SP ENERGY NETWORKS

Distribution Environmental & Innovation Report

April 2021 – March 2022

Contents

Executive summary

In this, our seventh Environmental and Innovation Report, we provide an overview of our environmental and innovation performance and give progress updates on our RIIO-ED1 commitments.

This year has presented unique challenges and opportunities for the UK energy sector. In 2021/22, as we continued to recover from the impacts of Covid-19 and settle into new ways of living and working, numerous global events have highlighted that we must continue to accelerate the transition to a Net Zero Carbon energy system.

SP Energy Networks (SPEN) provides a critical service, and over the course of 2021/22 we worked tirelessly to ensure our network operates safely and reliably to deliver electricity to the 3.5 million customers spread across our SPD and SPM licences. As part of our RIIO-ED1 work programme, and as we begin to look towards RIIO-ED2, SP Energy Networks continues to plan the development of our network to ensure that we service all of our customers, with a particular focus on those most vulnerable.

Further to this, we also play a vital role in supporting the transition to a Net Zero Carbon energy system and achieving the UK Government's goal of achieving Net Zero Carbon by 2050. COP26, held in Glasgow in November 2021, sent out a call to action to Governments and businesses alike that we can no longer afford to rest on our laurels when it comes to climate action and decarbonisation of the energy system. We were incredibly proud to play our part in welcoming the world to Glasgow for the landmark conference, taking the opportunity to highlight a number of innovative projects to stakeholders, including our Net Zero Carbon substation, which operates free of the polluting gas sulphur hexafluoride (SF_6).

We must balance our role supporting the green revolution with our ambition to lead by example. We are committed to becoming a fully sustainable networks business, and will play our part in enabling societal decarbonisation whilst ensuring our activities have a net positive impact on people and planet. We are proud to be leading the way towards a Net Zero Carbon future, and this report highlights our ongoing work to manage the network and its impacts, deliver network improvements and enable the connection of low carbon technologies, whilst demonstrating our progress on all aspects of sustainability.

SP Energy Networks have now set targets validated by the Science-Based Target initiative to achieve Net Zero Carbon by 2035, in line with the latest climate science to ensure global warming is limited to 1.5°C above pre-industrial levels.

In 2021/22 we achieved a 56% reduction in our combined (SPD and SPM) carbon footprint, excluding losses, compared to our 2013/14 baseline, putting us firmly on track to reach our target of an 80% reduction by 2030. In addition to this, we have seen dramatic decreases in emissions associated with business travel, partially due to changes due to Covid-19 and partially due to behaviour change across our business. We also continued to drive forward innovations to implement sulphur hexafluoride (SF_6) free technologies. We also recognise that a resilient, forward-thinking business needs a supply chain to match, so we have begun working more closely with our supply chain to ensure that they too are supported to set their own Net Zero Carbon targets.

During the 2021/22 reporting year, we have introduced another 11 electric vehicles to our fleet of pool cars. This brings our electric vehicle fleet to 33 in Distribution. Since the start of RIIO-ED1, we have installed 53 charging points for Electric Vehicles at our Depots and Offices.

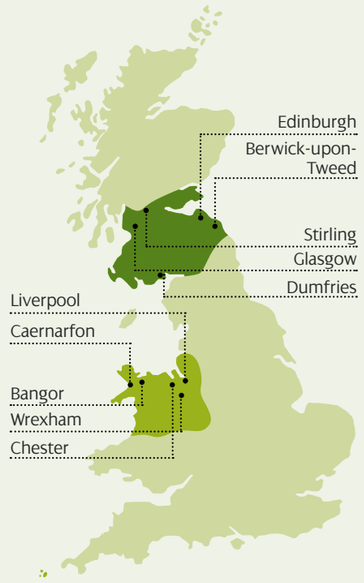
It has certainly been a busy year, but we will continue to strive to work collaboratively to speed up our transition to Net Zero Carbon, within our own organisation and across society. We welcome your feedback on the information included as part of this report, which is invaluable as we look to deliver our vision to become a fully sustainable networks business.

Figure 1 – Our Sustainability Drivers

Who we are

SP Energy Networks own and operate three regulated electricity network businesses in the UK: SP Transmission plc (SPT), SP Distribution plc (SPD) and SP Manweb plc (SPM).

Figure 2 – SP Energy Networks Distribution Licence Areas



SP Manweb
1.5 million customers

SP Distribution
2 million customers

This report focusses on our two distribution licences, SPD and SPM only. Further information on our Transmission licence, SPT is available on our website. The SP Distribution network area in central and southern Scotland covers an area of almost 23,000km^2, whilst the distribution network SPM, in North Wales, Merseyside, Cheshire, and North Shropshire covers approximately 12,000km^2. SP Energy Networks is part of the Iberdrola Group – a Dow Jones Sustainability Index and Global 100 listed company.

As a Distribution Network Operator (DNO) our role is to maintain, operate and invest in our Distribution Network to secure a safe, reliable and economic service to 3.5 million homes and businesses in our licence areas, regardless of who they pay their bill to (please see **Figure 3** overleaf). In our licence areas, we are the point of contact for all enquires relating to the electricity network. The safety and security of electricity supply is paramount to our operations.

Within this context of maintaining existing assets, we are continually expanding our network to support the connection of new low carbon generation as part of the transition to the low carbon economy whilst also reducing our environmental impact. We are undertaking a network renewal programme involving the renovation or creation of new substations and the rebuilding of hundreds of kilometres of overhead lines and underground cables.

During planning and completion of these works, our activities must meet the requirements of Government policies and legislation. We also have a responsibility to stakeholders to ensure a consistent and secure supply of electricity as we deliver our vision of sustainability whilst also aligning with SPEN's strategic pillars. We have been continuously certified to ISO 14001 since 1997 and successfully achieved recertification to ISO14001:2015 in October 2018.

We recognise that in the undertaking of our role as distributors of electricity we will impact upon the environment in a variety of ways, from the energy losses that occur in our equipment to the visual impact of our assets in the landscape. In fulfilling our ambition to be a sustainable networks business, we strive to integrate fair and responsible environmental practices with socio-economic considerations. As a company, our reputation for excellence is valued and respected among stakeholders. SPEN employs approximately 3,000 people directly, around 2,500 contractors, and supports tens of thousands more jobs in our supply chain. By working together, we are delivering our goals to reduce our environmental impact in areas such as Carbon, Waste and Water (see **Table 1** overleaf). SPEN recognises the importance of acting responsibly towards the environment and we strive to maintain our reputation for doing so, enhancing it wherever we go.

SPEN's Strategic Pillars

Be the trusted partner for our customers, communities and stakeholders

Develop a safe, secure and resilient network that's ready for Net Zero Carbon

Innovate to ready our business for a digital and sustainable future

Who we are
continued

Figure 3 – Our Business

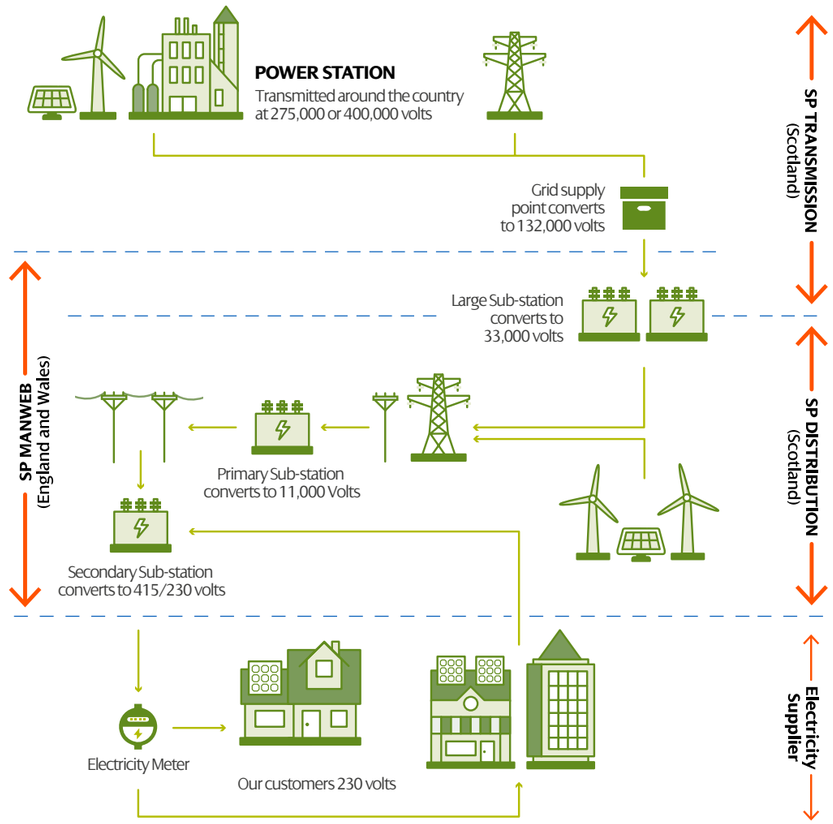


Table 1 – Key Goals and their Rationale

	Carbon and Energy Reduction	Sustainable Resource Use	Water Efficiency and Protection
2023	*Carbon Neutral Scope 1 & 2 excluding losses (pending RIIO-ED2 Draft Determination)*	*Divert 95% of waste from landfill*	*-10% in water use**
2030	*-80% carbon footprint**	*100% waste recycled or re-used*	*-25% in water use**
2035	*67% reduction across all scopes in line with 1.5°C Science Based Target trajectory*		
2040		*Zero waste*	
2050			*-50% in water use**
Rationale	Essential to meeting global and national CO_2 reduction targets.	Essential to meeting landfill diversion targets particularly in Scotland where the Scottish Government has Zero Waste Strategy target of 5% to landfill by 2025.	Climate change models forecast reduced summer rainfall putting pressure on scarce water resources. Treating water to potable standards and transportation of water is costly and uses energy.

*Targets from a 2013/14 baseline (carbon footprint target excluding losses).

Purpose of this Report

We play a critical role in the Low Carbon Transition, efficiently managing and developing our network to support our stakeholders in meeting UK and devolved Government carbon reduction targets.

We also seek to reduce our own impacts, aiming to achieve neutral or positive environmental and social impacts from our direct operations.

Our RIIO-ED1 Business Plan for 2015–2023 set out our goals and targets to reduce the impacts of our network in these key areas (please see **Table 2** below). The delivery of these commitments is realised primarily through capital investment and innovation activity.

This report provides stakeholders with a transparent account of our commitment to environmental matters and a progress update on the delivery of these commitments. The report also updates stakeholders on the continuing development of our Sustainable Business Strategy and the other progressive changes we are making in pursuit of becoming a sustainable networks business (please also see Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary).

Table 2 – Business Plan Commitments

Managing our Environmental Impact	Reducing Carbon Impact and Climate Change and associated environmental improvements	Our role in the Low Carbon Transition
Underground 85km of Overhead Lines in Areas of Outstanding Natural Beauty.	Reduce our carbon footprint (excluding network losses) by 15% by 2023.	Connect 4.5GW of Distributed Generation by 2018 with 5.5GW of generation connected to our network by 2023.
Reduce oil leaks by 50% through replacement of poorly performing 132kV cable in SPM.	Use electronic vehicle management system to optimise our vehicle utilisation keeping vehicle numbers, broadly similar in RIIO-ED1.	Identify Low Carbon Technology hotspots using network monitoring data from Smart Meters and Stakeholder Engagement.
Install oil containment around all new and high risk plant containing high volumes of oil.	Utilise low carbon alternatives to travel, through the use of technology and smarter ways of working.	Utilise Smart technology to ensure all generation sources are supported quickly.
Engage on the environmental impacts of our developments from a very early stage.	Increase the use of electric vehicles and charging points.	Reduce costs to customers by developing modern "Smart Grid" network solutions.
	Monitor and reduce energy used within our substations, invest in lower carbon buildings and reduce energy use in existing buildings.	
	Install lower loss transformers to reduce losses by 50% at more than 1,100 of our secondary substations.	
	Carry out "Smart" asset replacement – using future proofed assets where justified.	
	Exceed the IEC international standards for SF_6 switchgear by specifying a maximum leakage rate five times more stringent for 33kV and below, and twice as stringent for higher voltages.	

