track and target loss reductions, and by making network improvements deploying the best technologies to drive further savings	£2.2m (part of £172.3m EAP)	Reduced transformer losses by up to 30% through our TASS project £36m societal benefits delivered by energy savings and lower carbon emissions as a result of reduced losses
Reduce emissions by replacing mobile generators wherever possible with lower carbon alternatives or by using alternative lower carbon fuel types by 2028	Reduced emissions from mobile generators	Reduced emissions from mobile generators	Working more sustainably to reduce our BCF and the impact of our assets on the environment.	£2.2m (part of £172.3m EAP)	£1.4m financial benefits delivered by cheaper fuel £1.5m societal benefits delivered by a reduction in carbon emissions and improved air quality
Reduce reliance on diesel back-up generation, exploring local solutions and flexibility opportunities from the start of ED2	Diesel usage managed through Strategy	N/A	Provision of standby generation on the Scottish Islands. Note this is also captured in our ***Scottish Islands Strategy (Annex 8.1).***	£9.5m (part of £172.3m EAP)	£0.4m financial benefits delivered by cheaper fuel £0.2m societal benefits delivered by a reduction in carbon emissions
Plant 2,000 hectares of native woodland and restore 1,200 hectares of peatland in our licence areas, which are expected to remove up to 300,000 tonnes of CO_2e by 2045, and provide 3,000 biodiversity units by 2045.	2,000 hectares of woodland and 1,200 hectares of peatland across both Licence Areas	2,000 hectares of woodland and 1,200 hectares of peatland across both Licence Areas	New for ED2	£25.6m (part of £172.3m EAP)	A transformational and longer-term approach for net zero, that provides a legitimate and transparent record of carbon abatement Improved air quality and local habitats

Output	Northern Target	Southern Target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Remove all PCB-contaminated assets from our network by 31 December 2025	All removed by 31 December 2025	All removed by 31 December 2025	New for ED2	£45.1 (part of £172.3m EAP)	Compliance with new legislative requirement to remove PCB across all DNOs Transparency on the volume of PCB-contaminated equipment on the network (through our Annual Environmental Report)
Replace 78km of fluid-filled cables on our network and reduce oil leakages by 20% relative to 2019/20	78km replaced and leakages reduced by 20% relative to 2019/20 levels across both Licence Areas	78km replaced and leakages reduced by 20% relative to 2019/20 levels across both Licence Areas	Replace 76km of fluid-filled cable. Aim for minimum 15% reduction in oil leakage relative to 2012/13.	£33.6m (part of £172.3m EAP)	£15m societal benefit delivered by reducing oil leakage
Complete flood -related works at c.73 sites in line with ETR138	c.22 sites	c.51 sites	ED1 commitment North: £0.75m South: £19.79m [EBA2] ED1 to date North: £0.9m South: £11.1m [EBA1]	£24.2m (part of £172.3m EAP)	Reduced impact of flooding on our network leading to improved resilience to climate change
Sign up 80% of our supply chain (by value) by 2028 to our Sustainability Procurement Charter	80% (by value) of suppliers across both regions	80% (by value) of suppliers across both regions	New for ED2	Incremental	Contribution to lower emissions across multiple companies in our supply chain

Output	Northern Target	Southern Target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Electrify 80 % of our core vehicle fleet by 2028, reduce our average road mileage by 15% (from pre-Covid levels) and limit air travel where possible.	80% of core fleet electrified by 2028 Average road mileage reduced by 15% Air travel limited across both regions	80% of core fleet electrified by 2028 Average road mileage reduced by 15% Air travel limited across both regions	Undertake no more than 0.5 business flights per employee per year. Reduce average mileage of SEPD cars by 10%.	Incremental	£1.9m societal benefits delivered by reduction in carbon emissions
Complete undergrounding of up to 83km of lines	41km maximum	42km maximum	North: 48km South: 42km	£11.0m	Improved visual amenity of lines in National Parks and Areas of Outstanding Natural Beauty
Explore opportunities to improve our marine environment	Up to 17 hectares across both Licence Areas	Up to 17 hectares across both Licence Areas	New for ED2	£2.6m	Restoring ancient seagrass beds that have been destroyed by seabed activity provides carbon sequestration rates three times higher than on-land planting Improving natural habitats and protecting against coastal erosion £3.3m net benefit to the environment

Table 10: Measurement of success

APPENDIX B:
SF_6 STRATEGY AND APPROACH

INTRODUCTION

This approach paper builds on our current SF_6 Strategy - which sets out SSEN Distribution's Asset Management and Safety, Health and Environment (SHE) requirements for the management of Sulphur Hexafluoride (SF_6) gas. As a priority we have the responsibilities to reduce SF_6 leaks due to the impact they have on the environment. Addressing this area also contributes to the delivery of our Science Based Targets. This paper sets out SSEN Distribution would like to progress moving into ED2.

The development of our strategy and approach uses the Asset Management best practices compliant to the ISO 55001 standard.

The use of Information gathering through, business expertise, innovation work, workshops, data modelling and industry including our work with the ENA and DEFRA was used to help inform the development and objectives of this approach.

SF_6 belongs to a class of gases (F-gases) which are regulated in EU Member States by the F-gas Regulation [1]. In Article 21.4 of that Regulation. In 2019 the European Commission was tasked with assessing whether cost-effective, technically feasible, energy-efficient and reliable alternatives exist, which make the replacement of fluorinated greenhouse gases possible in new medium-voltage secondary switchgear and, if appropriate, make a legislative proposal to the European Parliament and to the Council. The ENA SF_6 working group, chaired by SSEN, produced a report covering the UK position for population, emissions, alternatives and economic impact and this has been used to develop our approach to SF_6 for RIIO-ED2. An update to the EU legislation is expected in Spring of 2022. In 2021 DEFRA have engaged with Industry and the ENA to begin the Power Sector review process for the F-Gas legislation to cover Great Britain (The devolved administration in Scotland have derogated this work to DEFRA). Again we are contributing to this process by being Chair of the ENA group developing the input to this process and plan to produce an update to the report presented to the EU. We understand that the likely timescales for the GB legislation is for the legislative proposal to be made in Spring 2023 and to be enacted in 2024.

We have committed to a 35% reduction in SF_6 leakage as a % of installed bank, by the end of RIIO ED2 (2028), using 2020 as a base. Our strategy to deliver on this target includes the following:

Adopt an alternative first approach

Be compliance ready for GB legislation developments

Procuring equipment with reduced quantities of SF_6 and lower leakage rates;

Enhance our equipment handling procedures and processes;

Recording usage at all life cycle stages (from purchase to disposal);

Quantify and minimise emissions during testing, manufacturing, installation, operation and maintenance and reclaim gas at the equipment's end of life;

Review the processes and training related to SF_6.

We will build on our ED1 KPI's to track our progress on a monthly basis internally, and will report on these annually in our Annual Environmental Report.

BACKGROUND – WHAT IS SF_6 AND WHY DO WE USE IT?

Sulphur Hexafluoride (SF_6) is an extremely potent and persistent greenhouse gas with a CO_2 equivalence factor of x22,800. We have a significant number of assets employed on our SEPD and SHEPD networks containing this greenhouse gas and any leakage from these assets contribute to our Business Carbon Footprint and the Scottish and UK greenhouse gas emissions totals.

SF_6 is a manmade gas. It is a fluorinated greenhouse gas and emissions to the atmosphere contribute to global warming. It consists of six fluorine's attached to a central Sulphur atom and is inert, tasteless, colorless and non-flammable. It is extensively used in switchgear providing a good insulator (2.5 times greater than air), has excellent electrical arc quenching properties (100 times greater than air) and is non-corrosive under normal operating conditions as well as enabling compact design at efficient, effective lifetime costs.

SF_6 has been used as an effective electrical insulator and arc suppressant since the early 1970s, mostly installed within electrical switchgear such as circuit breakers and switches, but also in Current and Voltage transformers. It has been used across the full range of electricity distribution and transmission voltages.

The earliest SF_6 equipment is now over 40 years old although the peak periods of SF_6 introduction were in the 1970s and 1980s. It has become apparent in recent years that the rate of SF_6 leakage from the ageing asset base installed across all GB Distribution Network Operators (DNOs) has been increasing. Therefore, it has been necessary for all DNOs, to develop and implement SF_6 leakage mitigation strategies and to introduce targets to reduce SF_6 leakage.

Ofgem have set a minimum requirement for all DNO's to set Science Based Targets (SBTs) that are accredited by the Science Based Target initiative (SBTi). In October 2021 we had our targets accredited by the SBTi. SBTs - which are a set of targets which address our material carbon impacts that contribute to our BCF, the target is set against our most recent base year data (2019/20) and we must deliver within 5-15 years. We have chosen 2033 as our delivery year. SF_6 is a material factor in our BCF and therefore as a minimum we need to reduce SF_6 emissions by at least 35% by 2028. In order to meet net zero, we must align with a 1.5°C trajectory, which our stakeholders support. A 1.5°C trajectory requires a reduction of at least 35% of SF_6 emissions by 2028, and 55% by 2033.

OUR SF_6 ASSET BASE, PERFORMANCE AND REGIONAL DIFFERENCES

The section provides a background to our approach and the assets under consideration and the key main and possible drivers for the intervention. It describes our SF_6 asset bases in England and Scotland, leakage rates

and emerging trends, the characteristics of different asset types and feedback received from our stakeholder engagement activities.

Asset Base

As of May 2021, our total population of SF_6 assets in service is 10,957 and >78% of these are between 10 to 30 years old. The top three asset categories by asset population are as follows:

6.6/11kV RMU (27.6%)
6.6/11kV CB (PM) (25.9%)
33kV CB (GIB) (ID) (GM) (10%)
It is important to recognise different equipment types contain varying amounts of SF_6 gas which can be more/less prone to leakage.

In total, our SF_6 bank amounts to just over 28,000kg and the top five asset categories account for approximately 66% of this total. The top 3 asset categories in terms of the mass of SF_6 contained per asset are the following Circuit Breakers:

66kV CB (GIB) (ID) (GM)
132kV CB (GIB) (OD) (GM)
66kV CB (AIB) (OD) (GM)

Leakage Performance

The leakage performance of different asset types and manufacturer models varies considerably across the installed asset portfolio as demonstrated by the following leakage characteristics and metrics specific to equipment types:

For 132kV CB (AIB) (OD) (GM), there are 22 different models within the 241 installed assets equating to 5,271kg of SF_6 in the overall bank.

Between the years 2019 - 2022, it has been necessary to top-up 42 out of this population of 241 at least once. The following models of 132kV circuit breaker requiring frequent top-ups include the NMG-SB6M145 (50%), ABB-LTB145D1B (43%), and REYROLLE -145SPM/1500/A6 (41%).

In terms of SF_6 amount emitted, the highest SF_6 emitting circuit breaker models are: ABB - HPL145A1 (55.5kg), REYROLLE-145SPM (53.5kg), and ABB-145PMC40/20 (17.8kg).

The models with the most emission occurrences are: REYROLLE-145SPM (81) and ABB-LTB145D1 (29).

These metrics only serve to reinforce that SF_6 leakage is commonplace across the broad range of circuit breaker types, largely installed in the 1970s and 1980s. However, we are continuing to analyse this data to detect trends and to direct working discussions with manufacturers.

Regional Variations

It is also important to differentiate between the SEPD and SHEPD distribution networks given the significant differences in relation to:

SF_6 Asset Population Size
SF_6 Leakage Rates
Exclusion of 132kV assets in Scotland, which form part of the transmission system
The majority of the planned ED2 SF_6 asset interventions are scheduled for the SEPD network where SF_6 leakage rates are significantly higher than in SHEPD. Another factor reinforcing the need for SF_6 leakage mitigation in SEPD is the comparatively high rate of SF_6 leakage compared with other GB DNOs.

SCOPE

Implementation of a strategy for the management of SF_6 gas in SSEN Distribution that delivers on our proposed ED2 commitments and ensures compliance with statutory regulations and reporting requirements. Our SF_6 Strategy will aim to reduce the amount of gas lost through leakages and reduce our BCF impact from the leakages by a minimum of 35%. The proposed investments in ED2 will reduce our SF_6 bank and improve the detection of leakage and repair of equipment. The SF_6 strategy will also as a minimum:

Commit to efficient and economic actions to reduce leakage rates and improve management of SF_6 assets;
Adopt target(s) for SF_6 leakage and/or SF_6 asset management; and
Commit to reporting on total SF_6 bank and leakage reduction rates using a common DNO methodology.

Develop and implement an "alternative first approach" for replacement of all of our SF_6 assets due for replacement. Our strategic aim is to work internally and externally to develop economic and efficient alternatives to SF_6 to enable the long-term removal of this greenhouse gas from our system.

Deliver on our Science Based Targets to reduce emissions as a result of SF_6 leakage by 35% by 2028 and 55% by 2033 from a 2020 base.

Develop a reporting system to report on total SF_6 bank , leakage reduction rates and where possible using a common DNO methodology. Our targets will be measured against output performance (KPI's) governed through our Asset Management System which will review and adapt as required to ensure it takes account of all relevant factors. This will ensure the most economic and efficient solution is implemented for customers while continuing to meet safety and environmental standards. Our focus will be on sustainability within our procedures and processes and where appropriate use innovative solutions to deliver our commitments. As a minimum we will report against our targets annually through our Annual Environmental report.

A SHE improvement Plan Strategy working group has been running since October 2018, initially to develop a long-term strategy for, Fluid Filled Cables, Oil bunding and SF_6, this work has fed directly into our Environmental Action Plan. This working group will continue to meet to ensure that the aims of this strategy and wider environmental objectives are implemented and achieved.

This approach paper will provide the asset management and environmental action plan direction required - as an enabler to achieve our target for RIIO-ED2 outputs. We will review this approach throughout and amend in line with Ofgem ED2 final determinations. The outcome will be our final ED2 SF_6 Strategy.

LEGAL, REGULATORY, STANDARDS & GOVERNANCE OBLIGATIONS

The main documents that set out our obligations are:

The RIIO ED2 Price Control, sets out minimum requirements that we must fulfil in order to demonstrate our commitment to reduce our SF_6 emissions. The performance of SEPD and SHEPD are reported to OFGEM annually through the regulatory reporting process and our performance is publicly benchmarked against the other DNO's.

Our Environmental Action Plan, which sets out our approach to SF_6, our science-based targets and wider environmental objectives. We will report against our targets internally on a monthly basis and annually through our Annual Environmental report, which will be published for all stakeholders.

The **Department for Environment, Food & Rural Affairs** and **Environment Agency** have set out requirements for businesses that operate or service high voltage switchgear that contains SF_6. The key points are described in Table 5.1 – Requirements for operation of SF_6 equipment which has been rreferenced from **https://www.gov.uk/guidance/how-to-operate-or-service-high-voltage-switchgear-containing-sf6**.

Table 11 – Requirements for operation of SF_6 equipment within The Fluorinated Greenhouse Gases (Amendment) Regulations 2018

Requirement	Details
Working with SF_6	For any work on equipment containing SF_6 operatives must have a F gas (fluorinated greenhouse gas) handling certificate. Contractors companies are responsible for making sure their staff have proper qualifications.
Leak detection	Where equipment has a pressure monitoring device, it doesn't require regular leak checks, however there is a requirement when a leak is detected that it is repaired and repeat the leak test within a month to check the repair worked.
Recovery	We must recover SF_6 when servicing switchgear and before you dispose switchgear that we are decommissioning. It is a requirement that operational colleagues must have an F gas handling certificate for work on high voltage switchgear.
Keep records, as required by the regulations	quantity of SF_6 in the equipment when it's installed quantity of SF_6 added during any maintenance (e.g. installation or leak repairs) quantity of SF_6 recovered during any maintenance (e.g. decommissioning at end of life or leak repairs) details (name, address and certificate number if relevant) of any companies that work on the equipment dates and results of all mandatory leak checks measures taken to recover SF_6, and the quantity recovered, when you decommission the equipment

The Fluorinated Greenhouse Gases (Amendment) Regulations 2018 (Preventing emissions of F-gases from existing equipment by requiring checks, proper servicing and recovery of the gases at the end of the equipment's life) http://www.legislation.gov.uk/uksi/2018/98/contents/made.

Engineering Recommendation S38 Issue 2: 2016 (sets out a common reporting methodology for ENA Member Companies to report banks, emissions and recoveries of SF_6).The key points of SF_6 Reporting in EREC S38 are:

We will report the aggregated figures on an annual basis according to the methods stated in Engineering Recommendation S38 Issue 2 2016.

The "Bank" (at start of a reporting year)

Emissions (during the reporting year).

The "Bank" is the quantity of SF_6 held at the start of the reporting year including:

Cylinders or storage vessels

Filled equipment (all equipment containing SF_6 held by SSEN Distribution whether the equipment is or is not operational)

The information will be recorded in our Asset Management Repository and records kept for a minimum of 5 years.

WHAT OUR STAKEHOLDERS WANT

In preparation of our RIIO-ED2 business plan a programme of stakeholder engagement exercises have been undertaken to better understand what will be important to our network customers during RIIO ED2 and to ensure the views of our stakeholders are reflected in the cost and volumes we are proposing for each investment decision. Below is a summary of the key outcomes from this engagement from some of our critical stakeholders.

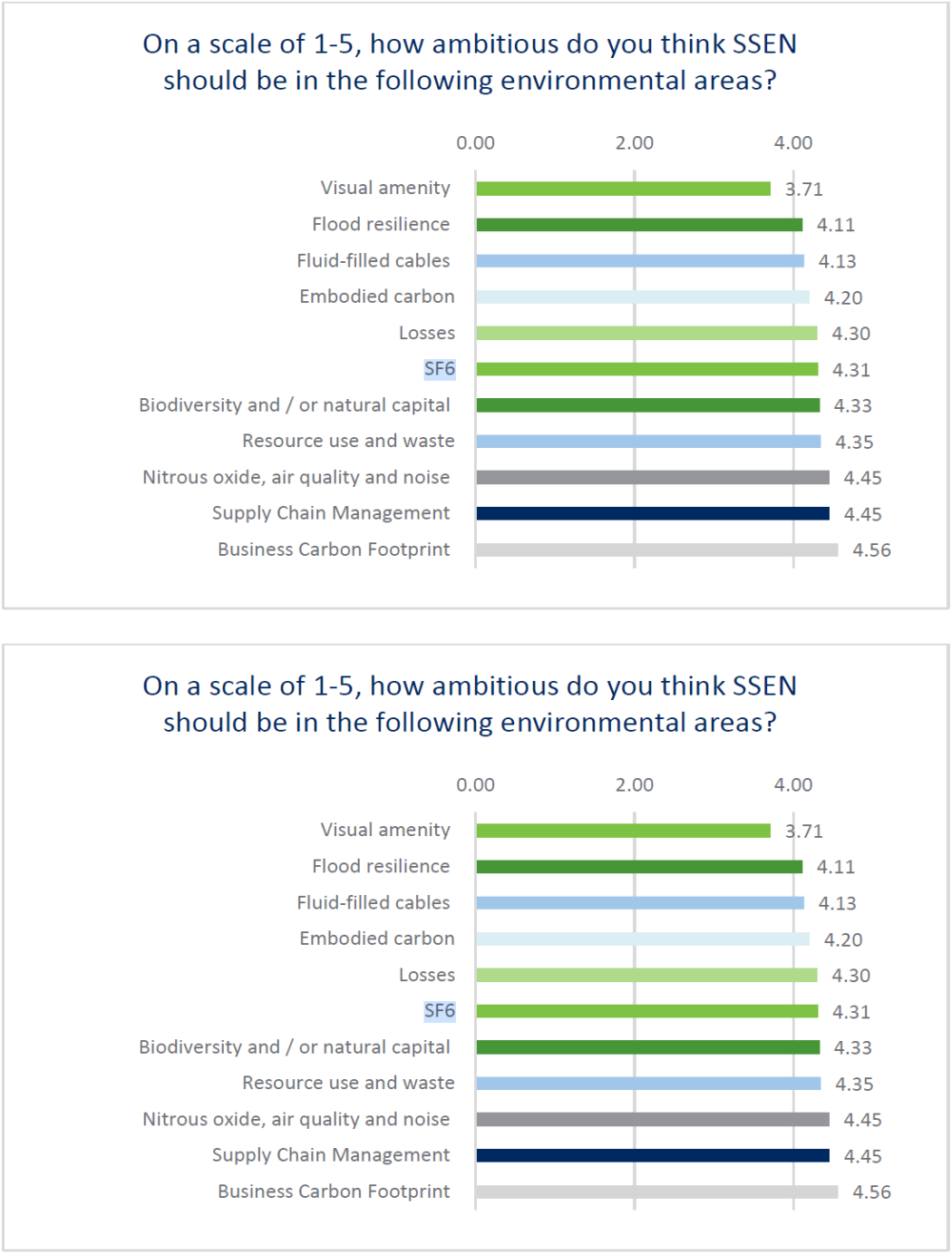
Feedback was sought at stakeholder events in England and Scotland in September and October 2020 to identify which elements of our Environmental Action Plan should receive accelerated targets. In general, there was broad stakeholder support for requirements to meet targets SBTs and to incorporate measures within the RIIO-ED2 business plan which mitigated climate change where possible.

In Scotland, delegates responded that Business Carbon Footprint should receive attention, with its importance rated at 4.36 out of 5, closely followed by SF_6 which scored 4.35 out of 5. Scottish stakeholders sought high levels of ambition from us regarding the removal of SF_6 equipment from the SHEPD network and suggested that this would be a significant milestone when achieved. Other Scottish stakeholder feedback included the following remarks:

"We need to get rid of this stuff as quickly as we possibly can. It's something that has hit various news articles. It would be brilliant both for visibility and your customer support to be able to promote that you've got rid of it all." Business representative.

"Be as ambitious as possible." Infrastructure / engineering representative.

"I would expect reducing not just leakage but overall usage to be a top priority." Business representative.