Stakeholder Engagement

Stakeholder engagement is central to everything we do. Our inclusive and proactive approach means we have a broad range of stakeholder contributions to our business plans, strategies and projects from the outset and throughout.

Stakeholder engagement is at the heart of everything we do. All of our strategies and businesses plans are developed in collaboration with our stakeholders, and we continue to engage throughout their duration to ensure our activities and approaches meet expectations. Our engagement strategy is driven by our CEO and Executive Team, supported by the Central Stakeholder Engagement Team and embedded across our entire organisation, regardless of the engagement topic.

Engaging in an effective and meaningful way means stakeholder feedback shapes our business decisions from Board level to our operational teams, with every decision we make aligning to our overarching strategic goals as guided by our customers and stakeholders. Together, we will ensure our efforts and investments are producing meaningful outcomes for a sustainable network and a better future, quicker.

Our strategic priorities as a business are developed through extensive engagement with our customers and stakeholders to ensure we are delivering a business in line with their needs and preferences. These priorities flow through everything we do, providing key focus and strategic direction to all our activities and business decisions and are directly embedded across our entire organisation.

We continue to align our stakeholder engagement strategy with the Stakeholder Engagement Standard AA1000 set by AccountAbility, the owners of the global standard. Every year we are audited against this standard, supporting our efforts to assess, design and implement our integrated approach to stakeholder engagement. It involves providing material evidence and detailed interviews with employees across 10 areas of the business from Directors to external stakeholders. This year we scored 85% (Advanced), holding our place in the highest categorisation possible and in the top 10% of companies assessed globally. This demonstrates our strong commitment to stakeholder engagement and our efforts to embed engagement into our organisational strategy, governance and operations.

This year we further enhanced our stakeholder engagement strategy to maximise the value of our engagement activities whilst adapting to new online methods ensuring our engagement programme continued throughout the pandemic. Our strategy was agile enough to overcome a number of challenges, helping us shape new ways of working to ensure the pandemic didn't halt our commitment to proactive engagement with our stakeholders.

For full details of our stakeholder engagement strategy, see: https://www.spenergynetworks. co.uk/userfiles/file/SPEN_Stakeholder_Engagement_Strategy.pdf

Our robust embedded engagement model enables every team in our business to identify and engage with stakeholders to understand their needs and preferences.

This is underpinned by a strong annual programme of core engagement that looks at the strategic issues facing our stakeholders and legitimises top-down changes in our strategic approach.

For a summary of past and upcoming events, see: https://www.spenergynetworks.co.uk/pages/stakeholder_events.aspx

Managing Our Environmental Impact

Managing Our Environmental Impact
Introduction

Our vision is to be a sustainable networks business, embedding the principles of sustainability in our decision making to efficiently manage and develop our network in support of the low carbon transition and to achieve neutral or positive environmental and social impacts.

Key to this is our robust Sustainable Business Strategy, which supports our progression towards:

- Net positive impact on the environment and the communities in which we operate;
- Protecting and continually enhancing the biodiversity around our assets, and in support of national and local strategies; and
- Incorporating the principles of Natural Capital Assessment in our decision making processes to ensure that levels of natural assets are at least protected, if not enhanced.

Environmental compliance underpins the delivery of all of our strategic aims. We have held continuous compliance with ISO14001 since 1997 and in October 2021 we achieved recertification to ISO14001:2015. To achieve this we continued to focus on our Environmental Aspects and Impacts and improved the controls for the environmental risks from our activities. These measures allow us to continuously improve our environmental performance and to meet our targets. In 2021 and 2022, our Depots are being reviewed for the pollution prevention arrangements in place, ensuring that we have the necessary controls and resources available for day to day operations and for responding to incidents. We continue to use the reporting tool, Cintellate/EHS360 to assist in measuring and driving compliance for Health, Safety and Environmental issues. Cintellate/EHS360 is used to record environmental incidents and to track the actions taken to resolve issues, such as actions arising from audits, together with details of any intervention by an environmental regulator, where relevant. The data is then collated by our central Sustainability Team and provided to the relevant business areas in easy to read graphs and pie charts. The data is further used to present and discuss specific trends at monthly director-level meetings to ensure lessons learned can be shared across the business.

Since their introduction in 2014, our Sustainability Drivers have underpinned our strategy for managing our environmental impact and delivering wider sustainability. The introduction of Driver Icons in 2016 has enabled us to communicate the drivers and their associated objectives to a broad audience, enabling improved understanding and greater recognition of environmental and sustainability successes.

The Driver Icons are presented in **Figure 5**. Several of our Drivers are connected to reducing our environmental impacts, helping us to focus on key biodiversity, land, waste minimisation and water outcomes and driving our progress year on year. In this first section of the report, we will focus on how we manage our environmental impact through visual amenity initiatives and the management of oil leakage. For more information on enhancing biodiversity, please see Biodiversity within Other Environment Related Activities. We have continued to provide environmental training courses, either in electronic form or trainer led, on the key environmental topics for our workforce. New courses have been added in the past year and we continue to review our training needs and expand our course content as required. As these courses are key environmental activities, we track the completion of the planned training and report it to our colleagues throughout the business along with the other environmental metrics that we track and report on. In the past year we have also reinforced our training by including environmental personal goals and producing an environmental roles and responsibilities document to further guide staff on their environmental responsibilities.

bsi. ISO 14001:2015 Environmental Management

Figure 5 – Sustainability Drivers

Visual Amenity

Historically, distribution networks in the UK have been constructed using overhead lines, taking the most expedient route towards electricity consumers.

We have over 38,000km of overhead lines supported on over 607,000 poles and towers across our operating area. Some of these assets are located in or adjacent to protected sites such as National Parks, Areas of Outstanding Natural Beauty (AONB) and National Scenic Areas (NSA) as these areas have become designated in the passage of time. These overhead lines may impact upon the visual amenity of the sites and visitors enjoyment of them.

A fund is available to network operators for mitigating visual impacts associated with pre-existing electricity distribution infrastructure by removing selected overhead lines and replacing them with underground cables.

Using this fund, our approach is to proactively underground overhead lines that have the greatest level of impact in nationally designated and protected landscapes, using the five stage process:

1. Develop approach to initiation and identification of distribution infrastructure.
2. Meet with relevant stakeholders.
3. Review nominations from relevant stakeholders.
4. Develop and implement undergrounding proposals.
5. Review undergrounding work.

Using this process, we are engaging with stakeholders to consider and prioritise the undergrounding of lines located in AONBs, National Parks and NSAs during the RIIO-ED1 period, assessing lines in the following locations:

In our SPM licence Area
- Snowdonia National Park
- Shropshire Hills
- Bryniau Clwyd A Dyffryn Dyfrdw
- Llyn Peninsula
- Ynys Mon/Anglesey

In our SPD licence Area
- Loch Lomond & Trossachs
- Nith Estuary
- Eildon & Leaderfoot
- Upper Tweedale
- Fleet Valley
- East Stewartry Coast
- Northumberland Coast

This prioritised list has resulted in the completion of three SPD and five SPM projects in 2021/22, shown in **Table 3**.

Our process enables key stakeholders to play a crucial role in the identification, planning and delivery of visual amenity enhancing projects, recognising their close relationship with the local landscape. Local stakeholders including Local Authorities nominate potential projects, and work together with us to determine the best route forward based upon local expertise and knowledge with regard to these protected landscapes. The assessment of nominated projects is supported by SPEN and by experienced chartered landscape architects to ensure that proposed projects provide the maximum visual amenity benefit whilst continuing to ensure acceptable network safety, operability, fault rate and security of supply.

Table 3 – Progress of Visual Amenity Mitigation Projects SPM and SPD in 2021/22

Location of OHL	Designated Site	Licence Area	Lines removed	Underground lines installed
Newstead, Melrose	Eildon & Leaderfoot	SPD	0.27km	0.30km
Gatehouse, Newton Stewart	Fleet Valley	SPD	7.43km	8.19km
Boreland Wood	Fleet Valley	SPD	0.04km	–
Rhoscolyn, Anglesey	Ynys Mon/Anglesey	SPM	0.04km	–
Sychnant Pass, Conwy	Snowdonia National Park	SPM	1.18km	–
LV AONB Dolwyddelan	Snowdonia National Park	SPM	0.16km	–
Llandduesant – Tyddyn Yr Hiddill	Ynys Mon/Anglesey	SPM	0.68km	–
Bodorgan Est, Anglesey	Ynys Mon/Anglesey	SPM	0.31km	0.29km

Visual Amenity
continued

This collaborative activity results in a priority list agreed by the local community. SPEN staff then proactively meet with local authority planning teams to understand local opinion and to facilitate further engagement as projects are developed and delivered. Further information can be found in Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary.

All sites benefiting from visual amenity programmes had intrinsic values including remote tranquil settings, high altitude exposure, and high visitor numbers due in part to their inclusions in national trails.

Figures 6 and **7** show the views before and after 0.31km of overhead lines were removed and replaced with 0.29km of underground cable in Bodorgan Estate Gardens, located within the Ynys Mon/Anglesey designated site.

Figure 6 – Bodorgan Estate Gardens before OHL removed

Figure 7 – Bodorgan Estate Gardens after OHL removed

Oil Leakage

Oil is traditionally used as an insulating medium for assets employed in the distribution of electricity, including transformers, circuit breakers and underground cables.

Although great care is taken to ensure oil does not leak from equipment through regular site visits and maintenance activity, some oil has historically escaped from equipment. This has the potential to cause pollution of nearby soils or watercourses or cause other related environmental damage.

To limit the release of oil in the environment we are undertaking a civil asset review in conjunction with the planned modernisation of our network. Based on the condition of the asset and nearby environmental receptors, the assets that pose the greatest risk of environmental harm are prioritised for replacement or mitigation works.

The modernisation or replacement of our transformers includes aspects of environmental mitigation such as building on low permeability concrete plinths and constructing reinforced concrete bunds to surround the oil containing equipment. Bund enclosures are designed to retain aqueous liquids to a volume of 125% of the oil contained in the equipment. A sump with a proprietary waterproof lining detects if oil is contained within liquids. The sump sounds an alarm to allow a staff member to arrive on site and assess what action to take on the oil leak.

Projects are presented in **Table 4**. Works are underway for the four SPD sites and at the SPM site listed. Transformer bunding replacement projects may take place over a number of years. The table (right) shows work carried out in the 2021/22 reporting year.

Table 4 – Summary of Oil Mitigation Schemes in 2021/22

Site Name	Licence Area
Craigendoran	SPD
Fauldhead 1	SPD
Fauldhead 2	SPD
Newton Stewart	SPD
Ellesmere	SPM
Total costs	**£1,231,344**

Oil Leakage
continued

In addition to carrying out the works detailed in **Table 4**, we also make use of MIDEL 7131 Synthetic Ester transformer oil at sensitive sites. Midel oil is fire safe and non-toxic but is more expensive than traditional transformer oil. We use Midel oil at sites with sensitive health and safety or environment factors, such as substations located near watercourses or those substations providing electricity at locations with an increased impact of fire.

SPEN owns and operates a number of underground fluid filled cables, which were historically installed as an alternative to overhead lines. There are 28.9km of fluid filled cables within SPD and 158.91km within SPM. Fluid Filled cables have been part of the network since the 1930's and were traditionally filled with a heavy mineral fluid with low biodegradability. The fluid used has been improved and since 1986, top ups to cables have been made using a light synthetic biodegradable fluid.