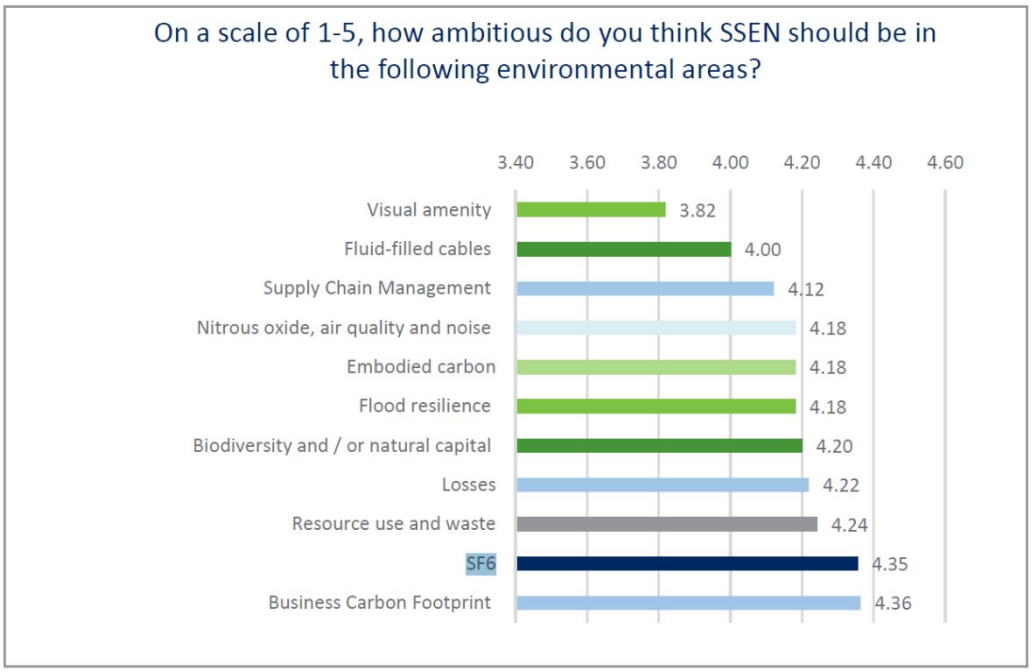


On a scale of 1-5, how ambitious do you think SSEN should be in the following environmental areas?
0.00
2.00
4.00
Visual amenity 3.71
Flood resilience 4.11
Fluid-filled cables 4.13
Embodied carbon 4.20
Losses 4.30
SF6 4.31
Biodiversity and / or natural capital 4.33
Resource use and waste 4.35
Nitrous oxide, air quality and noise 4.45
Supply Chain Management 4.45
Business Carbon Footprint 4.56

Figure 13 - Summary of Stakeholder Feedback Regarding Environmental Priorities from Scotland

There was some regional variation between stakeholders in Scotland and those in Southern England. Scotland Stakeholders wanted to see us be as ambitious as possible regarding removing SF_6, calling for this to be treated as a very high priority. However, in England it was felt that SF_6 leakages were not frequent enough to warrant such a high level of ambition, although this view is not consistent with the rate of SF_6 leakage currently being experienced in SEPD.

Figure 14 - Summary of Stakeholder Feedback Regarding Environmental Priorities from England



"While we can only control things in this country, we are facing an emergency as a planet: it won't wait for us to make things cheaper. We need to forget about the costs involved and persuade people that they are necessary. If there are people struggling with any increased costs, we can always find ways to help them." Environmental group

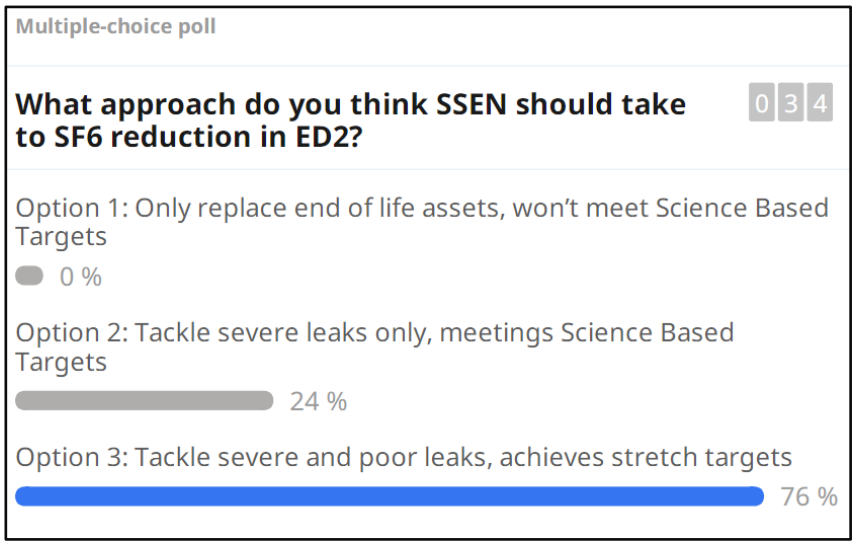
"Dealing with severe leaks should be the priority." Parish / community council

"I would be very much in favour of doing as much as you can, as early as you can, as long as it is as practical as possible." Charity / non-profit

"As SF6 is a really potent gas, it does really need to be tackled, but I would want to know the exact costs and to know what the best way is of achieving a carbon reduction. In principle I'm in favour of going ambitious, but it depends on the cost-effectiveness of achieving stuff. What are the relative costs?" Infrastructure / engineering representative

Stakeholder feedback obtained during our March 2021 Virtual Webinar provided the following response to the question **"SF_6: What approach do you think SSEN should take to SF_6 reduction in ED2?"** as shown in Figure 15.

Figure 15 – Virtual Webinar Slido Results Regarding SF_6 Leakage Mitigation Strategies



2021 engagement

Post draft submission we have held focussed bilateral meetings with our stakeholders. They have supported our plans and encouraged us to:

- "Focus on a clear plan on getting away from SF6 as soon as possible" Charity / Non-profit
- "SSEN should think about the scope to collaborate with partners on tackling SF_6" Environmental group

OUR APPROACH

This approach will be implemented in RIIO-ED2 through our SF_6 Strategy and will include our target to reduce leakage rates by a minimum of 35% in line with our SBTs, and we will report on our SF_6 bank and leakage reduction rates. We are actively working collaboratively with other DNO's through the ENA to develop a common reporting methodology. Our SF_6 Strategy will continue to be agile in nature to allow it to take account of the ENA work as it develops.

This approach will not only manage and reduce leaks to the environment and achieve our environmental and regulatory commitments, but also to kickstart our journey to reduce our SF_6 bank in the longer term.

We are proposing investments targeted at reducing the amount of SF_6 on our networks by replacing assets that are leaking SF_6 but whose condition would not otherwise merit accelerated replacement. A secondary investment driver and benefit will be to improve our overall asset health of equipment containing SF_6 as a result of defective equipment being replaced with new modern assets.

Increased environmental awareness of the impact of SF_6 gas released now merits enhanced leakage mitigation measures and it is anticipated that new environmental legislation will restrict the future use of such equipment. We have therefore developed a programme to target replacement of our SF_6 equipment with the highest leakage rates employed on our networks. We are proposing to explore alternatives to SF_6 and will install alternatives where solutions are available. We are also committed to better management of our leakage rates and are currently exploring improved technology to stop leakage at source.

This delivers the following outputs and benefits across the RIIO-ED2 period:

Target a reduction in SF_6 emissions of ~ 90.49kg SF_6.
A reduction, equivalent to more than 2,132 tCO_2e.
Facilitates the efficient, economic, and co-ordinated development of our Distribution Network.
Tackles our SF_6 asset bank

Asset inventory clarity

Building out our records and our knowledge of the asset base performance and characteristics, incorporating data analysis into our process to aim at forecasting issues ahead of time, identifying trends against factors such as model type, location, age etc. Will all help feed into our decision-making.

Inspection, condition assessment and Investment

Highlight the worst performers to ensure that leakage rate as a condition criterion for SF_6 is captured in CNAIM effectively to inform the investment process for the justification, replacement or repair of these worst performers within our investment process.

New equipment shall outperform natural leakage rates of legacy equipment and not use SF_6 as a disposable installation enabler.

Alternative First approach to replacement

The report and work done at the ENA in 2020 included analysis to understand the alternatives to SF_6 that are available on the market. For the UK these are currently limited and the DNOs will need to work with the supply chain to develop and supply plug and play alternatives that work on the UK network and standard substation designs. The report also analysed costs and potential developments of SF_6 alternatives from manufacturers to develop a matrix of the most effective action by voltage level to reduce SF_6 emissions from equipment. In summary the higher voltages (132kv and above) have a much better payback for £ per kg of SF_6 emissions saved. For the DEFRA review the ENA will produce an update to the report given to the EU in 2020 as there have been some positive developments from manufacturers in the period. We have used the ENA work to help with our stakeholder engagement, our RIIO-ED2 plan and our long-term strategy.

Change will not happen unless we all push for it and that is why we are adopting an alternative first approach to all SF_6 replacements, whereby investment decisions will have to justify why an alternative to SF_6 is not suitable for any particular project. Project teams will have to demonstrate the business case for SF_6 in every case put forward in ED2.

Our continued work with the supply chain has given us confidence that breakthroughs will come, and we will be ready to innovate with them, already in ED1 we are trialling alternatives and working at whole system levels to ensure we lay strong evidenced foundations that will allow us to take this “alternative first” approach.

Leak detection, repairs, and disposal

We investigate SF_6 gas leaks on all assets that are topped up more than once in a 12 month period. The first stage of the investigation to find and repair the leak is conducted by our own staff. Our existing leak management process is documented in WI-NET-SST-082.

Management of leakage rates:

Monitor trends of worst leaking equipment.

Development of a full inventory control procedure that captures all SF_6 for purchase to disposal (including Inventory control of top up bottles).

Ensure compliance with legislation, ensuring only trained and certificated people handle SF_6 and can access the bottles.

We will continue to investigate industry best practice response to leaks and learning from others to develop the timescales to be expected for leak response.

Management of incidents:

All SF_6 leaks and top ups must be reported through the 30mins reporting rule and managed through to resolution.

Leaks to be resolved without undue delay and development of timescales and KPI's for this.

Disposal:

We shall ensure that disposal procedures and processes minimise the risk of leakage during decommissioning and report accordingly.

Reporting

We will develop monthly KPI's and report internally on a monthly basis against targets, including the reporting of incidents. We will commit to report externally on an annually basis through our Annual Environmental Report, and Regulatory Reporting Process. We will also disclose emissions in line with sustainability disclosure requirements.

Funding

Base line - Through our ED2 baseline allowances we have proposed investment to tackle our Poor and Severe Leakers, we are proposing this is funded through a Price Control Deliverable (PCD) whereby should the volumes not be delivered in the time period then there is a mechanism to correct this within the price control framework.

Uncertainty Mechanism - SF_6 Legislation is being reviewed by the UK and the EU as part of the wider F-Gas Legislation reviews to achieve the UK and EU net zero targets. The UK legislation is expected to be updated around Spring 2023 with the EU thought to be on a similar timescale. In 2019 and 2020 the ENA worked with

the member companies to develop a report for the European Commission (Re: Review of the F-gas Regulation 517/2014). In Summer/ Autumn 2021 the ENA have been part of the DEFRA F-Gas Power Sector review which will inform the consultation in 2022 for the UK legislation for F-Gas and thus SF_6. We believe is it likely that the UK will enact the legislation as defined by the EU or very similar. We anticipate that there could be several possible legislative scenarios ranging from a ban on new SF_6 equipment at particular voltage levels from a defined future date to a full ban including replacement of all existing SF_6 equipment by a particular date. We will continue to chair the ENA F-Gas strategy group that is working with DEFRA on the Power Sector review and also with the manufacturers to encourage them to develop alternatives to SF_6 that work on the UK network and are viable for both reliability and lifecycle costs. Any learning will be fed back into our strategy work. There is a risk that the Legislation change expected in 2023 could mandate that DNO's go much further in removing SF_6 from their networks, however, Ofgem have indicated that the proposed ED2 Environmental Reopener could be triggered should the new legislation mandate a material change to the use of SF_6 e.g. a ban from a date, a restriction (or quota system) for SF_6 supply, removal from operation by a set date. We are proposing, through this EJP, to address the issues we are currently experiencing on our network.

GOVERNANCE

The SHE strategies Working Group – The Working Group made up of representatives from the business will continue to meet monthly to track progress of the performance against targets, propose updates to the strategy and develop and enact the action plans needed to implement the strategies.

The Distribution Asset Management Steering Group (DAMSG) and the SHE Committee – The director level DAMSG and SHE Committee will continue to monitor progress against targets and provide leadership on any escalations from the Working Group and provide direction in line with corporate objectives.

Our Sustainability Sub Committee to the SSEPD Board is our governance route for approvals and hold us to account on performance.

CONTINUED IMPROVEMENT, MONITORING & REVIEWS & NEXT STEPS

Data Analytics – The data analytics discovery for SF_6 took place in 2019/20. Outputs from this exercise were evaluated and have informed future plans including the ED2 Business Plan. The data analytics could be revisited and expanded based on the additional data feeds that are now available in the "data lake" due to the progression and evolution of the Data Science capability in the company.

The Working Group will monitor performance against targets on a monthly basis via the KPI's. This will track the effectiveness of this approach over time and enable management intervention in period. Any lessons learnt or adjustments required will result in update in our approach and resultant strategy. The Working Group will also develop the action plans to enact this strategy.

The Steering Group (Director level) will monitor progress against targets and provide leadership on any escalations from the Working Group and provide direction against corporate objectives. The strategy will be updated if required based on these.

Continue to work collaboratively with industry, other DNO's and our own innovation and Transmission teams to ensure we share industry wide best practice and identify industry wide solutions to this manage SF_6 Leakage and push for alternatives.

We will continue to work with suppliers – to explore trends in existing equipment and identify alternatives at different voltage levels. With respect to new technology readiness, we will continue to actively monitor market developments and engage with equipment manufacturers regarding early opportunities to deploy SF_6-free technologies through our network innovation team and collaborative working with other DNO's through the ENA to develop SF_6 free equipment specifications.

Throughout RIIO ED2 we will continue to update our SF_6 strategy as appropriate ready for implementation in ED2.

APPENDIX C LOSSES STRATEGY EXECUTIVE SUMMARY

WHAT ARE LOSSES?

Distribution losses refer to the electricity lost from our Distribution network either as a function of the electricity travelling through our equipment or through measurement inaccuracies and theft. Either way, this lost electricity presents a cost to both customers and the environment, and we are compelled to manage this so that distribution losses are as low as reasonably practicable.

There are measures that we can take to reduce this loss and this is primarily demonstrated through:

1. The choice of network assets we install; and
2. The improvements we make to our processes to reduce measurement errors and theft.

Understandably, this cannot be at any cost and we have to balance the measures taken with the costs and benefits of implementing them.

TODAY'S CHALLENGES

Importantly, the more distribution network assets are utilised (or 'sweated'), the greater the distribution losses.

Despite a reduction in the amount of electricity distributed through our network in 2020-21 as a result of the Covid-19 pandemic, the general drive is towards greater demand for electricity and steps to ensure that the existing electricity infrastructure is used as efficiently as possible. This is most evident through the following initiatives:

- The decarbonisation of transport and heat and the resulting increase in demand for electric options.
- Whole System thinking – where network owners and operators must consider the wider impacts of their system development and decision-making.
- Ofgem's review of how customers are charged for access to the network and what rights they have. This is about understanding spare capacity on the network and, where possible, potentially making this available to others.
- New obligations and commitments around the procurement and use of flexibility services where this is an economic alternative to investment in traditional network assets. These mechanisms generally result in an increased overall utilisation of existing assets, which has an incremental relationship to losses. Again, this seeks to make better use of the existing network.

By increasing the amount of electricity passing through our assets through increased generation and enabling more low carbon technologies, and working our existing assets harder, all of the above will cause losses to

increase in the absence of counteracting measures. As a result, our ability to reduce the losses on our network is increasingly at risk.

OUR STRATEGY

To date, our aim has been to reduce losses on our network, as a percentage of units distributed, whilst removing barriers and empowering solutions that benefit the whole system. In the current eight-year price control period (RIIO ED-1), we have been delivering this through:

- The strategic installation of lower loss assets, where this is demonstrably the right approach;
- The trial of known and new losses reducing techniques, such as methods to stabilise power factor and improve power quality, to assess suitable applications within our network; and
- Tackling electricity theft and calculation anomalies through investigation works and wide-reaching communications highlighting the issue.

We plan to continue these efforts into the next price control period but also take these opportunities further amongst developing new ideas that will manage losses on our network. Through the initiatives outlined in this strategy we aim to reduce losses as much as we possibly can. To do this properly, we need to understand where the losses are occurring on the network and commit to doing a full study and using the output to drive policy and ongoing investment decisions. We also recognise the challenge the transition to DSO will bring and as a result, intend to manage our losses and avoid overpromising on an absolute reduction. Our Innovation Strategy will target loss reduction technology and our RIIO-ED2 investments will help us achieve results on losses.

OUR FOCUS FOR RIIO-ED2

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.

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

As of 2020, losses account for 92% of total Scope 1 and 2 emissions, which equates to 538,820 tCO_2e. Figure 2 shows a breakdown of Scope 1 and 2 emissions.

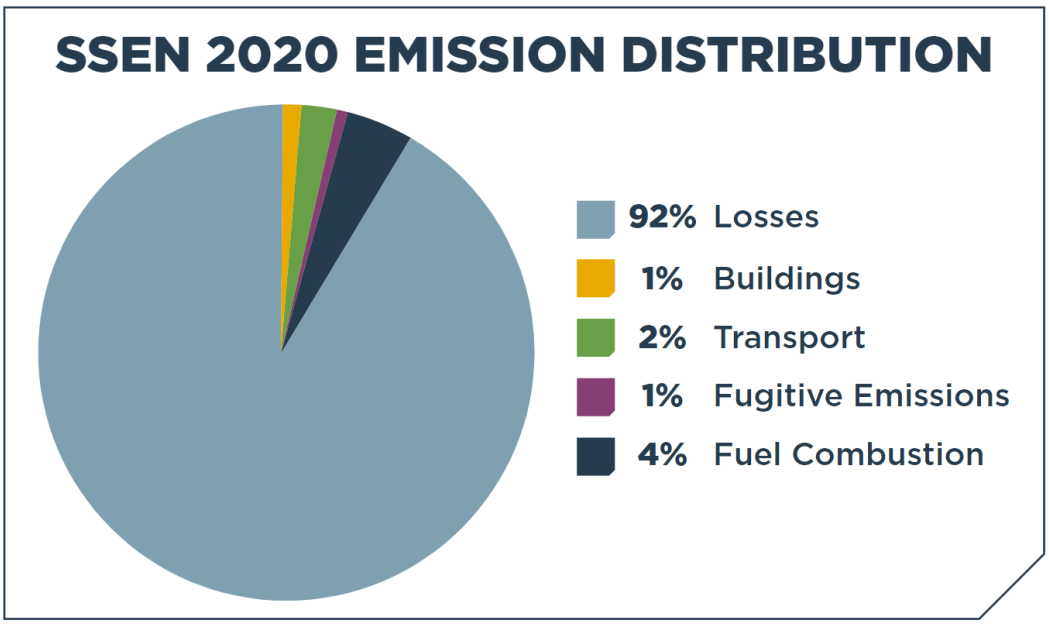


Figure 2 – SSEN 2020 Emission Distribution

We recognise that we cannot solely rely on grid decarbonisation to meet net zero targets and ambitions and want to reduce the actual losses occurring on our network. Losses will increase as a result of increased generation and the connection of lo carbon technologies. In response, we have classified losses as a Scope 2 emission in line with Ofgem RIG Reporting and the GHG Protocol. In addition, 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 Green House Gas (GHG) Protocol. This SBT targets a 55% reduction in GHG emissions by 2033, meaning at least a 35% reduction in our combined Scope 1 & 2 emissions in RIIO-ED2. 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.

DURING THE REMAINDER OF THE RIIO-ED1 PERIOD, WE PLAN TO:

- Continue to drive reductions in losses through our justified and evidenced asset choices, such as the types of conductor or transformer we install.
- Further reflect on and embed the learning from key innovation projects which target losses, such as our LEAN innovation project.
- Increase our deployment of monitoring devices and use of more advanced smart meters (SMETS2) to improve our understanding of network loading.

We plan to continue these efforts into RIIO-ED2, whilst seeking out new opportunities to reduce losses on our network. All investment decisions going forward will need to include losses, meaning efforts from all areas of the business are required. Whilst ensuring the assets on our network are chosen with losses reduction in mind continues to gain significant focus in our strategy, we do believe that understanding our network; in particular the LV network, is paramount in our ability to recognise and reduce losses. This will continue to be an area where we actively seek opportunities for improvement and therefore, this strategy will be updated throughout RIIO-ED2 to reflect any new developments.

Notwithstanding the impacts of the Covid-19 pandemic, which has seen a temporary reduction in units of electricity distributed in 2020-21, we continue to anticipate an increase in network utilisation as further

efficiencies are driven in the operation of our network and the decarbonisation of transport and heat increases the demand for electric solutions. This will result in increased losses in the absence of any measures to counteract this.

Therefore, whilst we continue to focus on reducing losses as set out above, we are broadening our approach in this area, including working with the Science Based Target Initiative to strengthen our approach and exploring opportunities to reduce the carbon impact of any losses from our activities. Informed by stakeholders, this will be a strong focus in RIIO-ED2.

PROGRESS TO DATE

Table 5: RIIO-ED1 performance overview

Intervention	Losses savings to 2020/21 (MWh)	Forecast ED1 losses savings (MWh)
Upsizing to three phase 500kVA GMTs and 50kVA PMTs	684	1,140
Cable upsizing at LV and 11kV	7,688	20,266
Cable upsizing at 33kV	0	2,144
6.6kV to 11kV network upgrade	1,838	3,433
LEAN - Switching out underutilised plant (trial sites only)	124	331
Losses savings consistent with EU Ecodesign Directive requirements:		
Installation of Low Loss Transformers	20,822	48,293
Replacement of historical high loss transformers	941	2,294
Total	**32,097**	**77,901**

BACKGROUND

Electrical losses are the difference between the amount of electricity that comes into our network from embedded generators and the national transmission system, and the metered amount that is taken off the network by customers. These losses can either be technical (as electricity can turn to heat as it is transported) or non-technical (for instance, due to theft or measurement errors). Electrical losses are included 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 the consumers.

TECHNICAL LOSSES

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. The variable loss will change as demand increases and decreases. Additional factors such as the effect of network imbalance, power factor and power quality also has an impact on the technical losses.

1. **Fixed losses -** The fixed element of losses is the energy which is required when plant such as transformers or conductors are energised. For example, as transformers require electrically produced magnetic fields to operate, the energy used to create these fields is dependent on the applied voltage but is essentially fixed as the applied voltage is relatively stable while they are energised.