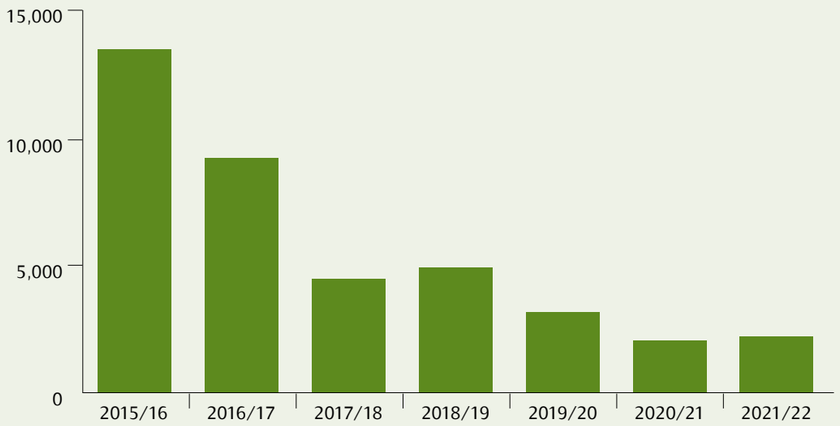
Fluid filled cables are monitored by pressure alarm systems. An alarm from one of these systems indicates a drop-in pressure and a potential leak from the cable. Once the alarm is triggered, detecting the exact point of the leakage can prove difficult, especially when the leaks are small. Traditionally, fluid leak location has been conducted via freezing the cable fluid with liquid nitrogen and then monitoring the cable pressure either side of the freeze or by tagging with Perfluorocarbon PFT tracer.

At the start of ED1 we identified several small leaks within SPM which resulted in a 2% leakage rate. To combat this, we set ourselves an ambitious ED1 commitment to reduce leakage by 50% and adopted an ongoing policy of strategic leak repair management alongside targeted asset replacement.

The afore mentioned methods were adopted with success as can be seen in the continuous reduction of leaks shown in **Graph 1** below. (In 2018/19 we had a catastrophic failure due to third party damage to our cable that increased our leakage in that period significantly).

As a direct result of strategic repair and targeted asset replacement we have reduced leaks by 83% since reporting year 2015/16.

Graph 1 – Annual litres of leakage from Fluid Filled Cables



Carbon Impact and Climate Change

Introduction

Our Sustainable Business Strategy describes our aim to be a carbon neutral company throughout our value and supply chains, and the ways in which we actively support our customers and local communities towards achieving this goal.

Our ambitious carbon reduction targets are aligned with international agreements to restrict global temperature increases to less than 1.5°C across all scopes. Our goal is to reach 15% reduction from 2013/14 levels by 2023, 80% reduction by 2030 and achieve a 67% reduction across all scopes by 2035 in line with our validated Science Based Targets.

In this section we report on our Business Carbon Footprint (BCF) excluding losses. Losses are covered in a separate section in the report. Full details of our BCF reporting can be found in Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary.

Our carbon footprint is categorised into three scopes following the Greenhouse Gas Protocol Corporate Standard for Greenhouse Gas Reporting. Each scope is summarised below:

- **Scope 1** – Direct emissions from activities owned or controlled by our organisation which release emissions straight into the atmosphere. Our Scope 1 emissions include fleet transport, SF_6 gas emissions and diesel use.
- **Scope 2** – Emissions being released into the atmosphere associated with our consumption of purchased electricity, heat and cooling. These are indirect emissions that are a consequence of our organisation's energy use, but which occur at sources we do not own or control. Electricity losses, depot and substation energy use sit within this scope.
- **Scope 3** – Emissions that are a consequence of our actions, which occur at sources which we do not own or control and which are not classed as Scope 2 emissions. Business travel and the emissions reported from our contractors' activities sit within this scope.

This year we achieved our 6th year of certification with The Planet Mark™ for our Business Carbon Footprint, undertaken by Planet First in accordance with ISO 14064-3 (2006). The Planet Mark™ Code of Practice adheres to the highest of recognised standards and is administered by an independent Advisory Panel composed of leading academic and industry experts.

The Planet Mark™ is partnered with Cool Earth, the award-winning charity that works to halt rainforest destruction in Central Peru. For every Planet Mark™ Certification delivered, a pledge is made to protect an acre of rainforest.

In 2020/2021, we worked with Carbon Trust to develop a Science-Based Target aligned with a 1.5°C trajectory and developed a Feasibility Study to better inform our carbon reduction roadmap. In 2021/2022, we had our Science Based targets validated by the Science Based Target initiative, committing to reducing our Scope 1, Scope 2 and Scope 3 emissions by 4.2% per year. This is in line with the scale of reductions necessary to meet the goals of the Paris agreement and aligns our carbon reduction targets to an internationally recognised methodology.

PlanetMark

Table 5 – tCO_2e by scope for SPD 2020/21 and 2021/22 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2020/21	5,534	282,318	4,110	291,961
2021/22	5,983	270,890	1,409	278,282

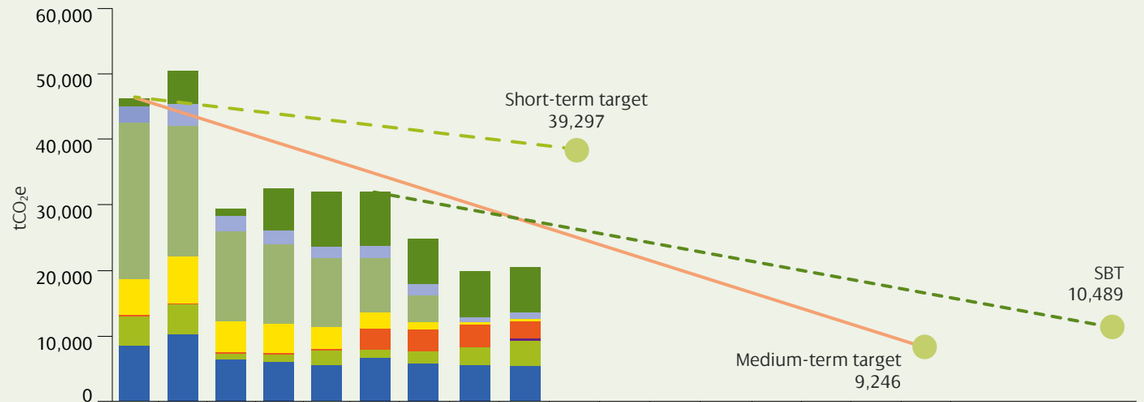
Table 6 – tCO_2e by scope for SPM 2020/21 and 2021/22 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2020/21	6,222	222,923	3,541	232,686
2021/22	6,315	230,007	6,524	242,845

Business Carbon Footprint

Since our 2013/14 baseline year SPD and SPM have jointly achieved a 56% reduction in business carbon footprint excluding losses.

Graph 2 – Distribution Business Carbon Footprint (excl. Losses)



We have measured our Business Carbon Footprint emissions since 2013/14. Since then, in 2021/22 we have achieved a 56% reduction in our combined (SPD and SPM) carbon footprint, excluding losses. The Business Carbon Footprint graph shows our progress through ED1. This represents a 15% reduction in SPM and a 76% reduction in SPD. In comparison to 2020/21 we have increased our carbon footprint by 4%. This has largely been driven by an increase in fugitive emissions associated with SF_6 gas and the inclusion of air conditioning gases for the first time. The increase in SF_6 emissions is due to improvements made to our data on asset disposals. Despite this increase, our rate of decarbonisation has significantly exceeded our short-term goal of achieving a 15% reduction in emissions by 2023. We will continue to focus on our medium-term goal of achieving an 80% reduction in emissions by 2030. We will also focus on reducing our carbon footprint in line with our 1.5°C aligned verified Science-Based Target.

Losses (energy lost or stolen from the network as it travels from source to user), is the largest category of our overall Carbon Footprint – and also the most influenced by external factors. We describe this category in detail within the losses section of this report.

Despite an increase in overall emissions compared to last regulatory year, there have been significant reductions over key emissions sources – notably fuel use and fuel related activities which have collectively decreased by almost 1,800 tCO_2e.

Sustainable Reporting Tools

We have implemented a contractor reporting tool which allows our contractors to upload carbon emissions associated with the development of infrastructure projects. This data will be aggregated down to departments within SPD and SPM, allowing us to analyse data trends, highlight where improvements and reductions can be made, and ultimately help to reduce not only our business carbon footprint – but also the scope 3 emissions associated with the development of our infrastructure.

Business Carbon Footprint
continued

Building Energy Use

When we started measuring our carbon footprint in 2013/14, energy consumed within our depots and substations was our second biggest emissions contributor after losses. It was therefore imperative that we worked to reduce the carbon emissions related to energy use at our sites. In 2021/22 we continued to purchase energy through REGO '(Renewable Energy Guaranteed Origin)' tariff, which provides us with guaranteed zero emission electricity.

The move to the REGO tariff has reduced our recorded emissions from building energy in SPD from 23,408 tCO_2e in 2013/14 to 162 tCO_2e in 2021/22 and in SPM from 6,063 tCO_2e in 2013/14 to 50 tCO_2e in 2021/22. This is equivalent to a 99% reduction in both SPM and SPD since we started measuring our emissions. Energy used at our sites now represents around 1% of our total carbon footprint excluding losses, down from 64% in 2013/14.

While we recognise that annual fluctuations in grid carbon intensity and our move to a REGO tariff contribute greatly to the reduction in the carbon footprint of our depots, substations and buildings, we recognise the need to take tangible action to reducing the kWh consumed to free up renewable energy on the grid. In this reporting year we have installed modern efficient heating, ventilation and air conditioning systems at our Bonnybridge and Dumfries depots, which will save an estimated 72,459 kWh of energy annually.

In addition, we have installed PV solar panels at our Lister Drive and Prenton offices and while we are still awaiting official estimates, we anticipate these installations will dramatically reduce our net energy consumption. In future years, we will continue our programme of replacement and refurbishment of inefficient older buildings to further reduce our energy use.

Fugitive Emissions

In 2021/22 we reported a 60% increase in fugitive emissions across both licence areas – a 95% increase in emissions from our SPM licence and 34% increase in emissions from our SPD licence. This is the first year we have reported emissions from air conditioning units, which accounts for 14% of the increase in total emissions. The balance relates to SF_6 emissions and can be attributed to an improvement in the way we report and account for SF_6 leakage when an asset is removed from our network and disposed. More information is detailed in the following section: 'Sulphur Hexafuoride Emissions'.

SF_6 remains arguably the most challenging area of our business carbon footprint, especially at voltages lower than 132kV, where SF_6 free solutions remain technically challenging. We will continue to work with our supply chain to drive innovation, piloting SF_6 free solutions where these are market ready and technically compliant, in addition to replacing the worst of our leaking assets.

In 2021/22 we trialled the UK's first 'clean air' substation in MacLean Square in Glasgow. The substation was developed across the River Clyde from the Scottish Event Campus (SEC), where the United Nations Climate Change Conference (COP26) took place in November 2021.

Fuel Combustion

Direct Fuel Combustion is principally associated with the use of generators used to provide temporary power in the event of a power cut. Between 25-27 November 2021 Storm Arwen caused significant power outages across the UK which required unprecedented levels of operational activity to bring power back to 200,000 customers across our districts. During this period, we relied on generators to provide temporary power to homes effect by the storm.

Recognising the need to reduce the carbon footprint of diesel generation, but also recognising the threat of storms like Arwen to public safety, we have replaced diesel with Hydrogenated Vegetable Oil (HVO) in our new generator hire contract. Although HVO produces more emissions than an electrical generator, it produces 90% less emissions than diesel – and can be adapted into our current generator fleet with limited disruption to operations and can reliably produce energy in a power cut. We anticipate this will result in significant savings to carbon emissions associated with generator use in future years.

In 2021/22 we reduced the carbon emissions associated with fuel combustion by 26% across both licence areas. This included a 14% reduction in SPM and a 39% reduction in SPD.

Business Travel

In 2020/2021, the effects of Covid-19 resulted in a significant decrease in business travel emissions as we moved to a system of remote working and reduced face to face meetings.

Across both our distribution licence areas, business travel has increased 27% to 1,071 tCO_2e due to a return to an easing of restrictions. This included a 30% increase in SPM and a 24% increase in SPD.