2. **Variable losses -** The variable element of losses is created due to the heating effect of energy passing through conductors. These conductors have a small resistance and when currents are passed through them, they heat up. This heating effect is a function of the resistance and the square of the current flowing through the conductor. High load (when an item of equipment is running near or at full capacity) produces proportionally more losses than when an item of plant or network is partly loaded.

The resistance of a cable reduces as its cross-sectional area increases so the effect of losses is reduced in larger cable sizes. There is a very similar variable loss element created through the wires and windings which are found in all transformers. The cross-sectional area of winding conductors, and the material used for them, dictates the level of variable losses seen in transformers.

NON-TECHNICAL LOSSES

Energy lost that is not directly related to the transportation of electricity through the system is categorised as a non-technical loss; this could be from theft or measurement errors. Situations where there is no registered supplier at a connection point, or no meter installed also occur from time to time. In many cases however, non-technical losses are due to illegal activities for example, consumers bypassing the meter or making an unauthorised connection to our network.

Measurement errors can occur through legitimate unmetered supplies as the energy demand is estimated rather than metered in these circumstances. Our substations are an example where the total energy is projected from:

- battery charging;
- transformer cooling;
- protection / control systems; and
- substation auxiliary supplies – heating, lighting and security systems.

HISTORICAL APPROACH AND PERFORMANCE

Currently, around 5-8% of the electricity distributed on our networks is reported as losses; however, this varies every year depending on customer demand. We calculate and report on losses in order to monitor the changing levels.

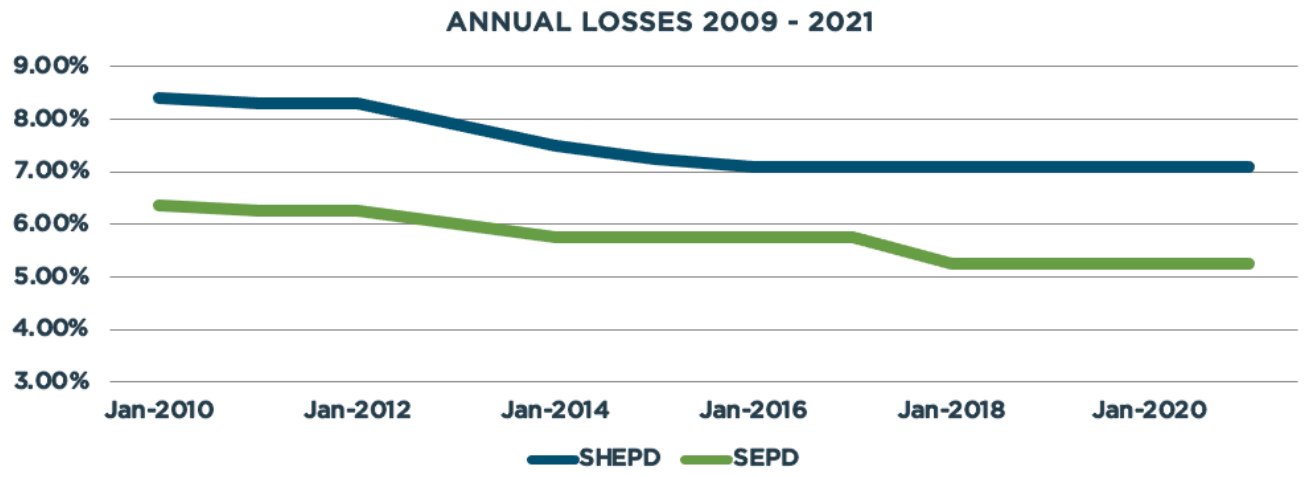


Figure 2: Annual electrical losses 2009 – 2021

The total amount of electrical losses on our network is calculated by subtracting the number of energy units known to be delivered to customers from the number of units that originally entered our network. Whilst this value is a good guide to overall performance, it is not an exact representation of our network's losses as factors including street lighting and energy used in between domestic meter reads make calculating the exact value challenging. We have worked to ensure the measurements of energy entering and leaving our network are as comprehensive as possible using metering data which helps to ensure the calculation of losses is as accurate as it can be. Our strategy for RIIO-ED2 will see us making progress on and improving how we monitor our network in the short-term and also how we plan to model our network in the long-term.

The losses depicted in Figure 2 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 circuits. Whilst there is less electrical demand on our network in SHEPD, energy generally has to be transported over a far greater distance which increases the losses.

The downward trend in SEPD in 2017 is related to a calculation change to set the 2017/18 Line Loss Factors (LLFs). This resulted in a 0.5% reduction in losses.

UNDERSTANDING LOSSES ON OUR NETWORKS

MONITORING LOSSES

On the LV network, the intention for ED2 is to roll out the addition of monitoring devices installed in substations to monitor outages and identify issues. The information is connected via a cloud offering to the control rooms, allowing issues to be resolved. LV substation monitoring data can inform on losses estimations, further building how we monitor and then model losses.

There are plans to develop a digital twin using GIS in RIIO-ED2 helps to better understand losses on the LV network. The information provided by the digital twin will help us to identify "hotspots" or areas where there is the most potential for losses reduction, we would then be able to target these areas with interventions. Short-term monitoring of the LV network will also help with the longer-term modelling of losses on our network.

SMART METERING

SSEN will have access to larger penetrations of smart meter data in RIIO-ED2 and a key benefit of accessing such data is the ability to better monitor the LV network and understand maximum demand, voltage profiles and consumption profiles. Whilst these are integral parts of our Smart Meter Strategy and LV Strategy, we will work together 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 losses reductions.

MODELLING LOSSES

The current methodology to derive the loss factors; Loss Adjustment Factors (LAFs) and Line Loss Factors (LLFs) is based on load flows and asset data. The procedures vary for different voltage levels, depending upon the availability of load flows and coarser engineering models based entirely upon asset data. The estimation of the generic LLFs is carried out by program newLAF which is currently used by all major DNOs and by SSEN separately for their SEPD and SHEPD networks. The assumption is made that the losses consist of fixed losses which are independent of the actual power flows and variable losses. The latter are the ohmic losses due to the power flow in the conductors and the transformers. The input data consists of 13 loss constants which are separated into the two groups, Fixed and Variable.
We aim to model our losses beyond a pricing perspective in RIIO-ED2 and intend to do so with the support of our Academic links.

THE FINANCIAL IMPACT OF LOSSES

Whilst the grid is gradually decarbonising meaning the carbon impact of losses will lessen, there is still a financial impact of losses on consumers and customers, which will not change as the grid decarbonises. 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. We aim to do this with the support of our Academic links and partnerships.

TRADITIONAL METHODS OF REDUCING LOSSES

Traditional methods of reducing losses taken by SSEN are described in more detail within this section. The approach we have taken to managing losses in previous price control periods has been to complete a high-level CBA at the procurement stage of any investment decision. For instance, in our transformer framework contracts we specify that the manufacturers provide the fixed and variable losses for each particular unit. This allows a comparison, between manufacturers, of the lifetime costs as opposed to simply the initial capital cost.

The Ofgem specified societal CBA allows the lifetime benefits of lower loss plant to be predicted in more detail. The specified CBA incorporates a starting value for lost energy of £48.42 per MWh; this is discounted over time, with consideration given to the predicted cost of carbon. This methodology allows us to make investment decisions based on more accurate lifetime costs and defines whether installing an asset with a higher capital cost will result in long term savings for customers in the SSEN licence areas. This allows us to improve upon our decision making for reducing losses through the traditional methods described below. Details of CBA outcomes for the below measures are detailed in section 5.

TRANSFORMERS

The nature of distribution networks dictates that power is transferred at differing voltages; this necessitates the use of transformers to step the voltage up or down. Although transformers generally have total efficiency percentages in the high nineties, the substantial volumes of energy throughput mean that a small percentage improvement can result in significant energy savings over a potential 60-year plant lifetime. At present, transformers on the distribution network account for approximately one third of our total network losses.

1. LOW LOSS TRANSFORMERS

Transformer manufacturers now understand the importance of losses in the cost calculation and as a result now offer a range of high-performance lower loss units. The exact design improvements vary between manufacturers; however, they generally consider improvements to the core material or a reduction in the winding resistance. As of July 2021, all new transformers on the network will be low loss as they must comply with the EU Transformer Eco-design Directive[35] Tier 2 specification.

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. The Directive has two tiers, the first which was implemented in 2015 and the second in 2021. 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.

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

2. MINIMUM SIZING OF TRANSFORMERS

Over sizing transformers for a predicted load has the advantage of future-proofing sites for potential load growth. This has an associated additional cost over the minimum scheme, however, in addition to providing extra capacity, the larger capacity equivalent transformer will generally reduce losses.

3. ON-LOAD TAP CHANGING OLTC) TECHNOLOGY

To go beyond compliance with the EU Transformer Eco-design Directive Tier 2 specification, the utilisation and penetration of On-Load Tap Changing technology during RIIO-ED2 is being reviewed. We are exploring the benefits of replacing HV transformers with versions which include OLTC technology to conserve voltage, which are Tier 2 compliant. Currently regarding non-load, we intend to replace 562 transformers with OLTC technology and replace 630 with low loss compliant transformers. The use of HV ground-mounted (GM) OLTC across the plan are being reviewed.

REPLACEMENT OF HISTORICAL TRANSFORMERS

Historical transformers that pre-date a range of design specifications can have significantly higher levels of fixed technical losses than comparable modern units. Replacing existing legacy units before end of life with units that meet the EU Transformer Eco-design Directive specifications can reduce losses, as modern units have a more efficient construction, design and core.

CONDUCTORS

An increase in the capacity of the cross-sectional area of a cable reduces the impedance and hence reduces losses. Installing larger conductors at LV, 11kV & 33kV could therefore reduce losses over smaller size alternatives. Cables with a larger cross-sectional area will also futureproof the network, making it better equipped to cope with any higher loading requirements in the future, which are likely to occur as a result of increased Low Carbon Technologies (LCTs) being installed on the network and as the UK transitions to a greater dependency on electricity, in line with Net Zero ambitions.

Load profiles have been forecast to increase in RIIO-ED2 therefore the use of larger cables should be more justifiable from a cost perspective. Load profiling must also be reflective of net zero and the use of LCTs, therefore larger cables should continue to be a positive option.

1. CONDUCTOR TYPE

For both underground cables and OHL cables, low loss conductors such as Aluminium Conductor Composite Core (ACCC) should be the first choice in all new installations and when upgrading existing installations.

2. CONDUCTOR MATERIAL

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. Despite this, their benefits may outweigh the costs in certain installations. Due to their lower electrical volume resistivity, smaller cross-sectional areas can be used when compared to aluminium conductors. They have a lower coefficient of thermal expansion meaning it reduces the risk of destructive forces and they are resistant to corrosion. These positives can make them more effective in the long-term and therefore their use in new installations will be considered and assessed in the CBA, alongside aluminium alternatives. A

considerable amount of our asset replacement will involve switching out of old copper for new aluminium, which could drive losses up. In these occasions, we have upsized the cross-sectional area of the aluminium conductors.

3. CABLE TAPERING

In our LV interconnected networks, cable tapering should not occur due to the need for the cables to cope with full load in both directions and to allow for increased demand along the feeder during its lifetime. For new connections, we will prohibit cable tapering in new installations on LV and 11kV networks. With this being said, at the point of connection; depending where this is on the network, there may be instances where intermediate cables are needed to join from the minimum size cable to legacy cables. Therefore, for LV we may need to use 95mm^2 or 185mm^2 to transition between the legacy cables such as PILC/PICAS and 300mm^2 LV Waveform Cable. At 11kV, we may need to do the same with the 150mm^2 and 240mm^2. If the point of connection is at the substation, cable tapering can be avoided completely.

UPGRADING NETWORK VOLTAGES

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. 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.

We also recognise that voltage reduction can contribute to losses reduction. Opportunities to reduce voltage will be subject to system study for new schemes.

POTENTIAL METHODS OF IMPROVING LOSSES

IMPROVING POWER FACTOR

Power factor is a ratio between the real and apparent power flowing through a conductor. Apparent power is the scalar product of the current and the voltage of the conductor. Where the power factor is less than unity, the total current has to increase to deliver the required amount of power. This is inefficient and the losses increase. Traditionally, larger industrial and commercial installations have had a bigger impact on power factor. However, it is implicit with all energy usage, including domestic customers. Monitoring power factor across the networks is an important step in identifying locations where power factor is less than unity, so that interventions such as power factor correction can be performed.

SWITCHING OUT UNDERUTILISED PLANT

At times of low load at twin or triple transformer sites, it is theoretically possible to switch off one of the transformers. As the total energy lost in a transformer is a combination of the fixed losses (generally referred to as the iron losses) and the variable losses (known as copper losses), switching off a transformer at times of low demand saves the fixed iron losses, and causes the variable copper losses to be redistributed amongst the

remaining plant. At times when a transformer is loaded at less than 45% of its given rating and the combined iron losses are greater than the combined copper losses, this process can reduce total losses at the site.

Altering the network operation in this manner, does however have some significant technical and security of supply implications that would need to be addressed. The system would also not be suitable for high load sites and is dependent on the particular plant at that location.

POWER QUALITY

Certain loads connected to the network, such as switched mode power supplies can cause voltage and current distortions (harmonics) to the power system waveform. As well as disturbing adjacent customers' supply, this can cause inefficiencies in the way power is transferred, resulting in increased losses on our network.

Although the individual devices are usually compliant with existing manufacturing product standards, the sum of the individual harmonics may create a total value close to or above limits. For industrial customers, detailed assessments of the connected load are carried out to ensure compliance with the mandatory levels. For residential loads, this would prove more difficult as the individual customers may be within the limits, however, the cumulative impact on the network may be out with acceptable limits. This is an area which may increase in severity with the uptake of electric vehicles or other LCTs which rely on this type of technology. Thus, improving the harmonics on the network by solutions including active harmonic filters for example, could reduce network losses.

REDUCING NETWORK IMBALANCE

The GB network operates mostly on three phases where energy is transported along three conductors. A network which is not balanced across all three phases will have higher currents in at least one phase. Due to the non-linear relationship of losses with the current, these imbalanced currents can increase losses compared to a "balanced" flow.

The nature of the GB low voltage network means this imbalance is changing all the time as the connected loads increase and decrease. On higher voltage networks, imbalance can be caused by multiple factors including the uneven distribution of single-phase transformers or two wire spurs. In order to rebalance the network, first the imbalance must be identified, and then the connection redistributed across the three phases. It is worth noting that perfect balance is not possible as the load will ebb and flow throughout the day as customers use energy as they need it.

By improving visibility of the power flows on the LV system, networks that may suffer from imbalance can be identified. These can then be subject to a number of methods to reduce imbalance, ranging from altering network configuration to the installation of more sophisticated network balancing equipment.

NETWORK CONFIGURATION

Networks are electrically separated via switches, or 'Open Points'. These open points are strategically positioned to optimise customer numbers, load and to reduce switching operations under first circuit outages. Moving an open point to better balance customer numbers between two or more feeders usually results in improved balancing of load and hence lowers losses.

As the networks evolve, original network configurations can become inefficient. In certain cases, 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.

CONTACT VOLTAGE LOSSES

Defects in underground cables lead to the occurrence of losses in networks, which are defined as contact voltage losses. SSEN 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'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.

ANALYSIS CONCLUSIONS

ED1 PERFORMANCE

This table shows the CBA work completed on the losses reduction measures carried out to date in ED1 and the planned reduction measures and savings forecast for the end of ED1.

Table 2 – Summary of CBA outcomes and losses savings forecast for ED1

		CBA outcome	Savings to 2020/21 (MWh)	Forecast for ED1 (MWh)
Intervention	**Transformers**			
	Low Loss Transformers	Implemented	*20,822**	*48,293**
	Super Low Loss Transformers	Not Implemented - cost prohibitive		
	Minimum Sizing of Transformers	Implemented	684	1,140
	Replacement of historical high loss transformers	Select Incidences	*941**	*2,294**
	Conductors			
	Minimum Cable Sizing at LV	Implemented	4,552	10,986
	Minimum Cable Sizing at 11kV	Implemented	3,136	9,280
	Minimum Cable Sizing at 33kV	Select Projects	0	2,144
	Upgrading of 6.6kV to 11kV	Implemented	1,838	3,433
	Operational Measures			
	Power factor correction	Not Implemented - not currently applicable		
	LEAN - Switching out underutilised plant	Implemented at trial sites	124	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		
		Forecast Total Losses Saving ED1 (MWh)		**77,901**

CAPITAL MEASURES CONSIDERED TO REDUCE LOSSES IN ED2

In RIIO-ED2, the new proposed measures will see us looking to avoid approximately 124,027MWh in SEPD and 45,058 MWh in SHEPD by the end of the price control period. Measures that will realise these savings include:

- continuing the deployment of low loss transformers
- replacement of historical high loss transformers
- continuing with the minimum sizing of transformers
- installing OLTC technology on transformers
- setting a minimum cable size at LV, 11kV and 33kV of 300mm2

  continuing to deploy TASS technology.

However, there is no guarantee with losses and the changes that will happen when we transition to DSO and more generators are connection at Distribution level will drive losses up. To help us to understand this better, we will commission a study on our network at the LV level to better inform our investment decisions and tackle losses. In addition, we will continue to seek out other opportunities to reduce losses, some of which are described in section 6.1 of this strategy. Throughout the negotiation process in RIIO-ED2, we will update our measures table and strategy annually, to account for new developments and opportunities. 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 the transition to DSO will have.

All of the below measures have been taken through detailed CBAs. Unfortunately, not all measures have been implemented due to the nature of Environmental projects coming out negatively in CBAs, however we will review this regularly and hope to see a more positive outcome as we shift to a net zero future.

Low loss transformers

As a minimum, all new transformers on the network will be low loss as per the EU Transformer Ecodesign Directive Tier 2 specification. To date, we have installed over 170 transformers meeting the EU Ecodesign Directive minimum requirements for Tier 2. This equates to a saving of over 20,000 MWh to date and a projected 48,000 MWh by the end of ED1 compared with higher loss alternatives. We intend to replace 630 transformers with low loss compliant versions in ED2.

Super low loss transformers

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. Despite this, we will continue to assess whether super low loss versions that exceed the Tier 2 specifications are cost effective on a project-by-project basis.

Minimum sizing of transformers

We have completed analysis of the minimum rating of transformers we intend to install within ED1. The potential losses savings gained when upsizing three phase 315 kVA ground mounted transformers (GMTs) to

500 kVA, is around 114 MWh per transformer over the 60-year life based on a typical load cycle. The additional cost of a 500 kVA transformer is around 20% more expensive than a smaller 315 kVA unit. This analysis supports the roll out of 500 kVA GMTs as the minimum rating for three phase GMTs. We have concluded similar analysis for pole mounted transformers (PMTs) and plan to only use 50 kVA three phase transformers going forward. This upsizing will equate to around 1,140 MWh losses savings over ED1.

Whilst the upsizing to 500 kVA GMTs and 50 kVA PMTs is now our procurement standard, in a limited number of circumstances, such as sites with space restrictions, we may install smaller bespoke units.

OLTC technology

OLTC technology conserves voltage and is Tier 2 compliant. Currently, we intend to replace 562 transformers with OLTC technology.

Replacement of historical transformers

The work completed under a joint Innovation Funding Incentive project, 'Management of electricity distribution network losses' by Imperial College and SOHN Associates, funded by Western Power Distribution & UK Power Networks, provides an analysis of historical transformer losses. It 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 also makes them appropriate to be replaced before their end of life with modern equivalents, this is further supported from a losses perspective.

SSEN will have replaced 44 pre-1960 secondary transformers by the end of 2020/21 and expects to replace a further 11 by the end of ED1. This will equate to over 2,200 MWh losses saving in ED1. We will carry out further investigations to identify transformers to replace. Their replacement will depend on fault history, condition, and cost effectiveness but they would be replaced with low loss transformers as a minimum.

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. Based on a typical load profile for an LV circuit, we have concluded:

95mm^2 to 185mm^2

- Cost uplift £4.51/m of cable
- Lifetime losses benefits 553 kWh/m of cable
- Lifetime NPV losses benefits £19.08/m of cable

95mm^2 to 300mm^2

1. Cost uplift £15.06/m of cable
2. Lifetime losses benefits 778 kWh/m of cable
3. Lifetime NPV losses benefits £26.85/m of cable

We have made the decision to upsize the minimum cable size from 95mm^2 to 300mm^2 for new installations, where technically viable and unless space constraints make upsizing not possible. The ability of associated

equipment to accept the larger diameter cable will be assessed in each case and we must recognise that we may need to use smaller cables; 150mm^2 and 240mm^2, as intermediate cables to joint on to smaller legacy cables or for terminating purposes. Increasing cable size to 300mm^2 provides greater lifetime losses benefit over the 185mm^2 cable. When installing cable sizes of 300mm^2, the associated equipment must be able to accept the larger diameter cables. When replacing existing cable at the end of its life, a minimum size of 300mm^2 should be adhered to where possible.

We will upsize Overhead Line (OHL) conductors beyond minimum cable sizing wherever possible, where technically viable and where proven positive in a CBA for losses reduction. This upsizing should be considered on every new project. As per AR1 in the Climate Resilience Strategy (CRS), the design standards for OHLs are undergoing review and being updated to specify upsizing of capacity to meet future load demands and projected higher temperatures. The Climate considerations paired with the Losses perspectives will make for a stronger argument as to why OHL conductors should be upsized.

Minimum cable sizing at 11kV

Similar to LV cable upsizing, a minimum cable size of 300mm^2 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 taken into account.

However, in specific instances, there were 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 submarine cable, which connects the Orkney Islands to the mainland, underwent replacement in 2020. The 240 mm^2 cable was being 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 2,143 MWh over the remainder of ED1, and over 30,000 MWh over the cable's life.

Whilst the specification previously allowed the use of a cable size of 95mm^2, cables of 300mm^2 Al 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.

Upgrading of 6.6kV to 11kV

As part of our network capacity increase and standardisation, it is possible to upgrade our 6.6kV network to 11kV utilising existing cables without significant additional costs. Whilst capacity driven, the supporting CBA considers in detail the losses savings over the lifetime of the equipment to inform any upgrade. We identified 12 projects during ED1 to replace 77 km of 6.6kV network in our SEPD region. As of 2021, 11 of these projects have been completed with the remaining 125 m upgrade in Southampton scheduled for 2021/22. These projects present a losses saving of 3,433 MWh over ED1.

In ED2, any remaining projects should adhere to plans on implementing the new proposed minimum cable sizing where possible.

OPERATIONAL MEASURES TO REDUCE LOSSES

Power factor correction

The work completed within an earlier SEPD 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. 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. 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 network.