Despite an increase in business travel compared to the 2020/21 regulatory year, emissions from business travel have decreased by around 37% compared to prepandemic levels. This reduction can be attributed to efficiencies in operations as we have sought to continue to encourage online meetings where practical, and avoid travel unless it is essential.

Operational Fuel Use

Our Distribution operational fuel use is primarily associated with petrol and fuel used in our vehicles as we operate and maintain our network.

Total operational fuel use has reduced by 18% since the start of ED1. In SPM, the annual carbon impact from operational fuel use in 2021/22 decreased by 7% to 2,632 tCO_2e compared to the previous reporting year. In SPD, the annual carbon impact from operational fuel use in 2021/22 increased by 2% to 2,716 tCO_2e compared to the previous reporting year.

We are committed to decarbonising our fleet vehicles and will see the effect of introducing EVs in our future BCF submissions as we move towards a fully electric fleet. In September 2019, our parent company Iberdrola signed up to The Climate Group's EV100 initiative.

The agreement will see Iberdrola electrify their vehicle fleet (subject to local market conditions) by 2030.

In 2021/22 we installed 11 double charge points at our offices and have introduced another 11 electric vehicles to our fleet of pool cars. This brings the total to 53 charging points installed and 33 new electric fleet vehicles introduced since the start of ED1.

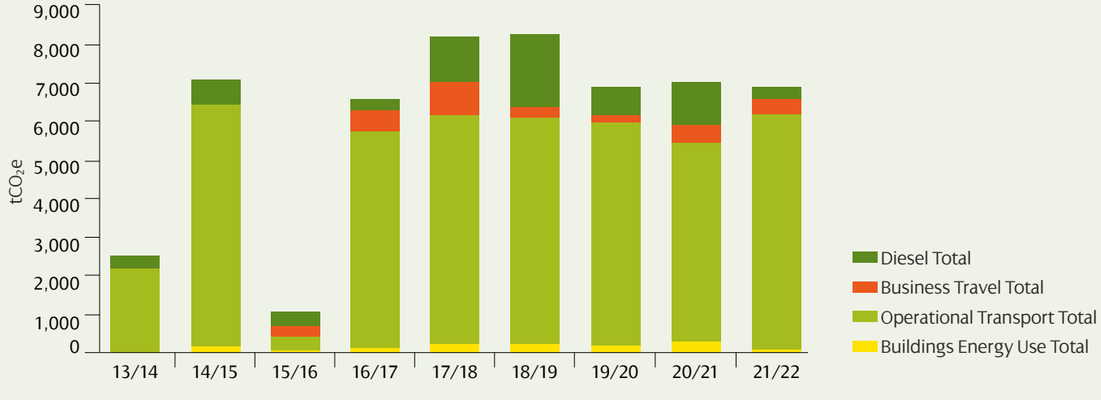
Contractor Emissions

Since forming a Sustainability Team at the start of ED1, the team has worked to improve data collection by moving away from estimations and providing accurate data. Since the start of ED1, we have worked to increase the number of contractors reporting their emissions and continue to target our top 20 contractors for accurate records of data.

In this way, we can record the impacts of our supply chain and continue to work with them to reduce their emissions. **Graph 3** shows contractor data from 2013/14 to 2021/22.

In 2015/16 we moved away from estimated data, and provided actual data as reported by a small number of contractors. From 2016/17 onwards, we have included a greater number of our contractors and reported accurate data, resulting in an increased figure. We have been working to improve data received from our contractors which has included instructing the help of SmartWaste to to collect carbon and waste data from our Distribution contractors in SPD and SPM.

Graph 3 – Contractor Business Carbon Footprint data



Business Carbon Footprint
continued

Summary of 2021/22 carbon and climate change impact reduction initiatives:

Reduce our carbon footprint by 15% on 2013/14 baseline year – Our target to reduce our carbon footprint by 15% was achieved in 2015/16. In 2021/22, we reached a 56% reduction in combined SPD and SPM emissions. Our primary focus is now on reaching our stretching target of 80% reduction by 2030 and focusing on reducing carbon in line with our 1.5°C Science-Based Target.

Reduce SF_6 on our network – We are continuing to work with industry to support the implementation of other SF_6 free solutions with a view to adopting suitable alternatives on our network wherever practicable, including tendering exclusively for non-SF_6 equipment where possible. In 2021/22 we trialled the UK's first 'clean-air' substation in MacLean Square in Glasgow. This demonstrates our commitment to continue to collaborate with our supply chain, leading the way in pioneering the use of SF_6 free solutions.

Undertaking planned transformer replacements and installed lower loss Transformers – During the 2021/22 reporting year we installed 78 lower loss transformers in SPM and 75 lower loss transformers in SPD. We have so far replaced a combined SPD and SPM total of 762 transformers during ED1, saving 26,288MWh of losses and 5,582 tonnes of CO_2 equivalent.

Incorporating energy efficiency measures in our buildings – Until 2019, energy consumed within our depots and substations was our second biggest emissions contributor after losses, and it was therefore imperative that we work to reduce the carbon emissions related to energy use at our sites. In 2019, we amended our tariff to REGO '(Renewable Energy Guaranteed Origin)' which provides us with guaranteed zero emission electricity. During 2021/22, our now second full year of reporting after our move to a REGO tariff, our buildings and substation energy use now makes up less than 2% of our total carbon footprint excluding losses. While we recognise that annual fluctuations in grid carbon intensity and our move to a REGO tariff contribute greatly to the reduction in the carbon footprint of our depots, substations and buildings, we must also concentrate on reducing the kWh consumed. In this reporting year we have installed modern efficient heating, ventilation and air conditioning systems at our Bonnybridge and Dumfries depots, which will save an estimated 72,459kWh of energy annually. In addition, we have installed PV solar panels at our Lister Drive and Prenton offices and while we are still awaiting official estimates, we anticipate these installations will dramatically reduce our net energy consumption. In future years, we will continue our programme of replacement and refurbishment of inefficient older buildings to further reduce our energy use.

Reducing the carbon footprint of our Diesel Generators – This year, we replaced diesel with Hydrogenated Vegetable Oil (HVO) in our generator contract. This has the potential to decrease the emissions associated with fuel consumption by 90% – and provide the same reliability as diesel fuel. We can implement HVO with minimum disruption to our operations whilst continuing to explore electric and hydrogen generator potential which will cut our emissions even further.

Setting Validated Science Based Targets – Recognising the importance of ongoing leadership and ambition, we have committed to reducing absolute scope 1, 2 and 3 Greenhouse Gas (carbon) emissions at the scale of reduction necessary to meet the goals of the Paris Agreement, limiting global warming to 1.5°C. In 2021/22 we had our targets validated by the Science Based Targets Initiative (See 'Companies Taking Action'). This goes beyond the scope of our Business Carbon Footprint which we have reported on since 2013/14 – and now includes all indirect emissions associated with our supply chain. In order to achieve this, we will reduce our carbon footprint by 67.2% by regulatory year 2034/35* (*from our 2018/19 baseline year).

Reducing Fleet Emissions – In 2021/22 we installed 11 double charge points at our offices and have introduced another 11 electric vehicles to our fleet of pool cars. This brings the total to 53 charging points installed and 33 new electric fleet vehicles introduced since the start of ED1.

Sulphur Hexafluoride Emissions

Switchgear filled with SF_6 is one of the predominant solutions offered in the electricity industry for new switchgear applications and the replacement of legacy switchgear. In some applications, it is the only viable solution available.

By installing modern SF_6 filled switchgear, SPEN have been able to enhance the operational safety of our asset base and reduce ongoing plant maintenance costs.

SF_6 is a colourless and odourless gas used for both insulation and arc interruption in switchgear applications. It has exceptional insulating properties which enable safe, compact and low-cost switchgear solutions. Although it causes no detectable impact on the local environment if released, it is a highly potent greenhouse gas with a global warming potential of 22,800 times that of CO_2.

We anticipate that in the short term, the quantity of SF_6 on our network, described as the 'SF_6 bank', will increase as the replacement of end-of-life oil-filled switchgear programmes proceed. Efforts to minimise the escape of SF_6 from equipment to the environment are therefore highly important, repairs and replacement of leaking assets is now vitally important to reducing our business carbon footprint. There are many challenges involved in the development of solutions utilising alternative gases and they vary by voltage level and application; there are also no commercially available gases that match the electrical insulation properties of SF_6. We are progressing an industry leading solution using GE Green Gas for Grid (G3) as the insulating medium within a 132kV Gas Insulated Switchboard (GIS) solution at our Lister Drive substation in SP Manweb.

We are also continuing to work with industry to support the implementation of other SF_6 free solutions with a view to adopting suitable alternatives on our network wherever practicable, including tendering exclusively for non-SF_6 equipment where possible. We will continue to prioritise works where we can achieve the greatest curtailment of SF_6 volumes to the SF_6 Bank possible wherever this is feasible and in our customers interests.

It is also important that we ensure we capture all possible SF_6 leakage scenarios. The design leakage rates of some SF_6 equipment is such that 'topping up' the asset during its service life may be required. Fugitive emissions are recorded as the volume of gas required to top up the equipment to its original capacity. However, most equipment containing SF_6 is hermetically sealed and not designed to require a top-up. Where SF_6 equipment reaches the end of its service life; either due to condition or the presence of leaks, we replace it and capture the volume of gas recovered at end-of-life via approved disposal providers.

Our networks in SPD are all below 132kV, while SPM includes networks up to and including 132kv. This results in SPM managing larger equipment with greater amounts of SF_6.

Since the equipment held by SPD is generally smaller and has much of its SF_6 held in sealed containers with no facility to top up, these pieces of equipment must be replaced when SF_6 levels are shown to have dropped below a defined threshold. In SPM, top ups are managed by either routine checking of assets or through alarms that are generated onsite.

In SPM, we have successfully reduced our mass of SF_6 from top ups from 28.7kg in 2020/21 to 16.3kg in 2021/22. However, we are now including final disposal emission values which are the value from the nameplate mass (original gas in the item) minus the gas recovered at end of life.

The value of these emissions is 72.6kg, increasing our total emissions to 88.9kg. In SPD, top ups have increased from 2.6kg in 2020/21 to 6.4kg in 2021/22. We have followed the same methodology for disposals as in SPM this year, resulting in an increase from 47.4kg in 2020/21 to 78.3kg in 2021/22, increasing our total emissions to 84.6kg.

Table 7 – Summary of SF_6 Information

	SF_6 Bank (as at 1st April 2021)	SF_6 Emitted	Actual Leakage Rate
SPM	20,850	88.9	0.43%
SPD	15,867	84.6	0.53%

Distribution Losses

About 7% of the energy entering the distribution system is not ultimately billed to customers – this energy is known as distribution losses. Much of this energy is lost in heat and noise as an inherent result of power flowing through network assets.

In addition, a small amount of energy is illegally abstracted, or lost due to inaccuracies in the billing and conveyance process. More detail on the types of losses is given below.

Electricity industry settlement systems charge suppliers for distribution losses and this cost is passed on to all consumers as part of their bill.

Electricity losses are an inevitable consequence of transferring energy across electricity networks, but they carry a financial and environmental impact. Delivering the right, cost-effective loss minimisation activities will lead to a more efficient network, reducing customer energy bills and carbon emissions. Therefore, we have a published Losses Strategy based upon a high-level vision that we will consider all reasonable measures that can be applied to reduce losses and will adopt those measures which provide benefit for customers. Furthermore, in ED1 we have invested in numerous activities that are over and above a return-on-investment basis under our Losses Discretionary Reward programme.

Managing losses is complex: losses are difficult to measure and are influenced by factors outside of DNO control. Furthermore, loss management must be considered within the Net Zero Carbon context. The electrification of heat and transport, greater levels of decentralised renewable generation, and the need to operate the network more flexibly will increase network power flows, leading to higher network losses.