In RIIO-ED2, we will deploy over 21,000 sets of LV monitors, allowing us to monitor power factor across much more of the network than before and will intervene where necessary. We will continue to identify locations on the network where power factor is low enough to justify intervention.

Switching out underutilised plant

SSEN's Low Energy Automated Networks (LEAN)[36] 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 a number of transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer. The TASS system provides local, automated control within the substation to monitor the loading, control the switching and to respond to SCADA alarms and status information from other network assets. In addition, commands incorporated into the Distribution Management System provide the central network Control Room with remote supervision and management capability.

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

As per our EJP (reference 5/SSEPD/ENV/LOSSES/TASS, in RIIO-ED2 we are committed to installing TASS technology to reduce our substation losses. We intend to install 59 TASS wall boxes in SHEPD and 74 TASS wall boxes in SEPD, which will deliver carbon savings of 595.41tCO_2e. This reduces actual losses, which tackles the affordability element of losses as well.

[36] https://www.ofgem.gov.uk/publications-and-updates/low-carbon-networks-fund-submission-sse-power-distribution-%E2%80%93-lean

Power quality

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 NIA and NIC projects that are looking to examine 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 demonstrated the use of these devices within its New Thames Valley Vision (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.

This is likely to become a potential future issue as the number of LCTs increases on the network. 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.

Low voltage static balancers

These devices essentially take power from a highly loaded phase and transfer it to a lower loaded phase, thereby stabilising 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 210 MWh 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 over RIIO-ED1 but will keep the CBA under review should specific circumstances result in positive benefits.

Innovative measures to alter network power flows

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. 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 have a variety of innovation projects targeting network power flows to minimise the impacts of peak demand.

Our ongoing EV smart charging projects[38] and Social Constraint Managed Zone[39] project could be particularly effective in reducing peak demand and helping to minimise network losses. The projects look to better balance consumer demand by using constraint managed services and flexible charging systems to redistribute

[38] https://smartenergycodecompany.co.uk/modifications/allow-dnos-to-control-electric-vehicle-chargers-connected-to-smart-meter-infrastructure/

[39] https://www.ssen.co.uk/SmarterElectricity/Flex/

peak demand. The outcomes and learning from these projects will be further developed and considered for optimising network power flows in the future.

NON-TECHNICAL LOSSES

The following section details the work focused 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.

NETWORK PROTECTION TEAM

SSEN's Network Protection team focus on reducing non-technical losses by addressing MPAN (Metering Point Administration Numbers) discrepancies. This can range from identifying sites without MPANs, or historical MPANs that must be closed off. The team investigate on average 4778 records per month and have resolved an average of 7821 records per annum since being established in 2014.

- The activities of the Network Protection 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;
- Assessing unrecorded energy and updating information systems accordingly;
- Participating in industry and government groups regarding energy theft; and
- Preparing cases for enforcement action and pursuing prosecutions.

CONVEYANCE & SETTLEMENT INACCURACIES

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, incorrect recording of the energisation status for metering points and incorrect registration of metering system information leading to inaccurate customer consumption data. Such non-technical losses are often regarded as 'Conveyance' related. 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 some operators have already implemented 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 reoccurrences.

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 settlement.

UNMETERED SUPPLIES TEAM

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 unmetered energy consumption.

We continue to work with the main unmetered supplies customer groups to ensure equipment inventories are regularly updated. We 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 both 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 (MUESLI) document in order to establish accurate consumption information for inclusion in energy settlements.

SSEN's #NotWorthTheRisk (since 2018) campaign has led to a significant increase in engagement with customers and the general public by the Network Protection Team. The campaign which was re-run in 2020 aims to educate on non-technical losses and highlight the risks of energy theft whilst promoting a platform where the public could potentially aid in the detection and resolution of incidents. This campaign has so far engaged with 1.6 million stakeholders and will continue going forwards.

SUB-STATION ENERGY EFFICIENCY

In substations, uncontrolled energy is typically consumed for heating and lighting, dehumidification and cooling equipment, 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, while still contributing to network losses. SSEN Transmission commissioned the Scottish Energy Centre (SEC) at Edinburgh Napier University to carry out a study on a typical substation in order to better understand electricity consumption at substations. This is being used to inform a wider strategy for substation loss reduction. Our EJP 6/SSEPD/ENV/SUBSTATIONBUILDINGIMPROVEMENTS sets out our plans to undertake refurbishment works to existing substations during the RIIO-ED2 period. The planned work will take place over 19 substations ranging from 33kV to 132kV in SHEPD and SEPD. Works to a further 25 sites will also be required to meet our science-based target, these 25 sites are yet to be identified so high-level estimates have been made.

CONCLUSIONS

In RIIO-ED2, we will continue to target a reduction in losses on our network as a percentage of units distributed, whilst removing barriers and empowering solutions that benefit the whole system. The critical part for us is understanding losses and where they occur on our network. We need to dedicate time and resource to produce a study of 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.

A considerable amount of our asset replacement in RIIO-ED2 will involve switching out of old copper cables for new aluminium ones, which could drive losses up. In these occasions, we will upsize the cross-sectional area of the aluminium conductors and will continue to carry out CBAs as the projects develop to ensure the best solution is proposed at the time. For this reason, we are reluctant to over promise on absolute reduction targets but despite this, through our targeted initiatives we hope to realise a losses avoidance of approximately 169,085 MWh from both SEPD and SHEPD by the end of the price control period (RIIO-ED2).

In summary, we will keep our Losses Strategy agile to respond to new challenges and inclusive of new technologies, and also develop according to our proposed network losses study. We will also work collaboratively with other DNOs to share learnings.

APPENDIX DTHE DIESEL STRATEGY EXECUTIVE SUMMARY

Based on the Business Carbon Footprint (BCF) in 2020, diesel consumption made up 34.5% of SSEN's Scope 1 and 2 emissions when excluding emissions from both Losses and from Lerwick Power Station. Currently, we rely on the use of diesel for Island Generation, Mobile Generation and Transport.

We need to maintain security of supply for all of our customers, whilst balancing the growing need to transition away from diesel to meet our Science Based Targets (SBTs) and net zero ambition, address aging asssets on embedded sites and the difficultly with getting fuel to the islands.

We are committed to our SBTs and need to meet our 35% reduction in Scope 1 & 2 emissions by end of ED2 and see a reduction of 55% by 2033 and therfore need to find new and effective solutions. RIIO-ED2 will be a transitional price control period, with innovation targeted at identifying alternatives to diesel. Areas we will focus our attention on will include generator upgrades, reduction in hours of usage, network maintenance, network configuration, active network management and flexibility offereings, alternative fuels and Whole System Solutions.

INTRODUCTION

This paper sets out SSEN's approach to diesel in ED2 in three main areas: Island Generation, Mobile Generation and Transport. We have always relied on the use of diesel to ensure that all of our customers have equal access to a secure supply. Our Embedded Generation sites ensure that those living in our Island Network have power during planned and unplanned outages. Similarly, we rely on mobile diesel generation to ensure our customers can regain a supply of power during faults. Finally, our company fleet which is key in carrying out our day to day activities across our license areas has relied on the use of diesel to fuel the vehicles. We know that our use of diesel in these three areas within ED2 are a key factor in reducing our greenhouse gas emissions (GHGs) which will contribute towards us reaching our SBT. The failsafe solution is expensive network reinforcement like additional subsea cables; however, this comes at high cost and is difficult to justify through a traditional cost benefit analysis. To protect the consumer from this cost we continue to utilise the standby generation system, meaning that this problem is not going away in the short term. There are also other subsea cable projects which again will help reduce the reliance on these generators in some areas. However, we need to accept and ensure that we make RIIO-ED2 a transition price control for our diesel consumption.

As per the below figure 16, when we exclude losses from our total emissions, diesel makes up 34.5% of the total carbon footprint and is mainly attributed to the consumption on the Scottish Islands, making it clear why a Diesel Strategy for RIIO-ED2 is so important.

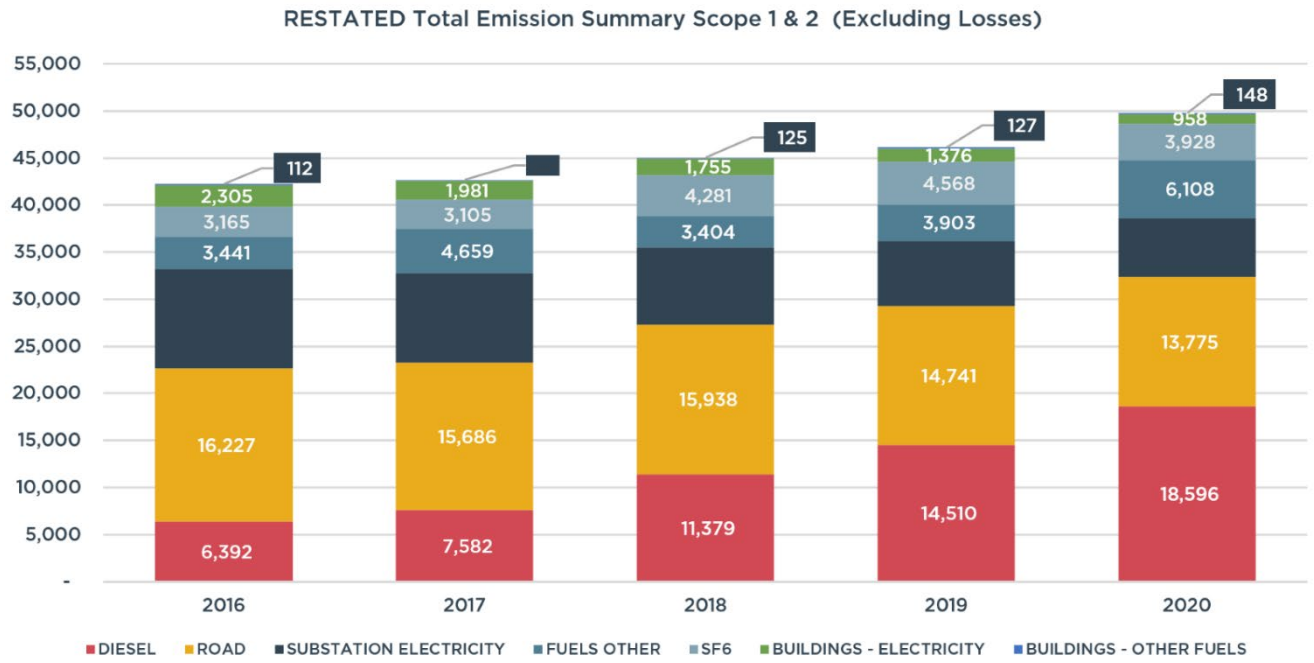


Figure 16: Emissions breakdown excluding losses

SCIENCE-BASED TARGETS (SBTS)

As part of our Environmental Action Plan (EAP) in our ED2 submission, setting a Science Based Target (SBT) is an Ofgem ED2 minimum requirement.

A SBT is a set of targets that addresses our material carbon impacts that contribute to our BCF, the target has to be set against your most recent base year data, and also has to deliver within 5-15 years. We have currently set our baseline year as 2019/20 and have set a target year of 2033, which will coincide with the end of ED3 (if this is also a 5-year price control). We will achieve our net zero at the latest 2045.

As part of our SBT we require a **55% reduction** in Scope 1 & 2 emissions by 2033 to achieve a reduction in line with a 1.5^{o}C pathway. As can be seen in the table below, we require a min of a 32% **reduction** in fuel combustion by the end of ED2 (2028). Our use of diesel for island generation sites, mobile generation and transport will need to change over the course of ED2 and ED3 to enable us to meet these ambitious targets.

Carbon Emission Category	2020 Total Emissions	Target Year - 2028			
Carbon Emission Category	**2020 Total Emissions**	**Total BAU Emissions (With Grid Decarbonisation)**	**1.5C Absolute Reduction Target**	**Reduction Needed Beyond the Target Year BAU (tCO2e)**	**Percentage Reduction against the 2020 baseline**
Building Energy	7,368	5,205	4,892	313	4%
Road Transport	13,775	13,611	9,147	4,464	32%
Fugitive Emissions	3,928	3,882	2,608	1,274	32%
Fuel Combustion	24,704	24,410	16,404	8,006	32%
Losses	538,820	377,572	357,777	19,795	4%
Total	**588,596**	**424,680**	**390,828**	**33,852**	**6%**

Table 12: Emissions reductions needed against the 2020 baseline

ISLAND GENERATION

OUR EMBEDDED GENERATION SITES

P2/7 is the Engineering Recommendation on Security of Supply. "The purpose of this Engineering Recommendation is to define the standard to which a **Group Demand** should be secured. It details the factors that should be taken into consideration to establish the magnitude of the **Group Demand** that needs to be secured and also the means of securing that demand using a combination of network assets and non-network assets. It does not detail how the **DNO** should meet the standard, however guidance on the means of achieving the prescribed security of supply is set out in Engineering Report 130.

This Engineering Report provides guidance on how to assess whether an electricity distribution system meets the security requirements specified in EREC P2/7 [N1] by means of security contribution from network assets, Distributed Generation (DG), Demand Side Response (DSR) Schemes, or Electricity Storage (ES). In order to achieve this, there is a need to establish the Group Demand, as defined in EREC P2/7 [N1] and to assess the means of securing this demand in accordance with the requirement of EREC P2/7 [N1] Table 1. This EREP provides technical guidance on this assessment."

Parts of our Island network does not currently meet P2/7 compliance. If we only consider the impact of demand interruption it remains inefficient to achieve compliance through network reinforcement which is why we have, historically, relied on Embedded Generation stations on our Islands. During the next decade many areas across our island network will experience concurrent and material drivers for investment. These include condition driven replacement of subsea cables, embedded generation at end of life, environmental limitations on our ability to use diesel embedded generation and significant low carbon technology load growth. Together, these could represent a shift in the economic balance towards network reinforcement or other appropriate whole system solutions which may allow us to achieve P2/7 compliance and materially reduce our reliance on diesel generation. **We will pursue these options in RIIO-ED2 through our proposed**

Hebrides and Orkney Whole System uncertainty mechanism and will bring forward proposals to Ofgem in the first two years of the price control (see *Uncertainty Mechanism (Annex 17.1)* for further details).

In the meantime our seven Embedded Generation power sites play a crucial role as what is often the last resort to keep power flowing to homes and businesses during planned maintenance or faults on our network. All our embedded generation sites are only ever used as a backup and offer a security of supply to some of our most isolated and vulnerable customers.

The Embedded Generation stations are however a large polluter of Carbon dioxide (CO_2) due to the engines within the standby stations being diesel fuelled. The age of some of the engines also contributes to the problem as many are considered ageing plant with some beyond their design life.

Table 13 below shows all our embedded generation sites with the number of engines on site, the oldest asset year of installation and the total tonnes of CO_2 produced in 2020.

Battery Point in Stornoway was running on 3 separate occasions in 2019/20, hence why the CO_2 produced was significantly higher than the other power stations. These 3 occasions were:

- To support refurbishment work on the OHL in Jura
- To support customers in Islay, Colonsay and Jura during the submarine cable fault
- To support the remainder of the refurbishment work on the OHL in Jura as it was cut short due to the submarine fault

Battery Point and Arnish, both in Stornoway, are used to support Transmission when a fault occurs or there is a planned outage. Bowmore is also a contingency.

Site	No of Engines	Oldest Asset Year of Installation	CO_2 – Tonnes (2020)
Bowmore, Islay	4	1977	6815.764
Tiree	4	1973	71.435
Kirkwall, Orkney	3	1975	436.365
Battery Point, Stornoway	8	1964	16928.722
Arnish, Stornoway	7	2006	4113.765
Loch Carnan, South Uist	5	1972	402.358
Barra	3	1997	20.934

Table 13: Embedded generation site details

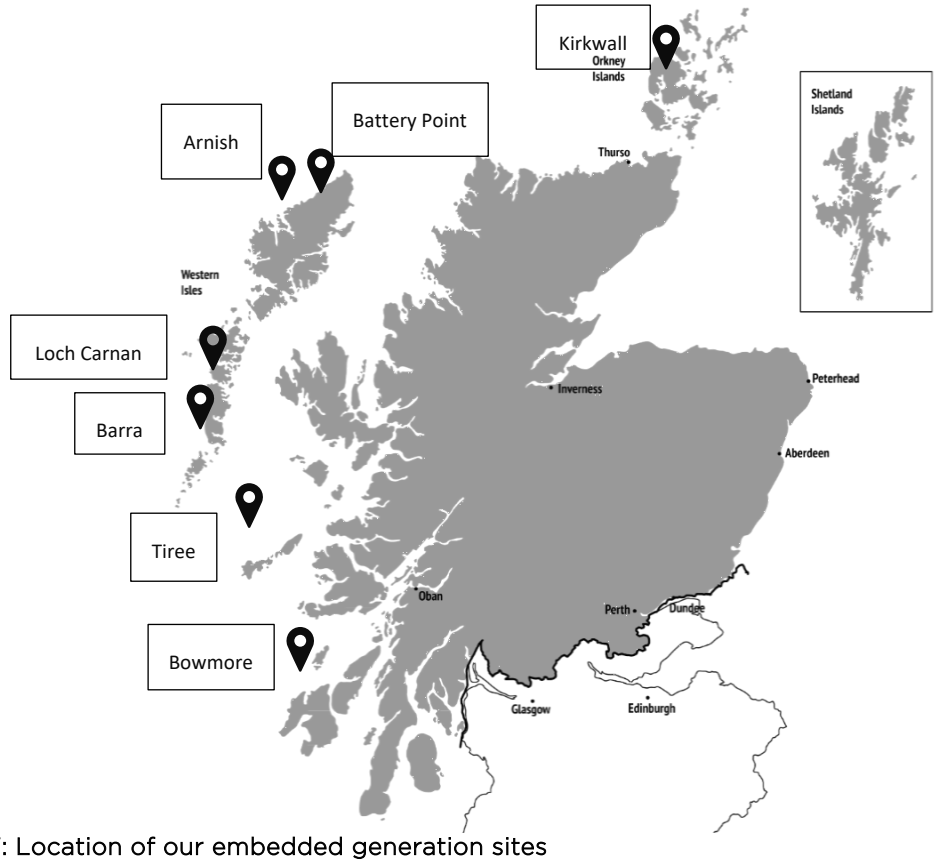


Figure 17: Location of our embedded generation sites

EMBEDDED GENERATION FUEL USAGE (2019/20 DATA)

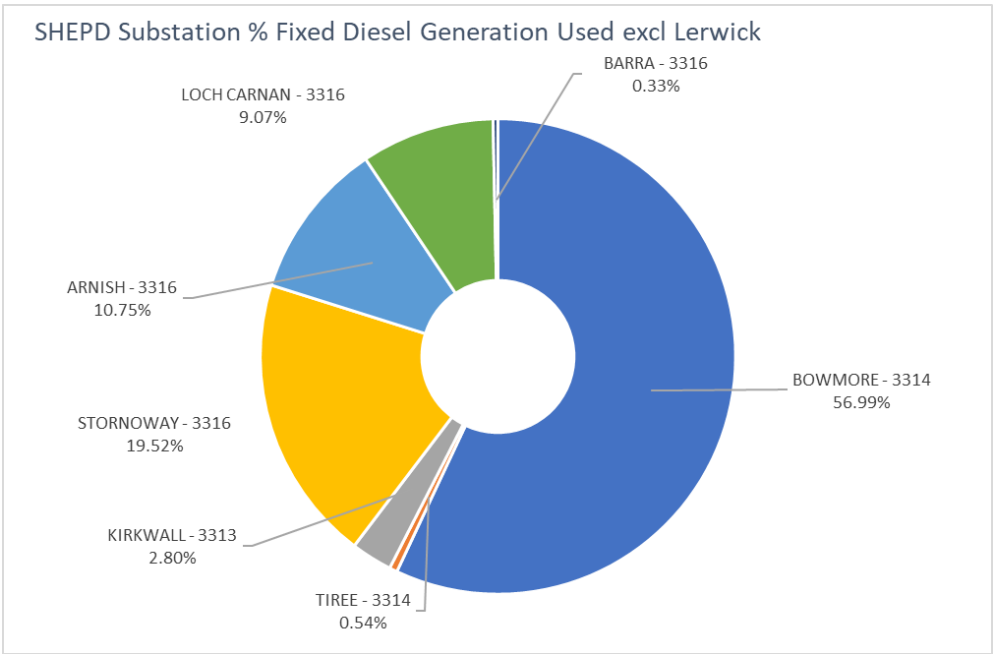


Figure 18: Diesel generation in SHEPD (excluding Lerwick)

LERWICK POWER STATION

Our RIIO-ED2 planning work has outlined the reasoning behind our performance and there are definite lessons we can take from ED1, particularly regarding high quality data, however, there are credible regional

differences that need to be highlighted. Our diesel consumption for our fixed generation on our Scottish islands is the main contributor to this at 34.5% of our combined Scope 1 & 2 emissions (excluding losses40), with this consumption predicted to rise over the short term with Lerwick transitioning. The Shetland HVDC Transmission link will remediate that consumption increase if it goes ahead as planned and is a great example of whole system solutions in practice, but in the short term our diesel use will go up. SSEN are planning to engage with Ofgem in early 2022 to agree the most appropriate and transparent way forward for reporting on Lerwick.

Best Available Technique Assessment

On 16th October 2020, the subsea cable supplying Lewis and Harris suffered a fault. While the cable is out of service, Battey Point (Stornoway) which is normally a stand-by station, is required the operate full time to maintain security of supply supported by an additional 6MW of mobile generation temporarily in place. In January 2021, The Scottish Environmental Protection Agency (SEPA) requested that a Best Available Technique (BAT) assessment was carried out following the stations in the Western Isles going into full time running. The purpose of the BAT assessment was to determine if the stations were operating optimally, given the additional pollution expected from running 24/7. The assessment results confirmed that the generation setup to support the submarine cable failure was considered BAT.

OUR SUBMARINE CABLES

We currently have 59 Scottish islands connected via subsea cables, with a couple not connected (Fair Isle & Shetland)

Figure 19 shows all SHEPD submarine cables including loch, estuary and river crossings (excluding Shetland Islands).
Green = 11kV
Red = 33kV

[40] Losses are a Scope 2 emission and make up 91% of our combined Scope 1 & 2 emissions. We will also report these separately to ensure our other material areas are also targeted.

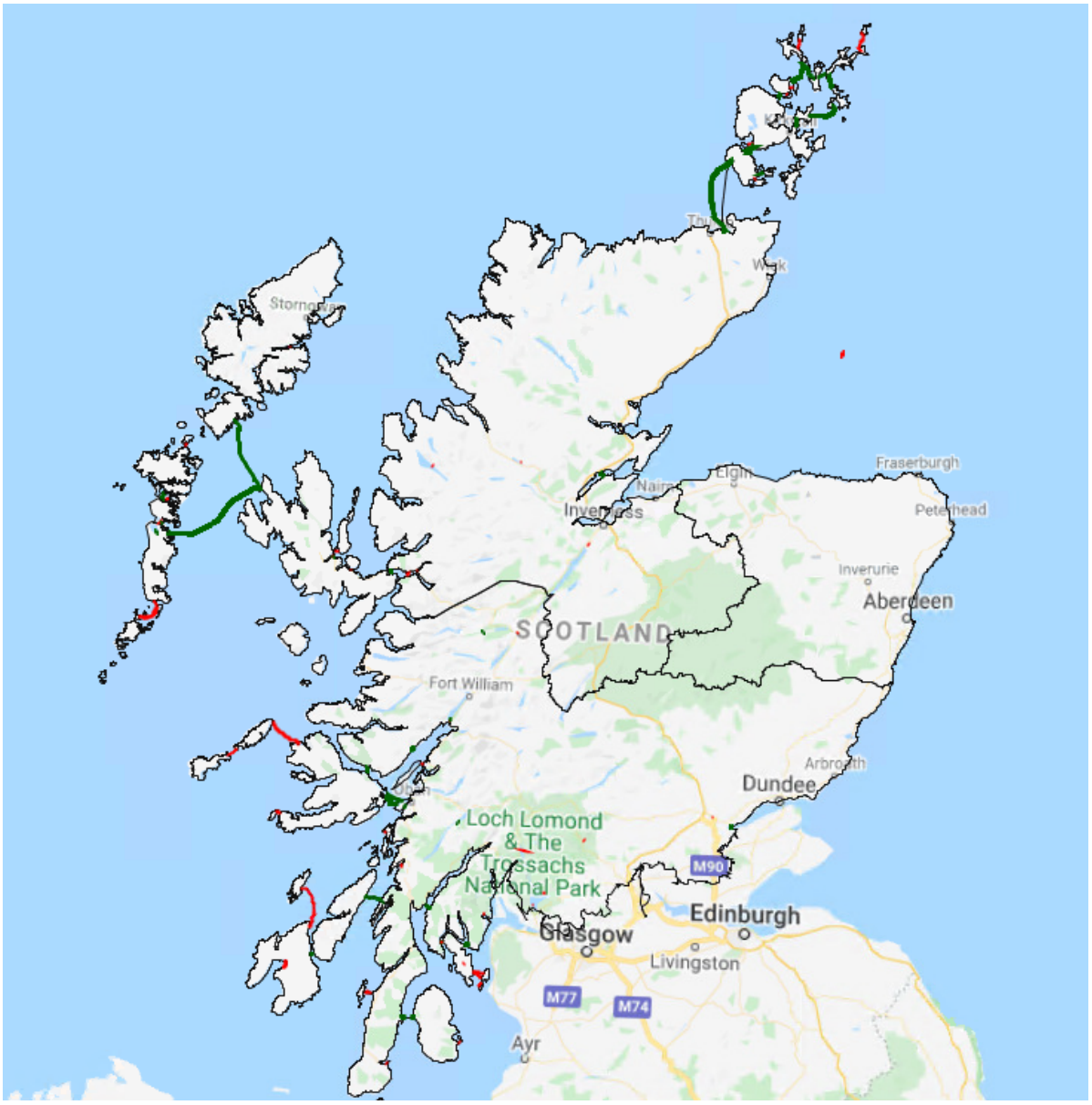


Figure 19: SHEPD submarine cable locations excluding Shetland Islands

The image below shows all of our SHEPD submarine cables including loch, estuary and river crossings (Including Shetland Islands).
Green = 11kV
Red = 33kV

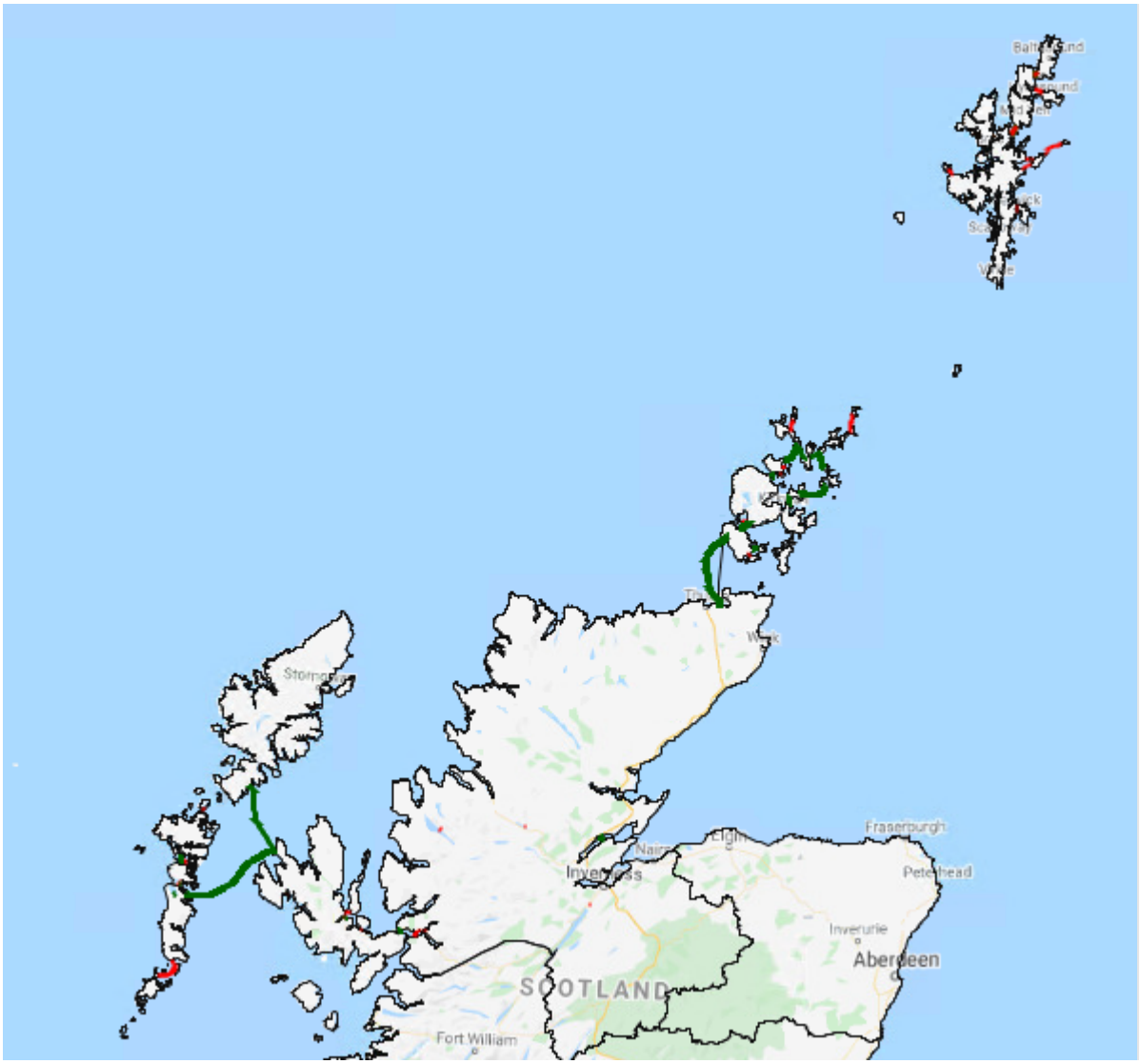


Figure 20: SHEPD submarine cable locations including Shetland Islands

Our Condition Based Risk Management (CBRM) system has limited information on our subsea cables and depends on an inspection being carried out. If a cable hasn't been inspected, it is automatically calculated as a HI3 and once inspected it can then be moved to a HI5 if the cable is in poor condition. The subsea cable team are currently carrying out an inspection on around 30 of our subsea cables which will contribute towards our health scores.

We currently have 110 cables located in SHEPD. 15 of these cables have direct links to our 7 embedded generation sites. These cables are listed below and show their current (ED1) and future (ED2) health index scores (HI1 is noted "as new" and HI5 as being at "end of life").
If a fault occurred on any of the cables below, this would require turning on one of our 7 embedded generation sites which would have a huge impact on our diesel usage.

Circuit Name	Current HI Banding (ED1)	Future HI Banding (ED2) (no investment)
Skye -South Uist	HI5	HI5
Skye - Harris	HI1	HI2
Mull – Coll*	HI5	HI1
Pentland Firth West (2)	HI2	HI3
Coll - Tiree	HI5	HI5
Mainland Orkney – Hoy	HI5	HI5
North Uist – Benbecula West	HI3	HI5
South Uist - Eriskay	HI3	HI4
Pentland Firth East (1)	HI3	HI5
Benbecula – South Uist East	HI5	HI5
North Uist - Berneray	HI3	HI4
North Uist – Benbecula East	HI3	HI5
Mainland - Jura	HI1	HI1
Jura - Islay	HI5	HI5
North Uist – Benbecula Centre	HI1	HI1

Table 14: HI Banding in ED1 and ED2.

The Cables highlighted in **green** above are proposed for replacement in ED2, as a result HI score will change. *The Mull – Coll Cable is due for replacement in ED1 meaning a HI1 in ED2.

PLANNED OUTAGES

Every year we invest millions of pounds into upgrading our electricity network to ensure our customers have a reliable supply of power. The investment we make involves carrying out maintenance to prevent our cables and equipment getting damaged, such as replacing old underground cables or upgrading substations so that they are well maintained and upgraded to cope with increased energy demand in the local area.

To enable our engineers to complete this work safely, we may have to turn the power off in the area. This is known as a planned power cut or outage and we give our customers as much notice as possible, unless it is because of an emergency situation.

ED2 EMBEDDED GENERATION EMISSION REDUCTION OPPORTUNITIES

RIIO-ED2 will be a transitional period for us as we move away from our reliance on diesel and explore alternative fuels, new technologies and innovative ways of working. We plan to look at the flexibility of services and provide local solutions as well as looking at whole system solutions with other parts of the energy chain - such as Transmission (further details can be found in ***DSO Strategy (Annex 11.1) and Whole Systems (Annex 12.1)***). To progress towards net zero and improve security of supply, we are investigating the following options:

NEW DIESEL GENERATORS AT BATTERY POINT

As part of our engineering justification paper, we have suggested replacing 4 existing Mirrlees KVSS Generators with 2 new larger 5MW diesel generators. The new diesel generators would be fitted with a

Selective Catalytic Reduction (SCR) system which will reduce air pollution (NOx and Particulate Matter). CO_2 emissions could be significantly reduced by replacing these old generators with a newer model that burns less fuel and therefore emits less CO_2 and air pollution.

REDUCTION IN HOURS OF USAGE

A review of all monthly engine test runs should be completed to determine if the hours run can be reduced with no detrimental effect on availability or reliability. This will provide small monthly savings in CO_2 that over the duration of ED2 could accumulate to a reasonable figure.

NETWORK MAINTENANCE

Engaging with other departments e.g., Transmission and Distribution regions to establish if maintenance programmes could be delivered more efficiently, with less requirement for station support.

NETWORK CONFIGURATION

Trend analysis on faults occurring that trigger the stations being mobilised, engaging with Distribution regions to investigate problematic island networks, perhaps susceptible to faults - to determine alternative solutions like for example undergrounding to reduce the fault risk and the potential to deliver improvements and negate the need for the station to run in certain scenarios in the future.

NETWORK MANAGEMENT

Engaging with system planning to determine if the introduction of an active management system (ANM) would allow further renewable generators onto the network when islanded. This review should include the opportunity to incorporate battery technology that could assist with Black Start or provide spinning reserve instead of operating thermal plant. This would provide a consistent saving on CO_2.

TRANSITIONAL SOLUTION

As a transitional option, until we get to a longer-term solution we will look at the viability of alternative fuels such as the ones below:

- Fatty Acid methyl aster (Fame) Biodiesel
- Biomass to liquid Synthetic fuel (BTL)
- Hydrotreated vegetable oil (HVO)
- Blending of alternative fuels for optimal Hydrocarbon and NOx emissions.

FLEXIBILITY SERVICES

Through its innovative Constraint Managed Zone (CMZ) initiative in 2016, SSEN Distribution was the first UK Distribution Network Operator (DNO) to introduce Flexibility Services and it continues to lead in the delivery

of flexibility across the GB Distribution networks. Since our first BAU contract in October 2019 and thanks to our ongoing commitment to 'flexibility first', our improving systems and supporting processes, and the evolving Local Energy Markets, we have grown our portfolio to 603 MW of Flexible Service contracts in place today in twelve zones across our two Distribution licence areas.

The procurement and use of Distribution Flexibility Services to manage areas on our network that are subject to constraint, is a key tool to avoiding the need for expensive and time-consuming network reinforcement and promoting markets for service provision, which should drive more economic, efficient and smarter approaches. We also recognise that the greater use of flexibility across our Distribution businesses will be an important strand in efforts to decarbonise the energy sector and enable the strategic delivery of net zero as required by the targets set by Government. Our current CMZ contracts have been used to support our networks during extended fault scenarios, reducing the need for embedded or mobile diesel generation and across these services SSEN has secured 8GWhs of renewable energy saving over 4,500t CO_2 emissions.

We will take this learning and explore how we can adopt this on our Islands to reduce the reliance on our Embedded Generation stations, which is critical for us to meet our own SBTs and net zero goals.

TARGETED INNOVATION

Following the publication of SSEN's Draft Innovation Strategy, we received clear feedback from our stakeholders on how our Innovation programme can be used to support SSEN's Sustainability ambitions and to reduce the Business Carbon Footprint. Sustainability has always been part of our innovation portfolio, in particular, the need to innovate to help identify alternative options for the operation of our Embedded Diesel Generation fleet in the Scottish Islands. Some of the steps we aim to take for our Islands; which can be found in our ***Innovation Chapter (Chapter 14)***, are to:

- Invest in subsea cable infrastructure to secure our network which will reduce the number of outages and therefore reduce reliance on diesel - Make the network more secure – we are investing in our subsea cable infrastructure to increase its reliability and resilience. The deployment of Subsense will give the option for proactive intervention to prevent catastrophic failure.

- Use Constraint Managed Zones (CMZ) as noted above to understand flex assets on the Island, understand Demand Side Response (DSR) potential and improve energy efficiency to reduce demand on the Island.

- Put in place advanced Active Network Management (ANM) and CMZ solutions to maximise use of local renewable resources.

- Explore alternative resilience options such as the use of battery technology and energy storage, hydrogen and other diesel alternatives. The RaaS project is looking at the use of batteries so will help improve our understanding in this area– the above measures should reduce demand and maximise use of local renewables leaving a much smaller quantity of energy to be supplied from traditional diesels.

WHOLE SYSTEM SOLUTIONS

We are engaging with other energy networks for a whole system (WS) approach, to understand network reinforcement solutions such as sub-sea cables being carried out potentially by others and aligning both to ensure a true whole system solution can be found. Cable reinforcement provides us with more confidence on cable reliability, reducing and potentially removing the need for embedded generation – it is not always the solution however - if there are other connections planned we must explore these and have the mechanism to do so. **We will pursue these options in RIIO-ED2 through our proposed Hebrides and Orkney Whole System**

uncertainty mechanism and will bring forward proposals to Ofgem in the first two years of the price control.

The WS solution can unlock material benefits for customers, stakeholders in the short term and, through more efficient and effective networks, in the long term.

Issues of security of supply, resilience, unrealized economic potential etc. on and around the islands will not abate or disappear until some form of step change is introduced. Incremental change will never be sufficient to address the barriers and investment by individual parties in a whole system context and are unlikely to collectively achieve an optimal result for the longer term

Drivers for investment:

Individual areas above (and elsewhere in our ED2 Plan) clearly highlight the DNO drivers. These include:

- Maintaining security of supply while existing standby generation solution are past their end of life (60-70 years old). The need is certain now – but solution dependent on medium term environmental solution.
- Maintaining security of supply and resilience for renewable generation while a range of strategic subsea assets are at the end of their life, aged and displaying deterioration. The need is certain now but optimal solution dependent on near term developer (Access SCR), CfD, ScotWind uncertainty (2022-2023).
- Achieving our commitments to eliminate 35% (2028), 55% (2033), 100% (c. 2045) of current CO_2 emissions from diesel generation which requires long term planning and investment to avoid stranding short term investments. The need is clear, however solution will change if network reinforcement changes.
- Meeting DNO connection customer expectations to facilitate increased potential for small scale renewable development
- Meeting future load requirements in an LCT world (Harris/Lewis load growth drives investment by 2027, Uist by 2033, and others). Uncertainty will remain but reduce towards end ED2 and into ED3. Depends on network investment to meet developer requirements and then environmental commitments.

Individual drivers across energy sector and beyond include:

- Political change and tighter net zero targets set in legislation
- Potential replacement of existing Gas network(s) (LPG and LNG)
- Impact on demand of replacing large industry diesel reliance (e.g. Stornoway and other HIAL airports)
- Transportation needs (large scale ferry fuel requirements and haulage – perhaps even fishing
- Developer ambition – local and wider renewable plans (large and small scale)

Scale of issue:

The costs involved in continuing the status quo are high, and likely to further increase as diesel costs, and carbon costs will continue to rise as the market dictates. The transition to white diesel alone could almost double the purchase costs.

Conclusion – the scale of the costs involved in providing solutions to all the DNO and wider system needs warrants a whole system review. This therefore requires a UM to facilitate the recommendation from that and to work in conjunction with Ofgem's CAM license mechanism.

MOBILE GENERATORS

We use mobile generators to get our customers back on supply during fault conditions. For ED2 we are aiming to improve the reliability of our networks and therefore reduce the amount of faults that occur thereby reducing the reliance on mobile diesel generator sets however, we cannot rule out the need completely thus, during ED2 we are proposing to swap 50 of our 30kVa diesel generators for a 23kVa hybrid alternative. These diesel generators will be reaching their end of life and the new hybrid generators will deliver the following outputs and benefits:

- Proposed CO_2 saving 5,600 t CO_2e for SHEPD & SEPD
- Contribute towards a reduction in air and noise pollution
- Reduced running costs compared to diesel generators

The generators we own will be replaced when they reach the end of their life to avoid any stranding of mobile assets however, we will work to look at alternative fuel types but that will run with the existing diesel set. We are continuing to look into alternatives for our larger diesel generator sets and are working with Procurement and our supply chain to find suitable options. We are also looking to learn from other DNOs and wider industry who are deploying innovations in this area like Silent Power.

The transition to white diesel from 2022 will also have a positive impact on our ongoing CBA's, as the cost of diesel will almost double from current prices.

TRANSPORT

In 2019, SSE joined the EV100 commitment which is managed by The Climate Group. We have committed to the following by 2030 for our fleet transition to electric:

100% of vehicles up to 3.5t and 50% of vehicles between 3.5t to 7.5t

As part of these commitments above we will be ensuring the staff charging infrastructure volume matches the demand and promote the awareness of EV's within the business. We have a 6-year plan for installation of charging points across our depots. By 2025, all depots will be at maximum capacity for EV chargers.

By the end of ED2, we aim to transition our <3.5t fleet to 80% EV and reduce our average road mileage by 15% when compared to pre-COVID 19 levels. Regarding our 3.5t to 7.5t fleet, we aim to transition to 40% EV where alternatives are available.

CONCLUSION

We recognise the challenge that faces us to transition away from the use of diesel in the next price control period and that we must balance this alongside the need to ensure security of supply to all of customers however, we are confident that by using RIIO-ED2 as a transitional period, we can increasingly decarbonise our networks and reduce our reliance on diesel.

APPENDIX E: SUBSTATION BUILDING EFFICIENCIES

EXECUTIVE SUMMARY

This report contains an analysis of the effectiveness of a range of different energy efficiency measures that could be applied to Scottish and Southern Energy Network's (SSEN) stock of older substation buildings.

The approach adopted was to develop a set of archetype substation building models, simulate their annual energy performance to quantify the potential for energy savings, and extrapolate these results to the wider substation stock, totalling over 10,000m^2 of floor area. The models were created using data from a wide variety of sources, and it should be noted that there was considerable uncertainty over many of the input parameters. The performance of the models was simulated on the well-validated ESP-r building simulation platform.

The models developed included a base case and variants, which represented a range of different energy efficiency measures: double glazing, external roof insulation, external wall insulation, draught stripping, combined insulation measures, heater control and replacement of existing heating with air-air heat pumps. The energy savings were quantified by comparing the results from the variants to the base case. The simulations produced data on the annual heating energy use and were run using climate datasets that were representative of SSEN's areas of operation – Scotland and Southern England, but the results indicated similar effectiveness of measures regardless of climate.

Annual savings in kgCO_2 and notional fuel costs savings were derived from the simulation results. Additionally, indicative costs were calculated for the different energy efficiency measures. Using this data, the most attractive option in terms of benefit against cost was the addition of timer controls to existing heating, saving around 190 tonnes CO_2 and £50 K in notional heating costs per annum, at a cost of £177K. The least effective option was combined insulation measured applied to the building fabric, which cost £5.2M, achieving savings of 420 Tonnes of CO_2 and £110K per year. The full list of costs vs benefits is shown below.

Table 15: Costs and savings from different measures over the entire building stock considered (10,000 m^2).

Measure	Indicative Cost £	Annual total kgCO_2 saved	Annual saving kgCO_2/ Cost £	Annual total £(notional) saved	Annual saving £(notional) /Cost £
Heater controller	177,375	189,125	£1.07	50,155	£0.28
Air-Air Heat Pump	950,597	607,104	£0.64	161,000	£0.17
Reduced Infiltration	220,248	131,280	£0.60	131,280	£0.16
Double Glazing	234,872	140,895	£0.60	37,364	£0.16
Roof insulation	1,208,259	227,779	£0.19	60,406	£0.05
Combined	5,277,539	422,270	£0.08	111,983	£0.02
Wall insulation	3,563,726	175,202	£0.05	46,462	£0.01

Finally, the results presented in this report are subject to considerable uncertainty and savings are expressed relative to an assumed base case. It is recommended that further investigation should be undertaken to verify

the assumptions underpinning results from this study, prior to implementing any energy of the efficiency measures analysed.