Technical losses

Technical losses are those losses that are lost as heat and noise as an inherent result of power flowing through network assets.

Our distribution networks convey energy from the interface with the transmission system to the lower voltage supplies used by our network customers. The system comprises overhead lines, underground cables, switchgear and transformers, and operates at several different voltage levels. The design is based on the principle that as the load to be transferred increases so does the operating voltage. This design ensures that the electric current does not become excessive which would create uneconomic losses. Each of these network components generates heat, noise or both as electricity is transferred, resulting in technical losses. Technical Losses can be described either as Fixed Losses or Variable Losses.

Fixed Losses occur because some parts of the system must be electrically energised at all times. Fixed losses include the energy consumed by the steel in a transformers magnetic core reversing polarity in every AC cycle. This causes the core to mildly pulse (emitting a humming noise) and to heat up. This steel inefficiency is called "Iron Losses". In addition, there is some small level of current flow across electrical insulation used in transformers, lines and cables. Taken together, this energy consumption is the "No Load" or "Fixed Losses" on the system. Energy is also consumed by our equipment to ensure safe and reliable network operation.

In our substations, energy is consumed for dehumidification and cooling equipment, oil pumps, air compressors and battery changers to maintain secure network operation and resilience.

Variable losses are those which vary with the current that flows through the system. All conductors, whether coils in transformers, aluminium or copper wires in overhead lines or cables and even in switchgear, have electrical resistance which causes them to heat when carrying electric current. This heat is lost to the environment.

Calculating the value of technical losses is complex because variable losses change with load on the circuit, which also varies with the time of day. Variable losses increase with the square of the electrical current, and therefore if the peak current was 10 times the minimum, peak losses would be 100 times as large as the losses at minimum load. To calculate technical losses with complete accuracy, the detailed power flows of every inch of the network would need to be known in real-time.

Significant progress is being made to make our network smart, and this is helping us learn more about technical losses. We recognise the importance and benefit of collaboration amongst DNOs in this undertaking, and have chaired the Energy Network Association (ENA) Technical Losses Working Group (TLWG) throughout RIIO-ED1, which is aimed at facilitating the sharing of best practice within the industry.

Table 8 – Assessment of Losses (Technical and Non-Technical) 2021/22

	SPD	SPM	Distribution Total
Units Entering (GWh)	17,444	14,691	32,135
Units Exiting (GWh)	16,170	13,608	29,778
Losses (GWh)	1,275	1,083	2,358
Losses (%)	7.31%	7.37%	7.34%

Non-technical losses

These are the losses that occur due to unidentified, misallocated or inaccurate energy flows. They can be thought of as electricity that is consumed but not billed. It is important to differentiate this from electricity that is billed but where the bills are not paid. In the case of non-technical losses the end user is unknown or the amount of energy being consumed is uncertain.

The three main types of non-technical losses are:

1. Energy theft – the illegal abstraction of electricity by customers, achieved through tampering with supplier meters or interference with network assets.

2. Unmetered Supplies – not all customer supplies are metered. Typical unmetered loads include communal areas in council owned buildings, street lamps, bus stops and advertising boards. Such consumption is quantified by establishing accurate records for each supply and applying a representative profile. Losses typically arise as a consequence of incorrect or incomplete unmetered supplies records and inaccurate estimated annual consumption information.

3. Conveyance errors – these occur when electricity is delivered but not accurately recorded in energy settlements. Typical reasons for energy not being accurately recorded include missing or unregistered metering points, incorrect recording of metering point energisation and incorrect registration of metering systems, which all result in inaccurate or missing consumption data.

Method to Calculate Losses

Currently, SP Energy Networks use industry settlement data to estimate losses. At Extra-High Voltage (EHV) (33kV) (and 132kV in SP Manweb) site-specific loss adjustment factors are applied to metered units distributed, and for LV and HV estimated loss percentage is derived from the 12-month rolling average models which captures losses at the various stages of settlement reconciliation. The model calculates the average difference between the total energy entering the system minus the EHV purchases and the HV and LV billed sales. The objective of the methodology is to smooth short-term fluctuations in losses which are a natural result of settlement profiling which can obscure actual underlying losses. Settlement takes 14 months from the initial reconciliation where the majority of actual data is estimated to final reconciliation which includes actual data.

The current approach to determining distribution network losses has several limitations:

- It is not possible to distinguish between technical network losses and non-technical losses,
- The process is very sensitive to data quality and accuracy,
- Estimated energy consumption is used to determine energy use from unmetered supplies, and
- Apportionment of losses across customers is reliant on educated estimates.

Therefore, over ED1 we have committed to improving our understanding of losses. Significant progress is being made to make our network smart, and this is helping us learn more about technical and non-technical losses.

Distribution Losses Strategy

In September 2015 we published our ED1 Losses Strategy. This strategy applies throughout the ED1 2015–2023 regulatory period and is subject to regular reviews. Underpinning this losses strategy is our strategic vision to:

Consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers.

Specific actions include:

- **Accelerating the replacement of more than 1,000 higher-loss transformers** that would have otherwise been replaced between 2031 and 2039. Over the last 60 years, advances in transformer core materials and manufacturing techniques have resulted in the significant reduction of fixed losses, such that the cost of early replacement is offset by the reduced losses over that period. The continuing programme led to the replacement of 153 high-loss transformers in 2021/22 – as shown in **Tables 11** and **12**, along with forecasts for 2022/2023. The latest figures bring the estimated total losses benefit to 26,288 MWh or 11,628 tCO_2e so far in ED1 – as shown in **Tables 9** and **10**.
- **HV main line new builds throughout the RIIO-ED1 period will be constructed using larger than usual (100mm²) conductor.** Furthermore, we will evaluate the installation of larger cross-section cables on new circuits on a project-by-project basis and perform ongoing cost-benefit studies to inform future policy revisions.
- **Increasing our Revenue Protection team by 22% to target illegal abstraction,** and improving the use of HV and LV network metering and smart metering to identify zonal problems. The continuing programme of Revenue Protection services led to the discovery of 2,643 irregularity cases in 2021/22 – as shown in **Tables 11** and **12**, along with forecasts for 2022/2023. The latest figures bring the estimated total losses benefit to just under almost 186,000 MWh or 84,048 tCO_2e so far in ED1 – as shown in **Tables 9** and **10**. Meanwhile, our continuing programme of Theft in Conveyance investigations led to the discovery of 307 interferences in 2020/21 – as shown in **Tables 11** and **12**, along with forecasts for 2021/2022. The latest figures bring the estimated total losses benefit to over 17,000 MWh or 7,774 tCO_2e – as shown in **Tables 9** and **10**.
- **Proactively improving the accuracy of records** for unmetered supplies by working closely with customers and settlement stakeholders.

Distribution Losses
continued

Losses Policy

In order to ensure that the strategy is simply and easily communicated, we have developed a Losses Policy that sets out our vision to consider all reasonable measures which can be applied to reduce losses.

We have developed supplementary material to set out the purpose of the Strategy and Policy and articulate the actions we expect our staff to take in the day-to-day activities where they can have an impact on reducing both technical and non-technical losses. In addition to providing a generic methodology for loss assessment, it also provides methods, and examples, where a more detailed assessment may be required, for example:

1. Line loss factor calculations
2. An approach for selecting conductors
3. Transformer loss calculations
4. Practices in Network Operations to control losses, e.g. load balancing, phase imbalance correction and optimising voltage levels

Furthermore, we are updating many of our technical policies and procedure to make specific reference to relevant aspects of the Losses Policy where appropriate.

Losses Discretionary Reward

The Losses Discretionary Reward (LDR) was set up to encourage DNOs to work towards a better understanding of how to manage electricity losses and to identify ways of reducing losses and therefore reduce costs for customers. The LDR was managed in three tranches during ED1, and our submissions are available here. https://www.spenergynetworks.co.uk/pages/what_are_we_doing_about_network_losses.aspx

Understanding losses – over RIIO-ED1 to date we have led considerable advances in understanding of network losses in the context of the low carbon energy transition and continued to progress our readiness for smart meter data and advanced modelling tools. We have continued to improve our understanding of theft in our network, and the accuracy of alerts that require further investigation, through continued engagement with Smart suppliers. In the development of our RIIO-ED2 losses strategy, we have undertaken deeper analysis into technical losses across various areas of the network – building a more detailed cost-benefit analysis of upsizing cables and transformer replacement that will help us optimise delivery of our ED2 plans (see next section on Preparing for RIIO-ED2).

Customer and stakeholder engagement, and sharing best practice – by convening and chairing the TLWG throughout ED1 we have provided an ongoing platform for DNOs to discuss and share best practice. In our revenue protection area, we continue to have a full-time member of staff working with Merseyside Police, significantly impacting energy theft detection, and wide stakeholder engagement and awareness sessions are ongoing, most recently with social landlords, local councils and the fire and rescue service.

We continue to consider losses holistically across the transmission and distribution system, and this includes engaging with NGESO and NGET to understand how to manage conditions at the transmission interfaces caused by transmission-connected generation and provision of reactive power services.

Processes to manage losses – one of the key process improvements developed over the LDR programme is work on our network modelling techniques. Over ED1, new modelling approaches for HV, EHV and 132kV assets give much more detailed information on the losses characteristics of the network, which facilitates the identification of high loss circuits and network components. This enables increasingly complex networks to be designed, which has continued to feed into our ED2 plans (see next section on Preparing for RIIO-ED2) and the procurement of flexibility services.

Losses innovation and incorporation as BAU – our investigations into contact voltage detection have developed into a plan (see next section on Preparing for RIIO-ED2), and trials of localised (LV) voltage opimisation has developed our understanding of how to treat losses in LV networks.

Figure 8 – Summary of Losses Initiatives

WORKSTREAM	Understanding	Stakeholder	Processes	Innovation
LOSSES DISCRETIONARY REWARD				
Initiative 1 Smart Meter Data analysis systems to reduce non-technical losses	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 2 Smart Meter Data analysis systems to reduce technical losses	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 3 Voltage Optimisation to Improve Network Losses and Load	Better understand potential for voltage optimisation		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 4 Improved Modelling of Complex Networks to Reduce Losses	Stochastic power flows in pockets of the network		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 5 Improved Modelling of Rural Networks to Reduce Losses	Understand suitable equipment upgrades		Developing processes ready for arrival of smart meter data	Innovative methods now incorporated for use as BAU
Initiative 6 Assessment of Power Factor to Improve GB Losses	Initial understanding of level of loss due to power factor was successful. This work is now progressing under Open Networks Workstream 1b.			
Initiative 7 Improved detection of theft through revenue protection	Continually improving understanding of theft patterns with detection	Police, Fire & Rescue, Suppliers, Councils, Housing Associations	Internal process for theft detection is best practice	Innovative methods now incorporated for use as BAU
Initiative 8 Improving Network Loading by Stakeholder Engagement		Proactively engaging across all initiatives		
Initiative 9 Substation Efficiency – Alternative uses for waste heat	Proactively engaging across all initiatives			Improved understanding about the technology
Initiative 10 Substation Efficiency – Monitoring and self-sufficiency	Better understand self-sufficiency measures, but no retrofit PV		Change to processes as a result of business case review	
Initiative 11 Consider case for Mobile Asset Assessment Vehicle (MAAV)	Understand contact voltage faults, further trials to understand loss impact	Learning from UKPN		Relatively new technology in US, very new to UK market
Initiative 12 Early viability of Loss Adjustment Factors (LAFs)		Driven by engagement with generators and Elexon	(Very) early beginnings of future process for site-specific LAFs	Requires cutting edge technology
Initiative 13 SCADA based near real-time losses calculations			In early/preparatory stages	
INDUSTRY COLLABORATION				
ENA Technical Losses Task Group	Used example datasets to estimate LV network usage		Developing processes ready for arrival of smart meter data	
ENGAGEMENT EVENTS				
Engaging with Stakeholders	Ofgem and Industry Teach-In Sessions	Presentations and Workshops; CIRED, CIGRE, LCNI		

Distribution Losses
continued

Preparing for RIIO-ED2

In RIIO-ED2 and beyond, we anticipate that under an efficient Net Zero Carbon transition, distribution network losses will increase as a result of the electrification of heat and transport and the increase of low-carbon distributed generation. As the mix of electricity generation in GB becomes increasingly low-carbon, so do the losses. Therefore, whilst losses still have a cost implication to the customer linked to energy prices, the carbon cost of losses is changing. It is crucial any loss management activities do not discentivise the connection of LCTs. Our focus in RIIO-ED2 is to build upon systems that enable a whole system, whole life assessments to be made when making design and operational decisions ranging from domestic service cables to 132kV connections.