BACKGROUND

In electricity substation buildings, environmental conditioning loads such as heating, lighting and cooling are unmetered and treated as supply-side losses. Many substation buildings, particularly those constructed prior to the introduction of more stringent energy efficiency standards in the 90's and 00's have a relatively poor quality building fabric, coupled with manual switching of heating and lighting and highly intermittent occupancy. In this situation, lights and heating could be left on in unoccupied spaces for significant periods of time, resulting in substantial and unnecessary energy losses across a large substation building stock. As part of Scottish and Southern Energy Network's (SSEN) ongoing efforts to reduce their carbon footprint and improve overall efficiency, the Energy Systems Research Unit (ESRU) at the University of Strathclyde were tasked with assessing the potential savings in energy that could be achieved through the implementation of a range of basic energy efficiency measures to the substation buildings, such as fabric improvements and introducing occupancy based control of heating.

AIMS AND OBJECTIVES

The basic aim of the work reported here was to use modelling and simulation to assess the energy, environmental and economic impact of energy efficiency measures applied to typical substation buildings across a number of SSEN sites, and to extrapolate the potential benefits across SSEN's older substation stock.

Specific objectives were:

- Acquire information on SSEN's substation buildings.
- Develop a set of representative archetype substation building models that can be used to generate base line energy performance data.
- Generate a set of model variants that incorporate a set of feasible energy efficiency improvements.
- Simulate the performance of the archetypes and variants against two different UK climates, representative of SSEN's areas of operation, and generate normalised energy performance data.
- Extrapolate the results from the simulations to the entire stock of older substation buildings to determine the most effective measures in terms of cost and energy/environmental benefit.

The simulations of building performance provide data that can be used to compare the effect of different measures in isolation and collectively against a modelled baseline and enables an informed choice to made regarding the most effective measures to implement. Typically where existing buildings are being studied, there is often measured energy data against which to calibrate the baseline model. However, in this case, as heating, lighting and cooling were unmetered, measured energy use data was scarce, and so the development and calibration of the baseline models was done using a variety of information sources including, condition reports, design guides and measurement campaigns that did not specifically target energy usage. Information sources are referenced throughout the report text.

METHODOLOGY

SIMULATION MODELLING

Modelling and simulation was used in this study to assess the likely impact of different energy efficiency measures being retrofitted to existing substation buildings. As the aim is to assess the benefit across of a large number of buildings, the approach adopted here is to (1) develop archetype buildings models – i.e. models that capture the key characteristics of the larger building stock; (2) simulate their energy performance over a calendar year and normalise the results by floor area (e.g. kWh/m^2/year); (3) extrapolate these results to provide an indication of the energy performance of the larger stock.

In order to quantify the benefits of specific energy efficiency measures, a range of models needed to be developed. Firstly, archetype models that characterised the current 'base case', were created. These were representative of the current stock of older substations, with little or no fabric insulation, poor quality windows and with high leakage rates of outside air (Bayliss and Hardy 2012, Corr 2020, Ritchie 2021). Secondly, variants of the base case models with specific energy efficiency improvements were created, these included roof insulation, wall insulation, improved glazing, etc. Comparing the energy performance simulation results from the variant models against the results from base case models enabled the impact of the efficiency improvement to be quantified.

More details on the models are provided in Section 0.

ESP-R SIMULATION TOOL

ESP-r (Clarke, 2001, ESRU 2021) was initially developed as part of a PhD project at the University of Strathclyde. Since then the software has been under continuous development and has been applied in hundreds of national and international research and knowledge exchange (KE) projects with industry.

ESP-r is a multi-physics modelling tool, which is primarily focused on modelling the technical performance of buildings. In ESP-r, a description of the geometry and materials of a building is decomposed into a large number of control volumes – defined regions of the building from which equations of conservation of mass, energy and momentum can be derived. This produces a large number of interlinked equations that together describe the physical processes occurring within the building. Solutions of these equations using real climate data and user-defined control settings allows the time-varying heat and mass flows and time-varying environmental conditions within the building to be determined over a user defined period, which can range from a single day to a calendar year.

ESP-r has been extensively validated in numerous international projects. A summary of some of these validation efforts was compiled by Strachan et al. (2007). More recently the programme underwent validation as part of the EU H2020 Hit2Gap project (Grant agreement ID: 680708) – which focused on narrowing the performance gap between simulated buildings and buildings in use (Monari, 2016).

MODEL DEVELOPMENT

SSEN SUBSTATIONS

The substation building stock to be analysed is shown in Table 16 Substation details, these comprise mainly secondary substations, across SSEN's areas of operation in Scotland and the South of England.

Table 16: Substation details.

Substation Name	Location	Size	Floor Area (m^2)	Easting	Northing	Grid Ref
Wootton Road	SEPD-Ridgeway	33kV	330.33	449271	198249	su49279824
Andover Local Grid	SEPD-Ridgeway	33kV	393.05	435331	146598	su35334659
Dorcan South	SEPD-Ridgeway	33kV	233.3	419266	183506	su19268350
Norrington	SEPD-Ridgeway	33kV	345.43	388272	164983	st88276498
Lovelace Road	SEPD-Ridgeway	33kV	212.6	450412	210371	sp50411037
Headington	SEPD-Ridgeway	33kV	325.8	454455	208145	sp54450814
Northolt	SEPD-Thames Valley	33kV	441.01	511550	183230	tq11558323
Taplow	SEPD-Thames Valley	33kV	301.56	491693	181254	su91698125
Burghfield Grid	SEPD-Thames Valley	132kV	433.74	469447	170508	su69447050
High Wycombe Grid	SEPD-Thames Valley	132kV	138.97	484774	192191	su84779219
Thatcham Grid	SEPD-Thames Valley	132kV	281.69	452828	166434	su52826643
Green Park	SEPD-Thames Valley	33kV	172.99	469581	168884	su69586888
Nuffield	SEPD-Thames Valley	33kV	41.38	468340	186763	su68348676
Southcote	SEPD-Thames Valley	33kV	97.06	468224	171304	su68227130
Hunston	SEPD-South East	132kV & 33kV	349.37	486946	102627	su86940262
Haslingbourne	SEPD-South East	33kV	393.34	498224	120282	su98222028
Dunblane	SHEPD-North	33kV	126.44	277907	701545	nn77900154
Milnathort	SHEPD-North	33kV	133.17	311899	705076	no11890507
Forres	SHEPD-North	33kV	138.77	303361	859428	nj03365942

Additionally, another 5,541 m^2 of similar floorspace was to be considered – 4211 m^2 in SHEPD-North and 1330 m^2 SEPD-South.

GEOMETRY

A survey of these sites was undertaken using Google maps, to identify and gather information on the types of buildings present. This indicated that almost all of the buildings were simple, single storey constructions, with a flat roof, naturally ventilated via dedicated wall or door-fitted openings and with limited external glazing areas, often at high level. Photographs and videos provided by SSEN of the Forres, Tealing and Headington

sites corroborated this impression, along with substation photos in the report by Corr (2020). Examples of buildings viewed are shown in Figure 21 and 22.

Figure 21 Example of 'typical' substation building – Headington Rd, Oxford.

Figure 22 Another example of a typical substation building – Forres.

Additionally, fabric condition survey material was provided by SSEN (SSEN, 2020a; SSEN 2020b) along with substation design guides (Bezuko 2020, Baker 2020). Unfortunately, the latter focused on the electrical systems and had little information on either the building fabric or operation of the environmental systems in the substation buildings. Consequently, additional material was sourced (Ritchie 2020; Bayliss and Harding, 2012), which provided more detail on typical construction types, ventilation and the operation of heating, lighting and cooling systems. Data from these sources was applied in the models, specifically ventilation rates and heating/cooling set point temperatures.

ARCHETYPE MODELS

A group of archetype substation buildings were developed for ESP-r were intended to be representative of the types of buildings found at the substation sites from Table 4 and to capture the main activities/usage spaces. The model is shown in Figure 23 and includes three distinct buildings types representative of those identified in the survey and for which information was available. Building type 1 – larger building featuring a greater variety of spaces including, mess room, battery charging room, switchgear room, storage space, WC and office. Building 1 also features a server room, however this is atypical of the types of spaces found at the substation sites analysed and so this space was excluded from the analysis. Building Type 2 – small 'crewed' building featuring office space, storage space, battery room and WC. Building type 3 – single storey, building housing storage space, switchgear and battery charging.

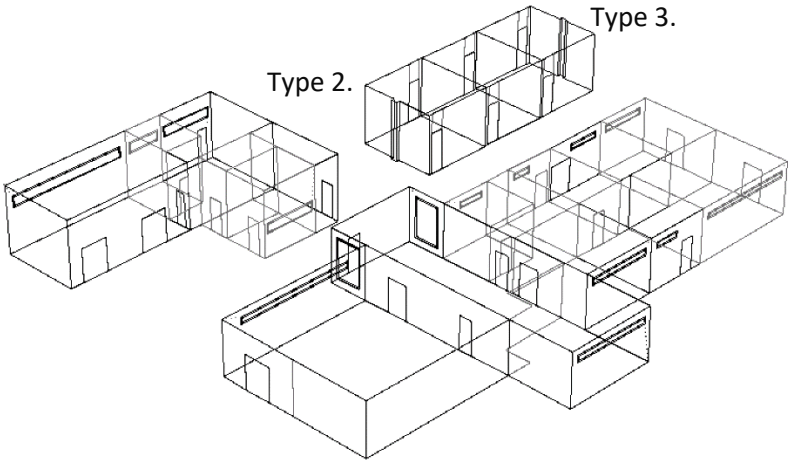


Figure 23 ESP-r model featuring a variety of archetype substation buildings.

GEOMETRY

The total floor area of the modelled buildings was 761 m^2, with 809 m^2 of opaque wall area and 46m^2 of glazing, of which 16m^2 was framing.

Table 17: Basic geometric details for archetype buildings.

Archetype Building	Roof/floor area	Wall Area	Glazed Area
1	374	909.5	18.5
2	128.2	506.1	9
3	115	392.7	2.3

MATERIALS

The building materials used on the models were derived from: design guides (Bayliss and Harding, 2012), the substation photos provided, substation condition reports (SSEN 2020a, SSEN 2020b) and conversations with SSEN staff. It was assumed that substation walls were brick cavity, with no insulation. The floor was cast concrete, again with no insulation and the ceiling comprised concrete slabs, with an outer water proof layer comprising bitumized felt. Glazing was assumed to be single glazing and frames were assumed to be wooden.

INTERNAL HEAT GAINS

There was considerable uncertainty regarding the levels of internal heat gains present in the substation buildings and this should be kept in mind when interpreting the simulation results.

According to SSEN, occupancy of buildings varies between north and south, with southern substation buildings often used as work bases, whist northern substations were far less frequently occupied. However, even in the south, levels of occupancy were extremely low in comparison to conventional buildings such as offices. Consequently, the impact of heat gains from people will be limited. Regarding other heat gains, an assumption of 20W/m^2 from switchgear was based on monitored temperatures in Corr (2020) and information in White and Piesciorovsky (2010), 4W/m^2 from lighting and 4W/m^2 for general equipment in crewed spaces was assumed, based on information from Ritchie (2020).

INFILTRATION/VENTILATION

It was assumed that each building was naturally ventilated via the infiltration of outside air through purpose made vents such as door louvres and air bricks, and through small gaps around doors and window frames in the external fabric (e.g. junctions between the wall and ceiling slab). The infiltration rate for each building of the base case building models was set at 4 air changes per hour, this was based on information from Bayliss and Hardy (2012), who recommend this level for the avoidance of condensation.

Note that a more accurate measure of air leakage characteristics would be achievable using a blower-door test, but the timescale and budget of this project did not allow this.

HEATING AND COOLING

There was only limited information regarding heating and cooling in SSEN's substations. Photographs from substations provided by SSEN, indicated that heating was provided by electrical convector units of the type pictured in Figure 24.

Figure 24 A typical electrically heated convector unit found in substation buildings.

Baker (2020) indicates that substation rooms should have a set-back temperature of 15°C, with the temperature boosted to during periods of occupancy 20-21°C when occupied. However, monitored data provided by SSEN from the Tealing substation provided a mixed picture of what was actually happening. The Tealing data showed temperatures varying between 10 and 26°C over the course of two years, some spaces appeared to be heated continuously to 20°C or above, whilst others appeared to have more intermittent or no heating. Continuous heating could be a cause for concern given the intermittent occupancy of substations, as it would indicate heating of spaces to comfort temperatures when no-one was present – a significant waste

of energy. The data from Corr (2020) provided a similar picture, though this report also suggested some heaters were switched off in the summer.

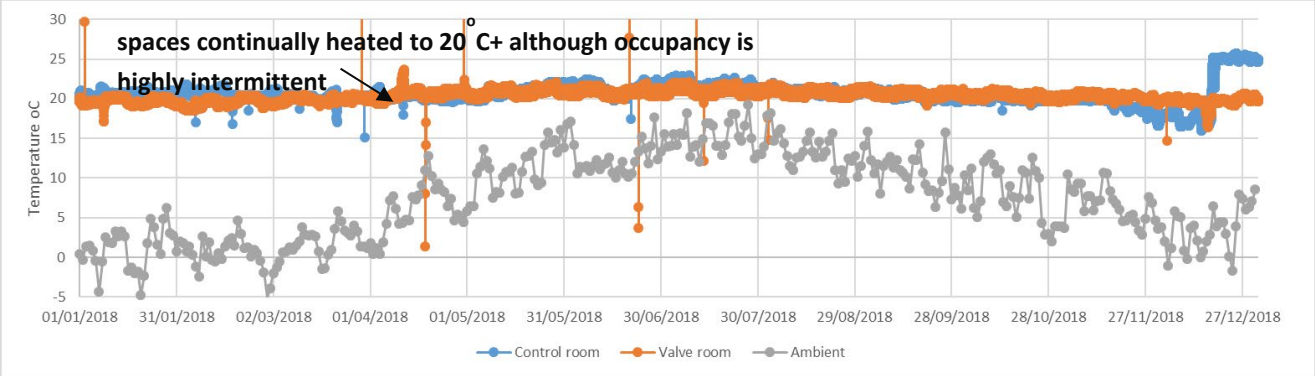


Figure 25: Temperatures in the SVC building, Tealing substation.

Subsequent analysis of heating power draws indicated that heaters remained on fixed settings for long periods of time (Figure 25). The predominant mode of heating in substations is using resistive heaters with manual control, the monitored data would indicate that heaters were being set and then left untouched for weeks or even months at a time, regardless of occupancy or outdoor temperatures – another source of energy wastage.

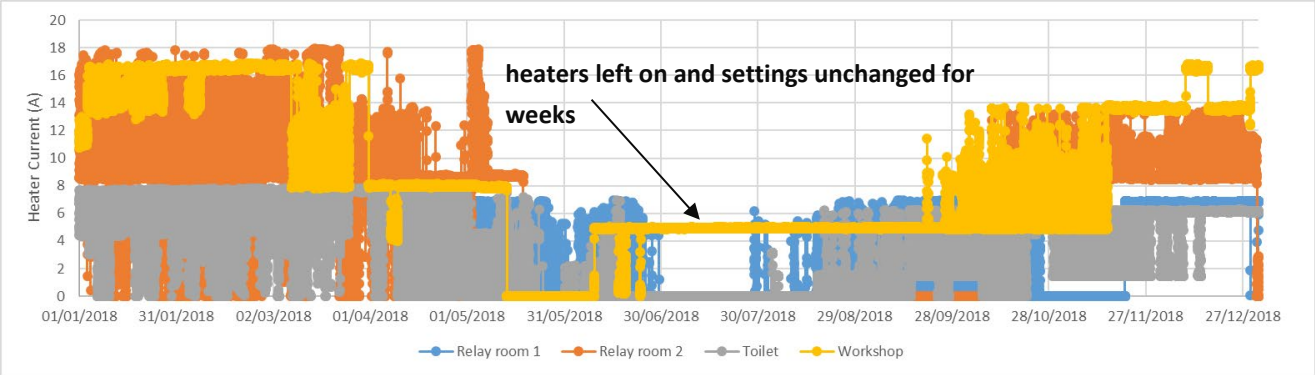


Figure 26: Monitored heater power draws, Tealing substation.

For the purposes of the base-line simulations, it was decided for the base case use heating to maintain indoor temperatures to a minimum of 15°C. This was done as (1) this temperature sits in the range indicated by the monitored data, (2) this is a temperature recommended by Ritchie (2020) for substation buildings and (3) detailed occupancy and heating set point information was unavailable for SSEN substations and consequently, no detailed, heating and occupancy schedules could be created for the archetypes. Whilst this approach does not provide a 'true' picture of the energy consumption of substation buildings, it does provide a point of reference against which to compare the effect of changes.

CLIMATE

As the simulations covered substations at locations in the North of Scotland and Southern England, models were run against two test reference year (TRY) climate data files for Aberdeen and Gatwick. These provide hourly information on temperature, solar radiation, wind speed and direction, and relative humidity for a calendar year. All of these parameters are used by ESP-r when simulating building performance. Modelling using the two distinct climate datasets allows any impacts of differing climate to be captured in the simulation results. A summary temperature data from each site is shown in Table 18.

Table 18: Summary temperature data for the two sites.

Climate station	Minimum temperature	Maximum temperature	Average
Aberdeen	-13.7	26.0	8.4
Gatwick	-5.9	31.3	10.2

BASE CASE MODEL VARIANTS

As was mentioned previously, the base case building models comprised the basic, uninsulated building structure, with a 4 air-changes-per- hour (ACH) ventilation and a minimum 15^{o}C heating setpoint. Additionally, after consultation with SSEN, a set of model variants were created, which were adapted from the base case model to account for different energy efficiency interventions. These were as follows.

- As the base case, but with replacement of single glazed windows with sealed double glazed units, this would also have the effect of reducing air leakage, so leakage rates were reduced from 4 to 3 air changes per hour.
- As the base case, but with the addition of 100mm of external insulation to the roof of the modelled buildings, again this would reduce leakage rates, which were reduced from 4 to 3 air changes per hour.
- As the base case, but with the addition of 100mm of external wall insulation to the modelled buildings, which would also reduce air leakage, which were reduced from 4 to 3 air changes per hour.
- As the base case, but with an infiltration reduction to each building (e.g. draught stripping) reducing infiltration from 4 to 3 air changes per hour, this model was developed to isolate the impact of infiltration reduction in the previous cases.
- As the base case, but with all of the insulation measures along with the reduction in infiltration .
- As the base case, but with the building set heating set point was increased to 21^{o}C; this simulation was used to assess the effect of heating control on energy use.
- Additionally, the results from the base case model were used to assess the impact of heating the buildings using air-to-air heat pumps, rather than with resistive heating.

SIMULATIONS

The key objective of the simulations was to produce data that would allow the impact of energy efficiency measures on heating energy use to be assessed. In the case of the SSEN substation buildings, the primary performance metrics of interest were energy use and emissions, consequently it was appropriate to simulate the performance of each building over a calendar year; this was undertaken using one-hour time steps – so in

each case simulated, data for 8760 time increments was generated. Typical simulation output is shown in Figure 27.

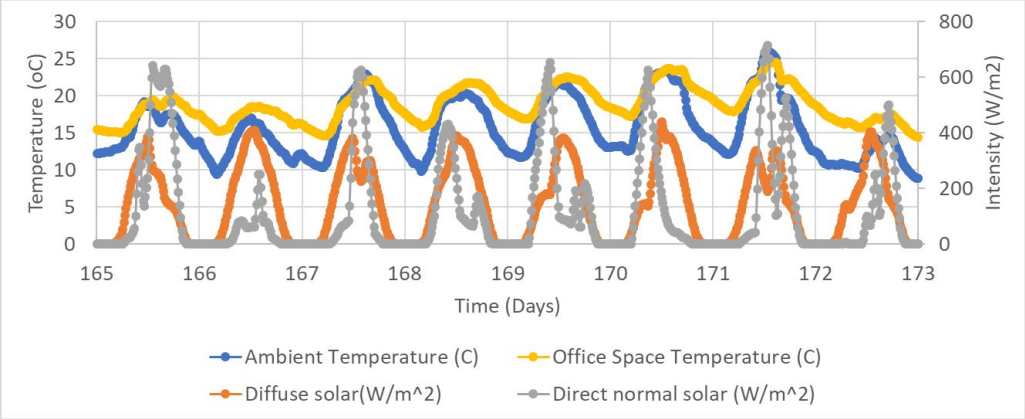


Figure 27: Simulation output for a substation room showing air temperature, outdoor temperature and solar radiation.

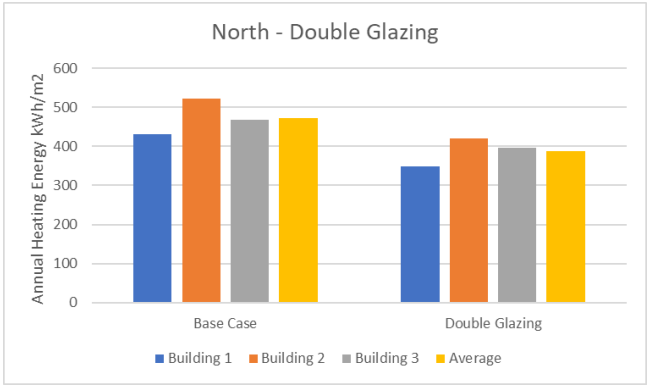
The variability in temperature shown includes the influence of weather (wind and temperature driven external air infiltration, solar gains through glazing), thermal storage and heat loss through the fabric, internal heat gains from people and equipment and the action of heating and cooling equipment. This 'raw' data can be further processed to derive other performance indicators such as heating/cooling energy use, greenhouse gas emissions, over and underheating heating hours, thermal comfort, etc.

RESULTS AND DISCUSSION

The results that follow were extracted from the ESP-r simulations of the building models. Results from both climate set simulations are shown. Note that, in order to facilitate comparison and later scaling, annual heating energy requirements were normalised to the floor area of the building modelled and so are expressed in terms of kWh/m^2. Results are shown for each of the building models, along with an average value. The average value was used when scaling up the results.

DOUBLE GLAZING

Figure 28 and Figure 29 show the effect of replacing glazing and the resulting reduction in infiltration. The figures behind all of the graphs are given in the appendices.



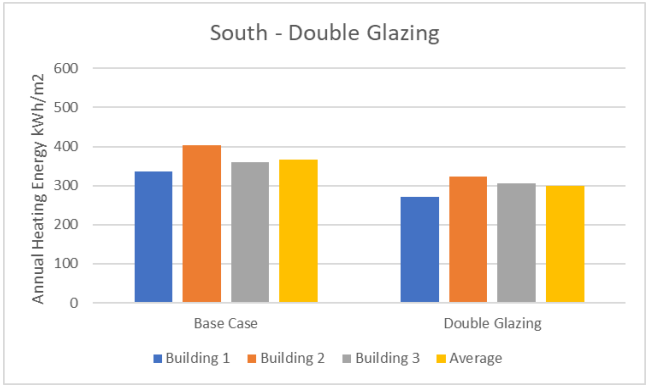


Figure 28: Impact of changing glazing – northern climate.

Figure 29: Impact of changing glazing – southern climate.

The addition of double glazing coupled with the resulting reduction in infiltration results in a reduction in heating energy requirement of 15 – 20% for all of the buildings modelled and for both the northern and southern climates.

It is also worth noting that the impact of this energy efficiency improvement is similar for all three buildings, despite the fact that they are of different sizes and room configurations.

Comparing the north and south climates, the heating energy requirement for the southern climate is approximately 75% that of the northern climate.

ROOF INSULATION

Figure 30 and Figure 31, show the effect of adding 100mm of roof insulation, with an attendant reduction in infiltration on the heating energy consumption. The heating requirement is reduced by between 27 – 32% for all of the buildings and climates modelled. Again, there is little difference in effect between the buildings modelled.

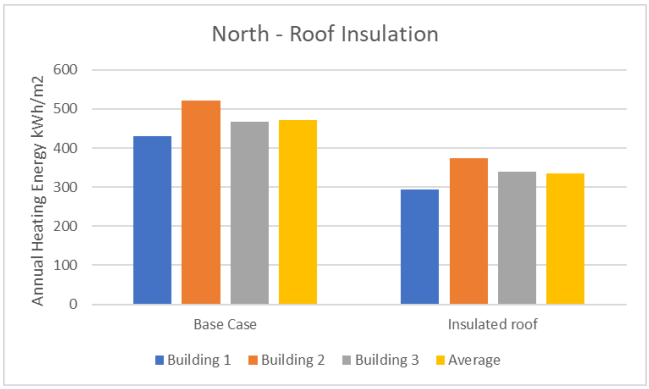


Figure 30: Impact of insulating the roof – northern climate.

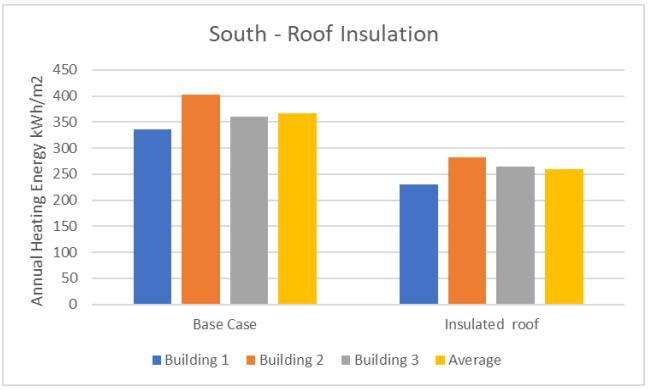


Figure 31: Impact of insulating the roof – southern climate.

EXTERNAL WALL INSULATION

The reduction in the heating energy by the addition of 100mm of external wall insulation is shown in Figure 32 and Figure 33. Heating demand was reduced by between 17 and 25% for all of the buildings and climates modelled. As with the previous two cases the reduction in demand was similar in the three buildings modelled.

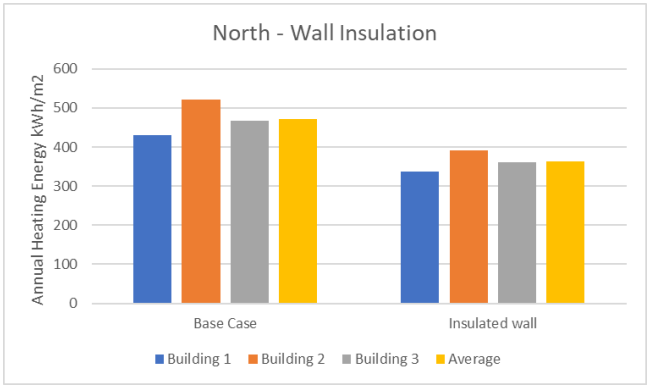


Figure 32: Impact of insulating the walls – northern climate.

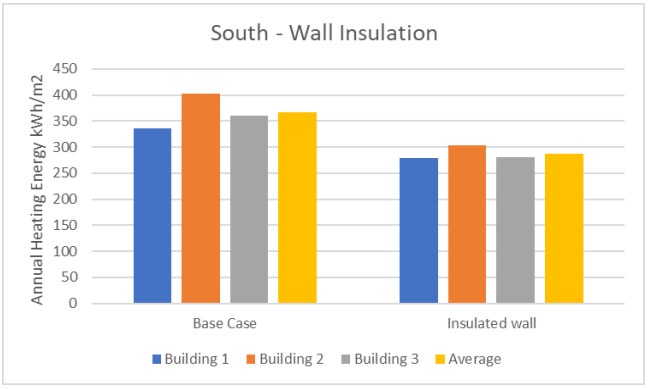


Figure 33: Impact of insulating the walls – southern climate.

INFILTRATION REDUCTION (I.E. DRAUGHT STRIPPING)

Applying only a reduction in infiltration to the models, resulted in reductions in heating energy demand of between 15 and 18% across all models and climates (Figure 34 and 35). This indicates that infiltration reduction plays a significant part in the demand reductions seen in the previous cases.

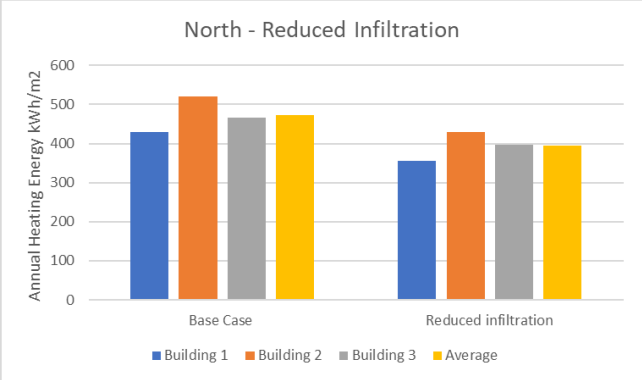


Figure 34: Impact of reducing infiltration – northern climate.

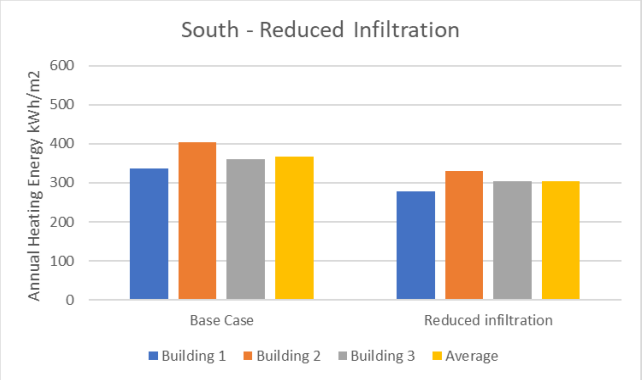


Figure 35: Impact of reducing infiltration – southern climate.

ALL INSULATION MEASURES

Applying all of the insulation measures (windows, roof, walls, infiltration) to the substation buildings, resulted in reductions in heating energy consumption of between 50-57% for all buildings and climates modelled, compared to the base case (Figure 36 and Figure 37).

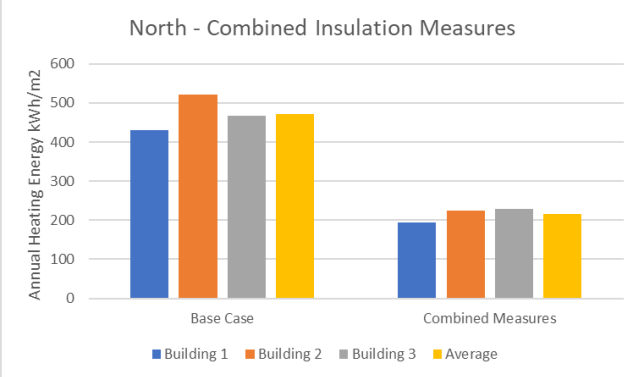


Figure 36: Impact of combined insulation measures – northern climate.

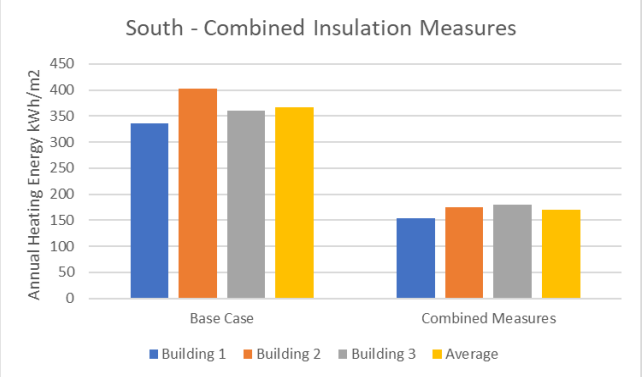


Figure 37: Impact of combined insulation measures – southern climate.

All of the previous simulations used retrofitted insulation of 100mm thickness. Additional simulations were run to assess the influence of this parameter on results. These were run for the model variant featuring both roof and wall insulation improvements, with thickness varied between 0 and 200mm. Figure 38 shows that there is a non-linear relationship between insulation levels and heat requirement, with a steep drop in heat requirement for insulation thicknesses up to 50mm. The reduction in heat demand then levels off between 50 and 100mm. With thicknesses beyond approximately 75mm providing only marginal improvements in heat demand.

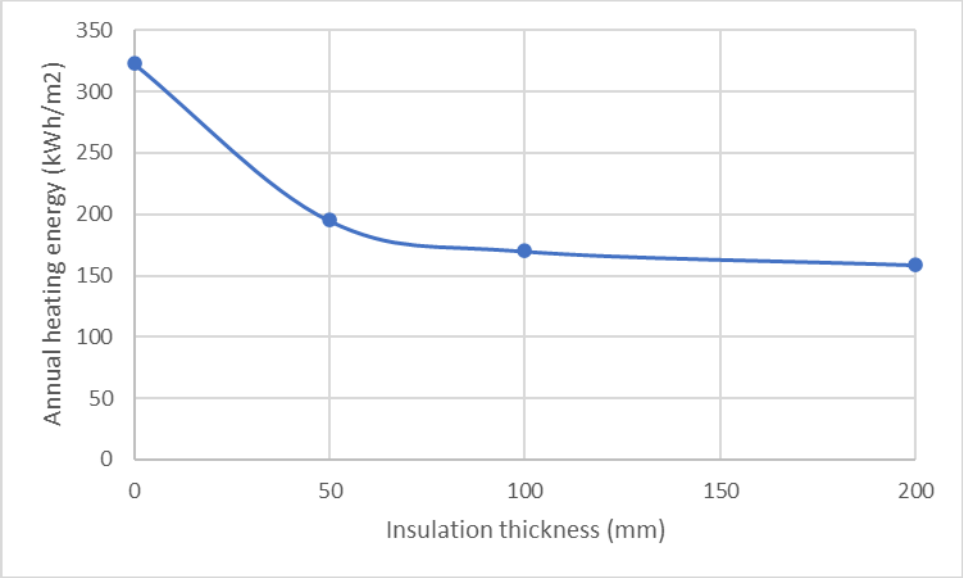


Figure 38: Reduction in heating demand with fabric insulation thickness.

There is an asymptotic heat demand in the graph above of approximately 150 kWh/m^2, this is the heat load caused by infiltration of outside air into the substation, and the only way to reduce demand beyond this level would be to reduce infiltration.

HEATING CONTROL

Given the lack of information available on occupancy and heating control settings in SSEN substation buildings, it was not really possible to estimate savings from enhanced heating control through a mechanistic simulation. Instead, a sensitivity analysis approach has been adopted, using the base case simulations and simulations where the set point temperature was increased to 21°C.

Currently in SSEN substation buildings, heating is generally manually controlled, so the duration of heating and heating level (setpoint) is entirely dependent on staff either switching off heating appliances at the end of occupied periods, and/or altering the heater output settings as outside temperatures rise and fall. Monitored data would suggest that this does not happen, with buildings heated during unoccupied periods and heating settings being untouched for long periods of time. Ritchie (2020) recommends that heaters are fitted with timer controls, which boost temperatures in occupied spaces to 20-21°C and then fall back to 15°C, after a fixed time (typically 2 hours); this avoids the problem of unoccupied spaces being heated to comfort temperatures outside periods of occupancy. Two key variables that therefore determine the degree of savings achievable from this type of control are the percentage of time buildings are occupied and the percentage of heaters that are intentionally or unintentionally left on outside occupied periods. Unfortunately, no detailed information was available providing figures for either of these parameters, though anecdotally it is likely to be that occupancy low – even in Southern substations, which are used as work bases for maintenance staff. In northern substations occupancy will be very low as staff work from depots, rather than the substation buildings.

The two temperature setpoints modelled represent two extreme scenarios – the 15°C case (E_{15}) represents no occupancy and all heaters fitted with a timer controls and setting back their output, whilst the 21°C (E_{21}) case represents heaters left on with no timer controls fitted, or continuous occupancy with spaces always heated to comfort temperatures. The likely savings accrued from heating controls would fall between these two extremes. So, a sensitivity analysis was undertaken, varying the two parameters outlined previously – the percentage of time buildings are occupied (o) and the percentage of heaters left on outside occupancy (h), each was varied between 0 and 100% in increments of 10%. The energy saving was calculated as follows:

$$E_{SAVE} = (E_{21} - E_{15})\left[\frac{h}{100} \times \left(1 - \frac{o}{100}\right)\right] \quad [1]$$

So, if o = 100% there are no energy savings as all of the spaces would be heated to 21°C this is regardless of the value of h. If o = 0% and if h = 100% the savings would be the maximum possible $(E_{21} - E_{15})$. Further, if h=0% and o=0%, again no savings are achievable as all heaters would be off (or at set back) outside occupancy. In reality, none of these extreme cases is particularly realistic so the true savings achievable from the implementation of heater control will lie somewhere in between.

The sensitivity results are shown in Figure 39.

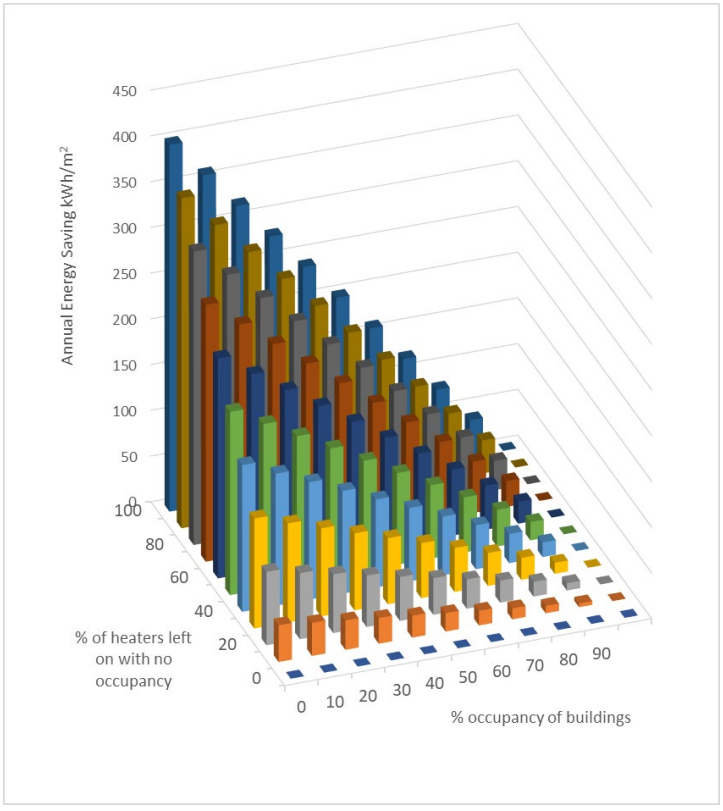


Figure 39: The energy savings from the sensitivity analysis with % occupancy a and % heaters left on without occupancy varied.

Figure 40 and Figure 41 show the annual heating energy demands (kWh/m^2) for the Northern and Southern climates with a 15°C and 21°C set points, respectively. Also shown are the mean savings from the sensitivity analysis.

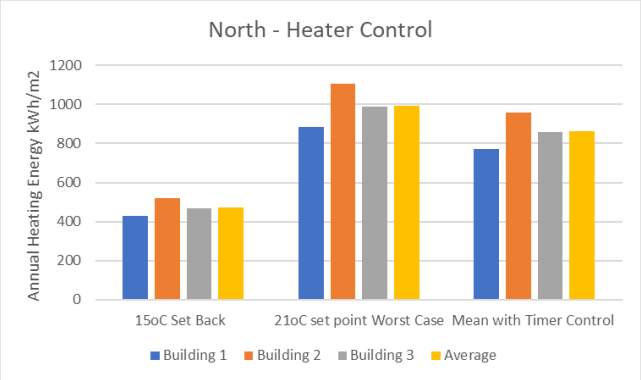


Figure 40: Base case, worst case and mean result from heater timer sensitivity analysis – northern climate.

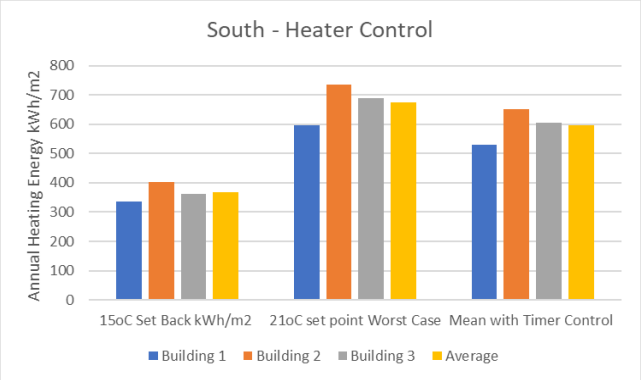


Figure 41: Base case, worst case and mean result from heater timer sensitivity analysis – southern climate.

The results show that running heaters at a continuous 21°C set point roughly doubles the heating energy use compared to the base case. The mean result from the sensitivity analysis indicates that fitting heater controls can reduce energy consumption by 25% relative to the 21°C set point case. However, as occupancy is (anecdotally) low in substation buildings, and heaters seem to be left unattended for long periods of time, actual savings could be greater than this mean figure suggests.

AIR-AIR HEAT PUMPS

The final energy efficiency measure examined was replacing the existing electrical convective heaters with air-air heat pumps, which can operate both in heating and cooling mode. A typical seasonal coefficient of performance (SCOP) of this type of heat pump is 4.5[41], although this does vary with external air temperature. The SCOP is the ratio of the useful heat delivered by the heat pump to the electricity consumed. The SCOP for an electrical convection heater is 1. Consequently an air-air heat pump will deliver the same heating effect for less than 25% of the electrical energy consumed by the electrical convection heater. Using the simulated base case results, savings of approximately 78% in heating electrical energy consumption are achievable, as shown in Figures 42 and 43.

[41] SCOP for a 20kW Mitsubishi air-air heat pump unit.

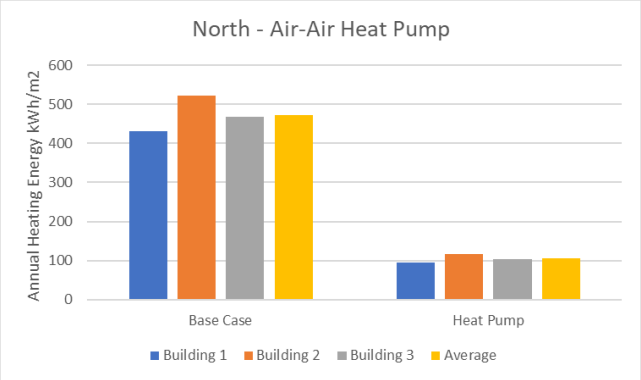


Figure 42: Base case and air heat pump annual heating energy usage – northern climate.

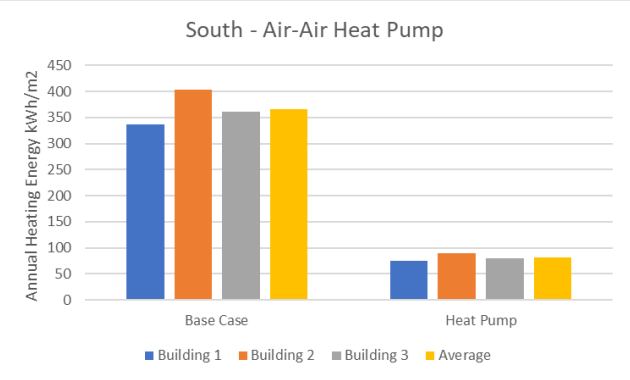


Figure 43: Base case and air heat pump annual heating energy usage – southern climate.

SCALING UP RESULTS

As the results shown previously have been normalised to provide annual heating demands in the form of kWh/m^2, the figures can be extrapolated to provide an indication of the potential impact across the substation building stock. Note however that this process involves significant uncertainties, given the many unknowns associated with the archetype models, these include occupancy, types of activities occurring in each substation, heating set points and operating times, etc. Consequently, the results presented here can provide an indication of the efficacy of energy saving measures relative to a base case, but cannot provide a 'true' picture of actual energy use and its derivatives. The two parameters considered in the scale-up, are the carbon savings and the cost savings associated with the different energy efficiency measures implemented, both of which are relative to the modelled base case.

CARBON AND COST SAVINGS

The estimation of carbon savings was based on an assumption that each kWh of grid electricity produces 0.181 kgCO_2 - 2020 figure (ReNEWS, 2020). Cost savings were estimated based on a notional unit cost of 4.8p/kWh provided by SSEN. Both cost and carbon figures are proportional, so a measure with a high carbon saving will also have a high cost saving.