We have worked collaboratively with the other DNOs and Ofgem to design a strong reputational losses incentive in RIIO-ED2, and we proposed this as part of our Business Plan. This builds upon the independent reports we commissioned as chair of the TLWG, which compared international regulatory approaches for managing network losses and proposing potential future incentive mechanisms in the context of the low carbon transition.

We have also taken key learnings from the LDR programme to shape both our Losses Strategy and plans for enhanced losses consideration in RIIO-ED2.

Some examples include:

- Use our complex modelling tools to identify the network assets with disproportionately high losses and optimise our proactive replacement programmes.
- Continue to assess the use of network management and nearer-real-time information to improve real-time understanding of losses (levels and locations) in development of our Engineering Net Zero Carbon platform, and using this understanding to inform operational policies.
- Continue to use our new processes and analytical tools to further our understanding as more smart meter and LV monitoring data becomes available in RIIO-ED2. We will install over 14,000 LV monitors in RIIO-ED2, which we estimate could help us save an additional 15 GWh per year by the end of the period through better detection. Specifically, we will use smart meter data to establish voltage pattern recognition algorithms to define phase connectivity and distinguish between technical and non-technical losses in the LV network using network impedance data. This will continually refresh our understanding of the scale of electricity theft.
- Conduct further modelling of specific LV network assets using the new tools, including service cables and LV mains. We will maintain processes for service cable upgrade and replacement, setting out exactly how to analyse the network and conduct losses-informed cost benefit analysis. In preparation for RIIO-ED2, we will generate simulated smart meter data where real smart meter data is not available.
- As a DSO responsible for delivering the Net Zero Carbon transition we will continue to engage with stakeholders including TOs, NGESO, aggregators and customers to ensure that DG and LCT load growth is accommodated through holistically optimised system design and operation, inclusive of losses.
- Continue to provide clear input to the Open Networks project which provides an additional route to stakeholders who will be impacted by new network solutions. We will incorporate stakeholder views to influence how policies and processes are developed, and ensure losses are appropriately considered as part of this work.
- Reduce technical losses by replacing faulted LV fuses; identified using LV main voltage drop profiling where there is sufficient smart meter data.
- Keep abreast of national and international innovations, and actively investigate and seek to reduce the barriers to adoption of newly discovered losses management innovations. Specifically, Central Voltage Control System technologies, Seasonal Normal Open Points (NOPs) routines, reactive power control technology for distributed generators and continued work into use cases to minimise losses as part of our flagship innovation projects into the use of DC distribution.
- Continue to work with the TLWG and Ofgem to monitor relevant international regulatory mechanisms and to develop future incentive mechanisms for losses management. We will also continue to present on and raise the profile of network losses at key industry events, and with international partners.

We published an updated RIIO-ED2 losses strategy along with our business plan – this is available here: https://www.spenergynetworks.co.uk/userfiles/file/Annex%204A.8%20-%20Losses%20Strategy%20FINAL.pdf

We will maintain our strategic vision to:

Consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers.

Acknowledging that losses are likely to increase in RIIO-ED2, we will optimise the levels of losses through comprehensive cost-benefit analyses such that the whole lifecycle costs to the customer are minimised. This includes continuing with our early replacement programme of 795 high-loss HV transformers and four high-loss EHV transformers, and continued Revenue Protection and Theft in Conveyance activities. Furthermore, we are continuing to actively pursue a programme of contact voltage detection as a Consumer Value Proposition, following collaborative support from our customers and stakeholders.

Table 9 – Summary of losses Costs and benefits (SPD) from activities in RIIO-ED1

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2021/22	Reduced Emissions Associated with Losses 2021/22	Cumulative reduced losses to date	Cumulative reduced emissions
Replace high loss transformers	£1.1m	3,010 MWh	1,252 tCO_2e	10,576 MWh	4,690 tCO_2e
Internal and External Revenue protection inspections	£0.7m	10,408 MWh	4,329 tCO_2e	84,097 MWh	37,786 tCO_2e
Theft in conveyance	£0.0m	637 MWh	265 tCO_2e	2,466 MWh	1,078 tCO_2e
Totals	**£1.8m**	**14,055 MWh**	**5,845 tCO_2e**	**97,139 MWh**	**43,555 tCO_2e**

Table 10 – Summary of losses Costs and benefits (SPM) from activities in RIIO-ED1

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2021/22	Reduced Emissions Associated with Losses 2021/22	Cumulative reduced losses to date	Cumulative reduced emissions
Replace high loss transformers	£0.9m	4,590 MWh	1,909 tCO_2e	15,712 MWh	6,938 tCO_2e
Internal and External Revenue protection inspections	£0.5m	16,589 MWh	6,899 tCO_2e	101,895 MWh	46,262 tCO_2e
Theft in conveyance	£0.0m	2,395 MWh	996 tCO_2e	14,691 MWh	6,696 tCO_2e
Totals	**£1.4m**	**23,574 MWh**	**9,804 tCO_2e**	**132,297 MWh**	**59,896 tCO_2e**

Table 11 – Summary of Amount of Losses Activities (SPD) in Regulatory Reporting Year and Estimate for the Following Regulatory Year

Programme/Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year
Replace high loss transformers	Transformer volumes	75	134
Revenue protection inspections	Visits made by revenue (metered supplies)	12,450 visits were conducted resulting in 1,678 irregularity cases	17,039 visits and 3,212 cases detected
Theft in conveyance	Investigations	228 investigations no significant interferences deemed appropriate to pursue	113 Investigations 27 Interferences detected

Table 12 – Summary of Amount of Losses Activities (SPM) in Regulatory Reporting Year and Estimate for the Following Regulatory Year

Programme/Project title	Description of unit	Volumes in Regulatory Reporting Year	Forecast volumes for Following Regulatory Year
Replace high loss transformers	Transformer volumes	78	154
Revenue protection inspections	Visits made by revenue (metered supplies)	6,510 visits were conducted resulting in 965 irregularity cases	9,559 visits and 3,046 cases detected
Theft in conveyance	Investigations	190 investigations no significant interferences deemed appropriate to pursue	134 Investigations 26 Interferences detected

Other Environment Related Activities

SP Energy Networks, Distribution Environmental & Innovation Report 2021/22

Introduction

We recognise the need to record and monitor our environmental, social and financial impacts and take action where required to fulfil our ambition to become a Sustainable Networks Business.

This section contains a summary of the works underway in relation to the other Sustainability Drivers identified earlier in this report (please see **Figure 5** on page 8). This includes resource management, noise and air emissions, climate change adaption, ecological enhancement and stakeholder engagement with communities, staff and other key groups to deliver this ambition.

Resource Management

In our Sustainable Business Strategy, we describe a vision where the principles of a circular economy and efficient use of resources will be embedded in our business.

The materials required for network construction and operation will come from sustainable sources. We will produce 'zero waste', with the components of all 'end of life' assets being reused or recycled into new products.

Efficient resource management – where we value resources both financially and environmentally – is a key element of our vision of sustainability. To drive this vision, we have set ourselves the challenging goals to divert 95% of our waste from landfill by 2023, and 100% by 2030 (excluding compliance waste).

To meet these targets, we are focusing on ways to avoid, reduce, reuse and recycle our waste. Key to this is ensuring that the many data inputs required become more robust year on year. Our approach is therefore twofold: working with our own staff and supply chain to gain better insights into the quantities, types and treatments of waste resources; and collaborating to develop ways of reducing waste and improving the ways in which waste resource is then processed. **Graph 4** shows our improvements in waste management since 2014.

In 2014, the relatively high percentage of waste diverted from landfill recorded was due in part to incomplete recording as we began to examine all waste streams in detail. Since 2014, we have worked closely with our contractors to increase and improve the data recorded as they undertake projects on behalf of SPD and SPM.

In 2021 we diverted 93% of our waste from landfill. We continue to work with our contractors and employees to make the final push and reach our 95% landfill diversion goal by 2023.

Key to this is further improvement of the data received from our contractors. This has led us to implement the use of the SmartWaste tool, launched in 2021, to collect waste and carbon data from our Distribution contractors in SPD and SPM. SmartWaste works by allowing contractors to upload their data directly to the system each month. We work alongside contractors, providing instructional videos and making ourselves available to assist in the data upload process when needed. Uploading the data to Smart Waste allows us to view and report on the data at different levels, whether that's by project, district or licence area.

Case Study:

3D Concrete case study

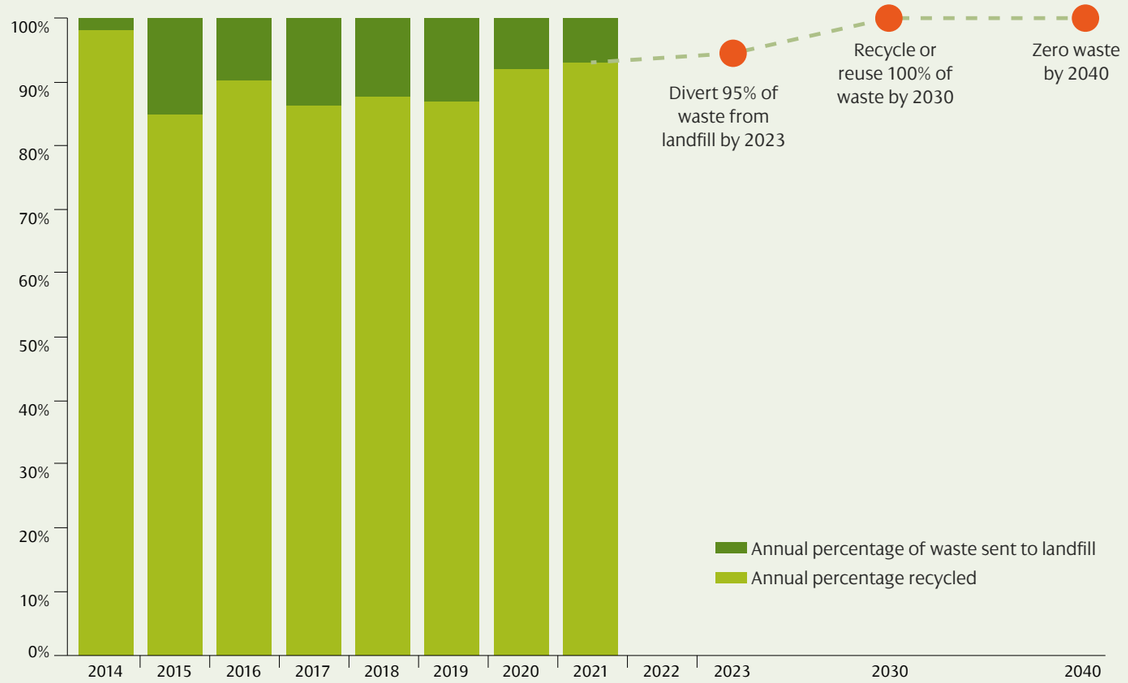
Concrete has a high impact on our greenhouse gas emissions and our civil engineering team have investigated ways to reduce this environmental impact associated with foundation works.

In May 2021 a collaboration with Hyperion looked into the feasibility of introducing 3D printing into the process. The aim was to reduce time, cost and environmental impact, maintaining the same concrete characteristics with less material.

Initial testing provided a 65% reduction of the embodied carbon and 75% reduction in the volume of material. However, in the initial phase printed concrete was considered cost prohibitive. Recent developments, linking up with a UK-based manufacturer, have proved more positive with a potential cost saving of 20%.

Next steps:
With some minor tweaks and more analysis on transportation, the 3D printed foundation is close to being a viable solution.

Graph 4 – Waste to Landfill Reduction



Case Study:

Transitioning from red diesel to HVO

What is HVO?
Hydrotreated Vegetable Oil (HVO) is a fuel which is made from any waste food products or plants that contain oils and fats. Chemically HVO is very similar to red diesel, meaning HVO can be directly substituted for red diesel in our generator fleet, with minimum or no modifications. Additionally, the two fuels can be mixed together and used in the event of abruptly high fuel demand, such as power outages following a major storm.

What are the benefits?
HVO has a much lower carbon footprint than diesel – up to 90% lower. The reason HVO has such low emissions is because the carbon has been previously been removed from the atmosphere and stored as plant matter. This plant matter is then turned into HVO before combustion. This releases the carbon back into the atmosphere, meaning the entire process is effectively carbon neutral – except for the manufacturing and transportation emissions – and the concentration of atmospheric carbon stays constant. In comparison, burning diesel releases carbon that was previously stored underground into the atmosphere, increasing the concentration of atmospheric carbon.

Additionally, HVO contains fewer impurities than diesel, so burns more cleanly and produces less particulate matter in the exhaust.

What does this mean for SPEN?
SPEN uses approximately 800,000 litres of diesel per year running temporary generators. Because of the significant environmental improvements, we are looking to transition away from using diesel to power our generators and use HVO as an alternative where practical. It is estimated this will prevent emissions equivalent to more than 650 flights from London to Australia.

While HVO represents a better option than diesel, we recognise that this is not a completely sustainable solution. There are still emissions produced and significant amounts of land are required to grow the raw materials. Our long-term goal is therefore to implement fully electric and hydrogen generators. We have undertaken initial trials with electric units and will continue to collaborate with our supply chain to drive innovation in this area.

Management of Noise Impact

We seek to minimise the impacts of noise resulting from the construction, maintenance and operation of our electrical infrastructure.

When we build new infrastructure or when the local environment changes around our existing infrastructure this can sometimes result in a negative effect in the local area.

Substation Transformers typically generate a noise level ranging from 60 to 80 dBA. Transformer noise will transmit and attenuate at different rates depending on the transformer size, voltage rating and design and can cause a nuisance to nearby neighbours in some circumstances.

The SPEN strategy is both proactive and reactive in mitigating and avoiding these impacts. SPEN operates a 24-hour customer helpline where customers, contractors and staff can report problems on the network including issues related to noise and dust. Enquiries regarding noise are logged in our customer complaints system and passed to regional contacts with actions and deadline dates.

In reviewing operational complaints with respect to noise, most issues relate to the use of temporary power generators that power emergency maintenance works and customers who are off supply, rather than ongoing issues related to static assets.

Where issues are highlighted with our static assets, SPEN has a good track record in mitigating the effects. The solutions are often relatively straightforward once these are known to us.

This reporting year, we have received two enquiries in SPD in relation to noise from our equipment.

The first inquiry related to the triggering of the door alarm of an 11kv substation. After the site was inspected and the alarm cleared, we contacted the alarm company and an investigation was carried out. Once the investigation was complete, the alarm was switched off while necessary repairs were completed and the customer was kept informed of all updates. We then followed up with the customer after two weeks and they confirmed that there had been no further issues.

The second inquiry related to persistent low-level noise from a substation. An Engineer performed a check on the site and found that there was noise coming from a reverberating plate and rattling coming from valves. These were both tightened up and a thorough check of the transformers was carried out. The customer was advised that the works had been completed and they had no further issues.

During the 2021/22 reporting year, we also received one inquiry in SPM relating to noise from our equipment.
This also related to substation noise. A noise survey was organised and we requested that our service partner contact the customer to make arrangements for a noise recording device to be fitted. After speaking with the customer, our service partner advised that the customer no longer wished to proceed with the survey. We repeatedly attempted to contact the customer to discuss this further but received no further communications.

Climate Change Resilience

In December 2021, we published our Climate Resilience Strategy for RIIO-ED2 and beyond. Here we can share some of the top risks and associated mitigation measures from that strategy that will ensure we will continue to operate a safe, resilient and sustainable network and enable the Net Zero Carbon transition.

SP Energy Networks worked with the Energy Networks Association (ENA) to finalise the identification of climate change risks based on the latest UK Climate Projection 2018 (UKCP18). The UK Met Office, author of UKCP18, was tasked with undertaking an electricity and gas network specific analysis based on UKCP18 with the final report completed by November 2020. The highest priority hazards identified from Met Office analysis and stakeholder engagement with network companies are:

- Extreme high temperatures
- Heavy rainfall/drought cycles
- Prolonged rainfall leading to flooding

Bespoke analysis of the UKCP18 data has been undertaken for each of these hazards and the impact on networks evaluated for the key operational risks.

SP Energy Networks Operational Risks

The following are some of the most highly-ranked risks in our strategy due to high relative likelihood and impacts.

Fluvial, pluvial and coastal flooding: Substations affected by river or coastal flooding due to increased winter rainfall, or flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply. There is also an impact on other types of work being prevented due to safety issues (including flooding of office buildings).

Summer drought: Underground cable systems and surface infrastructure foundations affected by summer drought and consequent ground movement, leading to mechanical damage/failure. The drying out of the soil surrounding underground cables will also lead to an increased thermal resistivity, reducing heat transfer from cable to surrounding soil/backfill, resulting in a reduced current (load) carrying capacity.

Prolonged growing season: Overhead lines affected from interference from vegetation.

Hurricanes and high winds: Impacting overhead line structures, resulting in increased frequency of extreme events causing additional faults and a strain on resources.

Ice and snow in winter: Major incidents increased due to increased frequency of ice events. Heavy snowfall leading to excessive loading on buildings. Increased heating demand causing additional load on network, leading to additional faults.

Increased temperature in summer: Increased cooling demand, causing additional loadings placed on network, leading to additional faults. Heat waves resulting in increased staff absence due to sickness, safety concerns for field staff.

Flooding remains our principal risk with the highest impact. SP Energy Networks is working to ensure full network compliance is attained with existing flood resilience standards through adoption of flood protection barriers, "tank-lining" civil assets and raising substation doors. Flood resilience measures have been installed at substation sites deemed at risk of flooding following detailed flood surveys. In 2018, the underlying flood resilience standard has been augmented (ETR 138 Resilience to Flooding of Grid and Primary Substations). We will work to that standard in RIIO-ED2 (2023-2028) to address the risk management of flooding at grid and primary substations in England, Scotland and Wales from coastal, river and surface water flooding.

We will also continue to engage with the environmental agencies Environment Agency (EA), Scottish Environmental Protection Agency (SEPA) and Natural Resources Wales (NRW) to undertake collaborative efforts in flood protection/mitigation schemes.

For our overhead networks, as part of RIIO-ED2 planning, we will continue to rebuild, modernise and refurbish our assets with the long-term plan of achieving storm resilience for 40% of all interconnected 11kV and 33kV overhead networks by 2034. We are also continuing our proactive tree management work (in line with ENATS 43-8 and ETR 132). Our vegetation management work has highlighted the opportunities to reduce the cost of damage and disruption to assets and property, and the positive impacts that adaptive investment can deliver. Ahead of RIIO-ED2, we will incorporate the analysis of potential impact from ground movement on poles/towers within the statutory 6-yearly inspection cycles and overhead line condition assessments.

Biodiversity

We aim to have a net positive impact on the environment and communities in which we operate, protecting and enhancing the biodiversity around our assets in support of national and local strategies.

Human activity is driving a decrease in biodiversity across the globe. Worldwide, around 25% of species are threatened with extinction and natural ecosystems have declined by almost 50% in relation to their previous conditions.* The biodiversity and climate crisis are interlinked: climate change negatively impacts biodiversity, and this ecosystem decline then impacts the Earth's ability to remove carbon emissions, exacerbating climate change even further.

SPD and SPM mitigate biodiversity loss most significantly through our actions to connect low carbon generation for societal decarbonisation. This leads to benefits in terms of climate change mitigation, avoidance of additional land use and reductions in pollution. While we do this, we also protect and enhance the ecosystems we operate within, mitigating the ecological impacts of construction by aiming for 'no net loss' of biodiversity by 2030, in line with the Iberdrola Group target, and avoiding the introduction or spread of invasive non-native species.

*Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report 2019.

Stakeholder Engagement

In September 2021 we hosted a virtual Biodiversity and Natural Capital stakeholder workshop. We received widespread support for the development of a Biodiversity and Natural Capital Action Plan (to be completed in 2022/23) with feedback highlighting the need for a longer term view of implementing the actions in our processes to develop rich biodiversity. The other key messages from stakeholders were setting ambitious future targets for biodiversity restoration and enhancement and developing our approach to carbon offsetting to maximise biodiversity and natural capital benefits.

Status Update

Our ambition goes beyond mitigation to create a positive legacy, by restoring and enhancing habitats and biodiversity. We recognise our maturity in this area is low and uncertainty lies in how this can be achieved across our distribution network, some of which will be challenging due to the distinctiveness of the habitats in many of the areas we work. Our current focus is to quantify our impact and trial enhancement approaches, working collaboratively to ensure the right solution for the right place, providing cost effective results to deliver value to customers.

Case Study:

SPM North Shropshire Reinforcement Biodiversity

SPM completed an £18m reinforcement project completed in 2021, 22km long 132,000 volt wood pole distribution overhead line between Oswestry & Wem.

Biodiversity considerations were integrated from design stages, including:

- Use of trident poles to allow more flexible route, based on avifauna surveys
- Use of existing farm tracks, reducing the use of temporary roads, protecting existing hedgerows and treelines

We worked with Shropshire Wildlife Trust and other local stakeholders to deliver additional biodiversity benefits and regeneration, including:

- Five pond restorations
- 2.5km of hedgerow planting
- 500 native species trees planted
- 0.3ha of wildflower meadow creation
- 2.26ha of wetland creation
- 0.5ha of woodland management, and
- Creation of otter holts at two sites

Employee Engagement

Effective employee engagement is vital in order to achieve our vision as a sustainable and innovative network business of the future.

Our employee engagement strategy

It is essential that our staff understand the environmental processes, programmes and targets contained in our Sustainable Business Strategy, RIIO-ED1 Business Plan and Environmental Management System. Our internal engagement strategy and plan are designed to ensure that all members of staff have the requisite knowledge of environmental aspects and impacts, and the awareness to be able to identify and solve issues as they arise and are better able to determine and address the priorities for change. Training and awareness raising is delivered via a suite of training courses, monthly team briefs, workshops, toolbox talks and online materials.

The Executive Sustainability Steering Group (ESSG) continued to meet quarterly, group membership includes SPEN Chief Executive, Chief Operating Officer, Directors and SPEN Sustainability Team. The main areas of focus in the reporting year:

- Identification of barriers or areas for improvement.
- Best Practice and how this can be replicated across the SPEN Directorates.
- Discussion around key priorities and strategic planning.

Transformation Milestone Plan – There is a significant level of business change required as we prepare for ED2. SPEN Sustainability Team, SPEN Directors and the Chief Operating Officer have developed a change management plan, around the Prosci change model, to deliver the people side of this change. The plan addresses the key areas of awareness, desire, knowledge, ability and reinforcement. In the reporting year the plan focused on the following areas:

- Internal sustainability best practice calls, with attendance from across the organization. There are two calls, an SPM South call and a North call covering SPD and SPT. The call discusses sustainability and environmental initiatives, shares observations, highlights processes/procedures, and strengthens responsibilities in controlling and reducing our environmental risks and impacts.
- Environmental roles and responsibilities formalised and communicated to staff.
- Sustainability personal goals for all SPEN staff.

Training – Staff undertake a range of mandatory environmental training tailored to specific job roles, these include environmental awareness, spillage control, resource management, SF_6 awareness and wildlife and countryside.