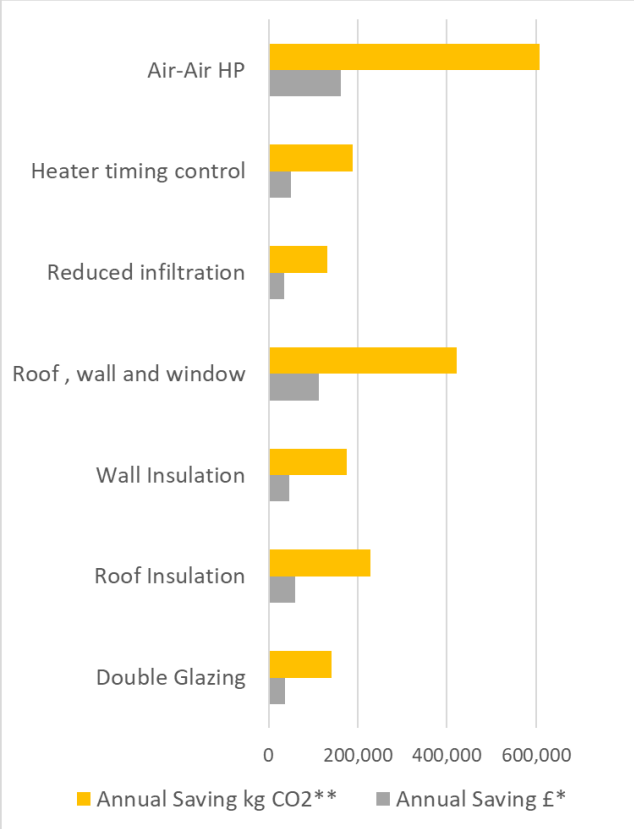


Figure 44: Estimated CO_2 and cost savings from different energy efficiency measures.

Figure 44 indicates that the most significant reduction in emissions and cost could be achieved by changing the existing electrical convective heaters to air-air heat pumps, which consume less than a quarter of the energy of the convective heaters to produce the same heating effect, saving over 600 tonnes of CO_2. Implementing all of the fabric improvement measures together also results in a substantial, notional cost and carbon saving, this is the installation of roof insulation, wall insulation, replacement of windows and a subsequent reduction in outside air infiltration. The simulation results indicate a saving of over 400 tonnes of CO_2 per annum relative to the base case across the substation stock. However, it should be noted that the cost and effort associated with each of these interventions would be substantial.

Of the individual insulation measures modelled, roof insulation appeared to be the most effective. This is due to the stratification of heated indoor air resulting in the warmest air being at trapped ceiling level and consequently heat losses for ceilings are more severe per unit area than other surfaces such as vertical walls. In the graphs shown in Figure 38, each fabric improvement measure includes an assumption that infiltration would be reduced. Implementing the infiltration reduction on its own (draught stripping) has a substantial impact on CO_2 and cost savings. It should be noted that a reason Ritchie (2020) recommend high infiltration rates, was to avoid the occurrence of surface condensation. However, there are few moisture generating processes occurring in substation buildings, so condensation in more likely to be caused by warm moist air entering from outside in summer and condensing on still cold building surfaces. A moderate reduction in infiltration, would actually reduce the severity and likelihood of occurrence of this type of indoor condensation. As noted by, Wysoglad (2019), surface condensation can also occur due to building faults e.g. rainwater or floodwater entering through gaps in the building fabric, resulting in high humidity levels due to evaporation. In this case, reducing infiltration would exacerbate indoor humidity levels and lead to a higher

risk of indoor condensation. It should be stressed, however, that the presence of liquid water in a substation building is highly undesirable condition and so this situation should be an exception.

The implementation of heater timer controls shows lesser savings compared to the impact of the combined insulation measures or roof insulation on its own. However, as was mentioned previously, the figures given are for the mean savings from the sensitivity analysis. Actual savings could be higher if (as is evidenced from monitored data) occupancy is low and heaters are left on and unattended for long periods of time. Also, the saving in this case were relative to a worst case of continual heating to 21°C, rather than the base case for energy efficiency interventions.

BENEFIT VS COST

In order to assess the most effective measures to implement in terms of their benefits against cost, indicative costs were generated for the modelled buildings and for each of the efficiency measures assessed. For comparison purposes these were then normalised by floor area. This is shown in Table 19.

Table 19: estimated and normalised costs for different energy efficiency options for the three building types modelled.

Efficiency Measure	Area m^2 or units	Cost/unit or area £	Estimated labour cost[42] £	Additional costs (e.g. scaffolding) £	Estimated Cost for modelled buildings £	Normalised Cost £/m^2 floor area
Double glazing	29.8	130 per m^2	9360 (15 days[43])	662	13,896	22.2
Roof insulation	617	80 per m^2	18720 (30 days[44])	3404	71,484	115.9
Wall insulation	1808	80 per m^2	56160 (90 days[3])	10,040	210,849	341.7
Combined					284,922[45]	506.1
Reduced infiltration	617	10 per m^2 floor area	6170 (10 days)	621	13,031	20.6
Heater control	30	225 per heater	3744 (6 days[46])	-	10,494	17.0
Air-Air heat pump	10	5000 per unit[47]	6240 (10 days[48])	-	56,240	91.2

The normalised costs can be used in conjunction with the carbon and notional cost savings to generate benefits accrued against cost metrics for both CO_2 and notional fuel cost savings. For CO_2, annual $kgCO_2$ saved per m^2 / cost £ per m^2 gives $kgCO_2$ saved annually per £ invested; and for annual cost savings £ notional fuel saving per m^2 / cost £per m^2 gives notional £ saved annually per £ invested. The estimated benefits and costs for both CO_2 and notional energy savings were extrapolated to the total substation floor area considered (10,430 m^2) and are shown in Table 20.

[42] Based on labour costs of £624/day for a 2 person crew (SSEN) and estimated time to implement change on 3 modelled buildings.
[43] Assuming ½ day per m^2 of window.
[44] Assuming 1 day per 20m^2 of insulation.
[45] Including only extra costs (scaffolding) from wall insulation.
[46] 1 heater per 20m^2 (from simulated heating requirements) and 1.5 hours installation of controls per heater.
[47] Cost for 20kW Mitsubishi air-air unit.
[48] Seasonal coefficient of performance of 4.5, approx. 1 per 60m^2

Table 20: Notional cost and CO_2 savings from energy efficiency measures.

Measure	Cost £	Annual Saving £ [49]	Annual Saving kg CO^2 [50]
Double Glazing	234,872	37,364	140,895
Roof Insulation	1,208,259	60,406	227,779
Wall Insulation	3,563,726	46,462	175,202
Reduced infiltration	5,277,539	34,815	131,280
Roof, Wall, Window & Inf.	220,248	111,983	422,270
Heater timing control	177,375	50,155	189,125
Air-Air HP	950,597	161,000	607,104

Referring to Figure 44 and Table 21, measures can be ranked by savings against cost. The greatest benefit to cost was achieved by implementing heating controls, which were cheap to implement and can produce substantial savings in heating energy use.

Table 21: Costs and savings from different measures over the entire building stock considered (10,000 m^2).

Measure	Indicative Cost £	Total $kgCO_2$ saved	Annual saving $kgCO_2$/£	Total £(notional) saved	Annual saving £(notional) /£
Heater controller	177,375	189,125	£1.07	50,155	£0.28
Air-Air Heat Pump	950,597	607,104	£0.64	161,000	£0.17
Reduced Infiltration	220,248	131,280	£0.60	131,280	£0.16
Double Glazing	234,872	140,895	£0.60	37,364	£0.16
Roof insulation	1,208,259	227,779	£0.19	60,406	£0.05
Combined	5,277,539	422,270	£0.08	111,983	£0.02
Wall insulation	3,563,726	175,202	£0.05	46,462	£0.01

[49] Electricity cost = £ 0.48/MWh
[50] Carbon intensity of electricity = 0.181 kg/kWh

The replacement of resistive heaters with air-air heat pumps, replacement of double glazing and reduction of infiltration had similar levels of benefit-to-cost. The benefit-to-cost of wall and roof insulation measures was deemed to be low, mainly because these measures involved external insulation. Fitting insulation is labour intensive and also invited additional costs such as scaffolding.

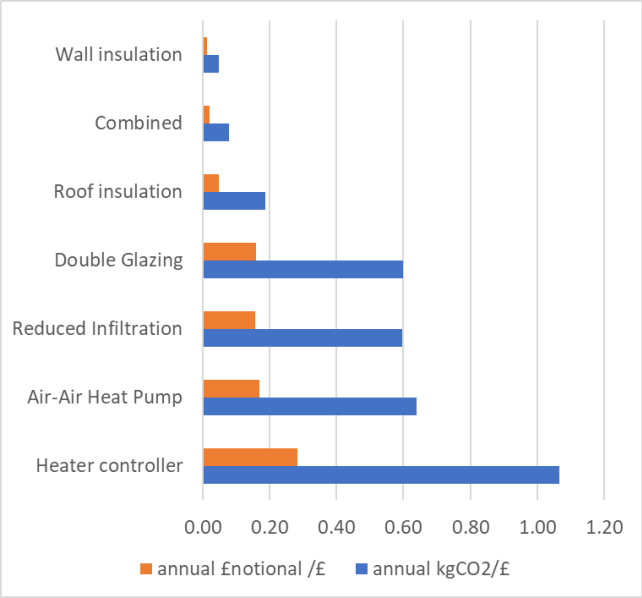


Figure 45: Saving (either kg CO_2 or notional £) against cost for different energy efficiency measures (ranked lowest – highest).

CONCLUSIONS

A base line building simulation model has been developed that attempt to capture the typical characteristics of SSEN's smaller substation buildings. This model has been used to generate base case heating energy use data against which the efficacy of different energy efficiency measures can be gauged. The model's performance was simulated using a northern and southern climate data set, with the northern simulation using 25% more heating energy than the southern case.

A range of model variants were created, each of which represents an energy efficiency improvement that could be implemented in SSEN's substation stock. These were: double glazing, roof insulation, wall insulation, draught proofing to reduce infiltration, all insulation measures combined, heater control and the replacement of resistive electric heating with air-air heat pumps.

The performance of the base case models and variants was simulated over a calendar year and heating energy use extracted from the simulation results. This was then normalised per unit floor area so that the results could be scaled. The substation stock floor area to which the results were scales was approximately 10,400 m^2.

The key metrics examined were notional[51] cost savings from reduced heating energy demand, based on an assumed cost of energy of £48/MWh, and CO_2 savings based on a carbon intensity of 0.181kg/kWh for grid electricity. The simulation results for both the northern and southern climates were similar and so the conclusions drawn here are valid for both.

In terms of CO_2 and cost savings, the most effective measure to implement was the replacement of the resistive heating with air-air heat pumps. When scaled, this saved over 600 tonnes of CO_2, and £160K per annum, relative to the base case. The next best measure was a radical improvement to the substation building fabric, with replacement windows, roof and wall insulation and reduced infiltration. This saved over 420 tonnes of CO_2 and over £110K per year relative to the base case.

Using data from SSEN, a set of indicative costs were generated for each energy efficiency measure, based on the three buildings included in the building simulation model. These costs were then normalised per unit floor area in order to generate a benefit to cost metric for each energy efficiency intervention. For CO_2 savings this was the annual $kgCO_2$ saved per £ spent on the measure and for notional costs this was £ saved in notional heating costs per £ spent on the measure.

The most costly measure was estimated to be the implementation of all the insulation measures combined, costing £5.3 M for all of the substation stock considered (10,000 m^2). The cheapest was the installation of heater timing controls at £177K for the whole stock.

In terms of cost-benefit, the most effective measure was fitting timer controls to existing heaters. However, it should be noted that the figure was based on the mean saving from a sensitivity analysis. Actual savings due to the implementation of heater control may well be higher than those indicated in this report.

[51] Substation electricity use for heating is unmetered, so any financial savings from energy efficiency are notional.

The next-best measures in terms of benefit to cost were the replacement of existing heaters with heat pumps draught stripping and replacement of the existing glazing with double glazing (assuming in both cases that these measures would also reduce unwanted infiltration by 25%).

Finally, it should be pointed out that all of the figures presented in this report are subject to considerable uncertainty and savings are expressed relative to an assumed base case. Whilst this provides a useful measure against which to gauge the efficacy of a particular energy efficiency intervention it does not provide a 'true' picture of the likely energy use or saving. Ideally simulation models would be calibrated using measured data prior to their use. In this project timescales and budgets rules this out and consequently a large number of assumptions were made regarding building form and fabric, building use and occupancy, heating use and control, air infiltration and heat gains. Additionally, all of the costs used in this report are estimates. Further investigation should be undertaken to verify the assumption underpinning this study prior to implementing any energy efficiency measure.

REFERENCES

Baker J R (2020), 66 kV and 132 kV Substations - Particular Requirements for Distributed Generation- Design and Installation Standard. SSEN Report TG-NET-SST-034.

Bayliss C R and Hardy B J (Eds) (2012) Transmission and Distribution Electrical Engineering (4th Ed), Newnes, Pages 189-228,vISBN 9780080969121, https://doi.org/10.1016/B978-0-08-096912-1.00007-1.

Bezusko E (2020), Primary Distribution Substations: Common Clauses - Design and Installation Standard, SPEN Report PR-NET-SST-005.

Clarke J A (2001), Energy Simulation in Building Design, Butterworth-Heinemann, Oxford.

Corr E (2020), Substation Environmental Condition Profiling Assessment, PNDC Report, PNDC/TAM-010/FR-01.

ESRU (2021), ESP-r Modelling Software, Available at: **https://www.strath.ac.uk/research/energysystemsresearchunit/applications/esp-r/** Accessed (18/05/2021).

Monari F (2016) 'Sensitivity Analysis and Bayesian Calibration of Building Energy Models', PhD Thesis, University of Strathclyde.

ReNEWS, (2020) '2020 'greenest' year for UK electricity', Online Article, 31/12/2020, Accessed, 16/05/2021.

Ritchie C, (2020) General specification for the civil engineering and building design and construction of primary and 33kv switching substations, SPEN Report SUB-03-025, Issue 4.

SSEN (2020a), Record of Visual Inspection of Substation Roofs – Ridegeway Region, Dorcan Substation, Survey Report.

SSEN (2020b), Record of Visual Inspection of Substation Roofs – Ridegeway Region, Harefield Substation, Survey Report.

Strachan, P. A., Kokogiannakis, G., & Macdonald, I. A. (2008). History and development of validation with the ESP-r simulation program. Building and Environment, 43(4), 601-609.

White N, Piesciorovsky E C (2010), Heat Gain from Electrical and Control Equipment in Industrial Plants, ASHRAE Transactions, Vol. 116, Part 2.

Wysoglad M. (2019) Ventilation of Substation Buildings an Example of Hunston and Brockhampton Substations, SSEN Report 26 pages.

APPENDICES

CALCULATED ENERGY SAVINGS FROM SIMULATIONS

Table 22: Annual heating electrical energy use, base case vs double glazing.

North	Base Case (kWh/m^2)	Double Glazing (kWh/m^2)	Change %
Building 1	430	348.6	-18.9
Building 2	521	419.7	-19.4
Building 3	467	396.2	-15.2
Average	473	388	-17.9

South	Base Case (kWh/m^2)	Double Glazing (kWh/m^2)	Change %
Building 1	336	271	-19.3
Building 2	403	323.3	-19.8
Building 3	361	305.2	-15.5
Average	367	300	-18.2

Table 23: Annual heating electrical energy use, base case vs insulated roof.

North	Base Case (kWh/m^2)	Insulated Roof (kWh/m^2)	Change %
Building 1	430	293	-31.9
Building 2	521	375	-28.0
Building 3	467	340	-27.2
Average	473	336	-28.9

South	Base Case (kWh/m^2)	Insulated Roof (kWh/m^2)	Change %
Building 1	336	230	-31.5
Building 2	403	282	-30.0
Building 3	361	264	-26.9
Average	367	259	-29.5

Table 24: Annual heating electrical energy use, base case vs insulated wall.

North	Base Case (kWh/m²)	Insulated Wall (kWh/m²)	Change %
Building 1	430	336.7	-21.7
Building 2	521	390.7	-25.0
Building 3	467	360.2	-22.9
Average	473	363	-23.3

South	Base Case (kWh/m²)	Insulated Roof (kWh/m²)	Change %
Building 1	336	279.5	-16.8
Building 2	403	303.1	-24.8
Building 3	361	280.1	-22.4
Average	367	288	-21.6

Table 25: Annual heating electrical energy use, base case vs reduced infiltration.

North	Base Case (kWh/m²)	Reduced Infiltration (kWh/m²)	Change %
Building 1	430	356.2	-17.2
Building 2	521	429.2	-17.6
Building 3	467	396	-15.2
Average	473	393.8	-16.7

South	Base Case (kWh/m²)	Reduced Infiltration (kWh/m²)	Change %
Building 1	336	277.5	-17.4
Building 2	403	331	-17.9
Building 3	361	305	-15.5
Average	367	305	-17.0

Table 26: Annual heating electrical energy use, base case vs combined insulation measures.

North	Base Case (kWh/m²)	Double Glazing (kWh/m²)	Change %
Building 1	430	195	-54.7
Building 2	521	224	-57.0
Building 3	467	228	-51.2
Average	473	216	-54.4

South	Base Case (kWh/m²)	Double Glazing (kWh/m²)	Change %
Building 1	336	154	-54.2
Building 2	403	175	-56.6
Building 3	361	179	-50.4
Average	367	169	-53.8

Table 27: Annual heating electrical energy use with differing heating set points and average from sensitivity.

North	15°C Set Back (kWh/m²)	21°C Worst Case (kWh/m²)	Mean with Timer Control kWh/m²
Building 1	430	885	771.25
Building 2	521	1106	959.75
Building 3	467	987	857
Average	473	993	862.67

South	15°C Set Back (kWh/m²)	21°C Worst Case (kWh/m²)	Mean with Timer Control kWh/m²
Building 1	336	596	531
Building 2	403	735	652
Building 3	361	688	606.25
Average	367	673	596.42

Table 28: Annual heating electrical energy use with base case vs air-to-air heap pump.

North	Base Case (kWh/m²)	AAHP (kWh/m²)	Change %
Building 1	430	95.6	-77.8
Building 2	521	115.8	-77.8
Building 3	467	103.8	-77.8
Average	473	105.0	-77.8

North	Base Case (kWh/m²)	AAHP (kWh/m²)	Change %
Building 1	336	74.7	-77.8
Building 2	403	89.6	-77.8
Building 3	361	80.2	-77.8
Average	367	81.5	-77.8

APPENDIX F: OFGEM'S MINIMUM REQUIREMENTS

The Table below provides details of where in the Annex Ofgem's minimum requirements are discussed.

	Ofgem minium requirement	Where and how this is addressed in narrative
3.33	Submitting an Environmental Action Plan (EAP) is a minimum requirement under Stage 1 of the BPI. An EAP in the Business Plan should encompass activities DNOs intend to undertake in RIIO-ED2 to decarbonise the electricity distribution network and to reduce the wider impact of network activity on the environment. As a minimum requirement under Stage 1 of the BPI, a DNO's EAP must:	
3.33.1	include a methodology that has been used to assess the environmental impacts of the company's network and Business Plan in RIIO-ED2. The assessment methodology must set out:	Our EAP assessment methodolgy is discussed in Section 5. It covers the environmental impact our business has today and the potential risk for the future. Our EAP scope and outputs are discussed in Section 6.
(a)	a review of the significant environmental impacts arising from its network activity.	These are discussed in Sections 3 & 6.
(b)	the opportunities and challenges for addressing material impact areas.	Managing our environmental impact is discussed in Section 10.
(c)	an options analysis to identify the value for money of initiatives to reduce its environmental impact.	Options analysis and modelling is discussed on Section 5.
(d)	evidence that consideration of impacts was coordinated with the company's wider business planning processes and decisions.	This is also discussed in Section 5.
(e)	evidence that wider stakeholders have been involved in the assessment.	Our stakeholder engagement activities, including involvement in our assessment methodology, are discussed in Sections 2 & 7.
3.33.2	clarify the DNO's long-term overall targets/objectives for the network's environmental impacts, beyond the RIIO-ED2 period.	These are discussed in Section 10.

	Ofgem minium requirement	Where and how this is addressed in narrative
3.33.3	inlude an assessment of the network's potential environmental impacts in RIIO-ED2 without intervention, in comparison to its current impacts.	Section 3.2 discusses the impact on the environment if we undertake no interventions.
3.33.4	set out the role the company envisages playing in supporting the low carbon energy transition.	This is discussed throughout the Annex. In particular, see our Executive Summary and Section 2.
3.33.5	set out the deliverables, outputs and environmental benefits the company proposes to deliver from implementing the EAP.	Our outputs table in section 6 outlines the deliverables, outputs, and environmental benefits that we intend to deliver from implementing the EAP. Section 8 goes through them in further detail.
3.33.6	set out clear links between the impact areas it has prioritised in the EAP, the deliverables and targets in RIIO-ED2, and how these are linked to the company's long-term environmental targets/objectives.	These are discussed in Section 10.
3.34	We expect that EAPs will draw together the direct carbon impacts claimed in any relevant Engineering Justification Papers (EJPs) and Cost Benefit Analysis (CBA) submissions (for example losses, Electric Vehicle fleet) and will include a list of all such submissions where:	All relevant EJPs are referenced in the individual sub-sections of Section 8.
3.34.1	carbon reduction is the main driver of the proposal.	
3.34.2	carbon reduction contributes to a substantial part of the benefits claimed by the projects.	
3.35	In developing their EAPs to meet the minimum requirement of Stage 1 of the BPI, companies must ensure their actions to address the specific activities in scope of the EAP demonstrate a level of ambition in line with the respective baseline expectation. The activities in scope and baseline expectations are outlined in Appendix 3.	Section 8 of the Annex provides the deatail of how we meet Ofgem's minimum requirements for each activity:
	Business carbon footprint (BCF)	Meeting the minimum requirements for BCF is discussed at Section 8.2.
	Ofgem minium requirement	Where and how this is addressed in narrative

	Sulphur Hexafluoride (SF_6)	Meeting the minimum requirements for SF_6 is discussed at Section 8.4.
	Losses	Meeting the minimum requirements for Losses is discussed at Section 8.3.
	Embodied carbon	Meeting the minimum requirements for embodied carbon is discussed at Section 8.10.
	Supply chain management	Meeting the minimum requirements for supply chain management is discussed at Section 8.9.
	Resource use and waste	Meeting the minimum requirements for resource use and wase is discussed at Section 812.
	Biodiversity/natural capital	Meeting the minimum requirements for Biodiversity and natural capital is discussed at Section 8.5
	Fluid-filled cables (FFCs)	Meeting the minimum requirements for FFCs is discussed at Section 8.6
	Noise pollution	Meeting the minimum requirements for noise pollution is discussed at Section 8.11.
	Polychlorinated Biphenyls PCBs)	Meeting the minimum requirements for PCBs is discussed at Section 8.14.