These bespoke courses were developed with an environmental consultant to provide an awareness and understanding of: environmental risks encountered in activities: how to identify risks; mitigate against them and ensure environmental compliance. In the reporting year 579 e-learning courses were completed by SPD staff and 797 by SPM.

New training: SPD and SPM joined the Supply Chain Sustainability School (SCSS) in 2020, a collaborative online school with a catalogue of free resources that offers extensive training in different areas of Sustainability. SPEN is a Partner of the School, enabling CPD accredited training both for internal staff and supply chain. SPEN specific learning pathways were created in 2020, providing more targeted topic specific training pathways in key areas of focus where upskilling is required, such as Carbon Management, Biodiveristy and Natural Capital and Circular Economy. Staff engagement with the school has led to achievement of gold accreditation

The ScottishPower group also launched a new climate e-learning course to increase climate literacy across the organisation.

Future Networks Learning Lunches – Learning Lunches to inspire innovation and sharing of best practice continued in the reporting year and they continue to be well attended by staff from across SPEN, including our Distribution Licences, SPD and SPM.

Regular face to face engagement – Discussing sustainability and environmental compliance and improvement through regular engagement with senior managers, their teams and other groups of staff, including staff away days, graduate and apprentice inductions and regular meetings with licence directors and their management teams.

Environmental Express and Toolbox Talks – A number of email publications highlighting legislative and behavioural changes to all front-line and management staff. Topics included proper waste disposal practices to avoid contamination; reuse and disposal of wood poles; Japanese Knotweed awareness; and environmental incident reporting.

ICAN – Employee Climate Action Network – Our Employee Networks are created and run by people with a drive and a real interest in bringing people and teams together. Supported by ScottishPower and led entirely by employees, the growing number of employee networks help build our business and help us to attract and retain diverse talent. The iCAN network is a fantastic vehicle for employees to share and build knowledge on sustainability, taking personal action and driving enthusiasm for climate action across the ScottishPower group.

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

Introduction

SP Energy Networks is committed to delivering the low carbon transition in the UK and are proud to be a part of Iberdrola's global leadership on climate change.

Our Sustainable Business Strategy identifies that we must support the low carbon transition in two key ways:

- By adapting how we operate our business and network; and
- By facilitating the low carbon transition ambitions of our customers and stakeholders.

Driving the transition to a low carbon energy system while minimising the impact of our activities on the environment is the underpinning concept behind our Business Plan, the focus of which is on:

- Delivering fast, efficient and innovative low carbon technology connections, and;
- Ensuring the efficient delivery of additional capacity where there is no available capacity.

As a regulated DNO, our priority is to provide a safe reliable supply of electricity to homes and businesses. Through innovation, we can continue to provide this safe, reliable supply whilst also facilitating decarbonisation and managing our environmental impact.

Our role in the Low Carbon Transition is to:

- Connect Low Carbon Technology;
- Develop our Innovation Strategy and culture of innovation;
- Develop Smart Grid solutions;
- Bring developments proven in innovation projects into business as usual; and
- Facilitate the roll-out of Smart Meters to homes and businesses.

This approach is underpinned by mature business processes and delivery platforms which enable all SP Energy Networks staff to be involved in the identification, development and delivery of industry-leading projects to support the low carbon transition.

Connecting Low Carbon Technology

One of the biggest opportunities and challenges for all distribution network operators is that networks were built for traditional one-way flow of energy.

Through the installation of Low Carbon Technologies our customers are increasingly becoming 'prosumers' (both consumers and producers of electricity), opening up opportunities to manage flows of energy on the network in a more hands-on way. Taking on these new opportunities to support the low carbon transition whilst maintaining system reliability and availability means a shift from the traditional role of Distribution Network Operator towards the more dynamic and proactive role of Distribution System Operator.

An effective system will reduce balancing costs and enable the flexibility required for customer use of Low Carbon Technologies.

In 2021/22, we installed a total of 9,950 Low Carbon Technologies (equivalent to 326MW). This includes the facilitation of Heat Pumps, PV and Electric vehicles.

[1]Our DFES documents published here; Distribution Future Energy Scenarios – SP Energy Networks describe how electricity generation and demand may evolve in our SP Distribution and SP Manweb regions over the next 30 years.

The uptake of heat pumps remains slow in comparison to Distribution Future Energy Scenarios[1] (DFES) forecasts. Whilst the volume of recorded new EV charge points (slow and fast charge) in both SPD and SPM have seen significant increases during 2021/22, it remains lower than DFES indications. It's likely that volumes particularity relating to EVs is much less than the actual uptake, the information here is reliant on notification from customers or accredited installers.

Stronger incentives and/or national registration systems need to be put in place to encourage customers to notify network companies of newly installed LCTs, ensuring that all LCTs connecting to the network are captured. Accurate reporting of these volumes will assist DNOs and Ofgem in planning and forecasting activities throughout RIIO ED1 and ED2.

The volume of other LCT DG connections during 2021/22 increased significantly on last year's published figures. We have not forecast any material changes to our longer term LCT uptake forecasts at this time due to (i) the continuing uncertainty regarding the impact of government subsidy mechanisms and broader economic forecasts; and (ii) expectation of increased connections as a result of opportunities afforded by our flexible connection policies.

Table 13 – Number of LCTs installed in SPD

Estimated Volumes of LCTs Installed SPD	Heat Pumps	Electric Vehicle Slow Charge	Electric Vehicle Fast Charge	Solar Panels	Other Distributed Generation including Biomass & Wind Generation	Total MW Connected
2015/16	20	405	0	5,497	145	146
2016/17	45	226	0	468	139	438
2017/18	132	73	553	671	178	88
2018/19	63	42	327	1,164	227	34
2019/20	79	30	968	287	111	17
2020/21	57	2	1,260	495	172	117
2021/22	200	0	3,027	793	485	180

Table 14 – Number of LCTs installed in SPM

Estimated Volumes of LCTs Installed SPD	Heat Pumps	Electric Vehicle Slow Charge	Electric Vehicle Fast Charge	Solar Panels	Other Distributed Generation including Biomass & Wind Generation	Total MW Connected
2015/16	42	437	0	7,966	120	98
2016/17	70	229	0	579	74	150
2017/18	62	85	413	268	282	64
2018/19	132	43	362	347	354	51
2019/20	182	102	426	64	94	116
2020/21	239	3	2,048	757	255	93
2021/22	469	35	2,432	1,585	924	146

Progress of the Innovation Strategy

We have challenged ourselves to deliver an ambitious innovation programme and have built a strong portfolio of projects which are impactful and deliver benefits for customers as we move into RIIO-ED2. Within RIIO-ED1 we have spent over £32 million on our NIA (Network Innovation Allowance) projects, 75% of which has gone to the wider community and industry.

Innovation is going to continue to be critical to tackling climate change. Our project portfolio puts us at the forefront of finding smarter, more agile ways to manage our network and to find solutions to challenges like the decarbonisation of heat and transport, and in enhancing network resilience and security of supply.

It's also why we've incorporated significant innovation investment and specific deliverables in our ED2 Business Plan. This includes a dedicated Innovation Strategy, focusing on key areas such as the electrification of heat and transport, hydrogen, and consumer vulnerability. We recognise the scale of the challenge faced by our industry and are committed to ensuring we bring everyone along on that journey as we drive a just transition for all. We're proud of what we've achieved so far and excited by what I know is yet to come as we build a greener energy future for all.

In the past year we have continued to develop and deliver innovation solutions that focus on a secure and stable electricity supply, and to support the most vulnerable in society. One of the key focus areas for us as we delivered our innovation portfolio in 2021-22 was preparation for the start of RIIO-ED2 by concentrating on new innovation challenges. One vital challenge is the Strategic Innovation Funding (SIF) mechanism which aims to support network innovation that contributes to the achievement of Net Zero Carbon, while delivering net benefits to energy consumers. Since early 2021 we have been using and leveraging SIF funding to ensure that we have a positive impact on our customers and can enable the transition to the new energy system.

NIA PMO Update

Within the past year, we have continued to develop and deliver projects through our dedicated Project Management Office (PMO), tracking project progress across the portfolio on a weekly basis, enabling timely decision making and maintaining a live record of current project progress which is then used as a source of management information by the Innovation Board.

We have formalised a process that focuses on the plausible benefits of the projects undertaken by the PMO. The benefits of the projects were anticipated by conducting a thorough review of all the current ongoing NIA projects which aided in the generation of benefit maps and schedules. The PMO comprises of experienced project managers and portfolio managers who ensure thorough internal reporting of every project by working hand-in-glove with the dedicated project managers. The internal reporting and logging of projects focused particularly on the projects which are in transition to the BaU stage, in order to unlock their true value and full range of benefits. We also ensure that all the projects meet NIA governance requirements and are on track to meet the milestones and financial forecasts. The detail focused approach ensures maximum return on investment possible from our yearly spend.

Portfolio Update

During the 2021/22 reporting year SPEN has registered 24 new Network Innovation Allowance (NIA) projects, out of these seven are Distribution lead. Overall, we have 36 ongoing projects. The new projects broad spectrum of development areas includes large scale trial of thermal storage and smart in-home control, trial of Flexibility using Tower Block Heating and Electrical Vehicles and a study into Innovative Replacement for Underground Substations. We are committed to identifying innovative performance improvements across all aspects of our business.

For details of SPEN led projects can be found in the NIA Annual Report [distribution] from 2021/22: Network Innovation Allowance (NIA) Distribution Annual Report: 2021/22

Progress of the Innovation Strategy
continued

Focus on Customer Vulnerability

In 2022, we have developed several projects which focus on our vulnerable customers, and how we can support them through innovation. The following projects are all managed through the NIA framework:

Security of supply for vulnerable consumers will identify and test technologies which will aid in system and communication restoration and develop a support tool to enable effective decision-making during loss of supply incidents.

Vulnerability in the Energy System Transition will develop a tool to assess the likelihood of customers being left behind in the energy system transition, based on their geographical area. This area-by-area breakdown will allow SP Energy Networks to provide improved advice and support to customers.

The PSR Comms Review project will look to assess the use of a behaviourally informed approach to communication to improve customer engagement with the Priority Services Register, and to understand the differences between consumer groups who may require bespoke approaches according to their needs.

We Innovate in Collaboration

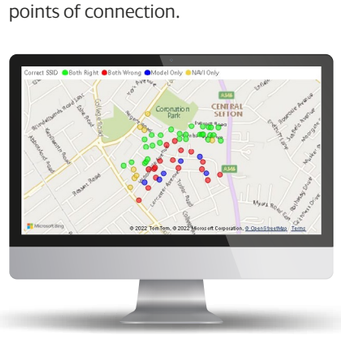
Collaboration is essential to enable innovation. We collaborate with other network operators and licencees on our projects, allowing us to share knowledge and increase our ability to steer new developments for the benefit of the industry. We also actively engage with several forums that facilitate these collaborations, in addition to academic and European collaborations. Two of these key forums that SP Energy Networks work with are:

Power Networks Demonstration Centre – The PNDC aims to **accelerate the adoption of innovative research and technologies from early-stage research into business-as-usual adoption** by the electricity industry through their close work with academic partners.

The Energy Innovation Centre – The Centre works with several UK energy networks to improve collaboration with Small and Medium sized Enterprises (SMEs) to accelerate innovation performance to enable the transition to a low carbon economy.

1. Automated verification of network connectivity

The methodology used for phase identification will also be used to verify the network connectivity. Customers' voltages that share the same source (from the same transformer) share the same voltage profiles. For those that were indicated to share the same transformer but with different profiles, there are high likelihood that they are not connected to the same source. Initial analysis has been made and further refinement is needed to ensure accuracy of the output. This includes impedance traces to fault locations, as well as traces to allow users to manipulate the network for analysis relating to faults and new points of connection.



Result of initial analysis of network connectivity verification, which compares the algorithm (model) and what was indicated in NAVI against what is reported in ESRI,assuming ESRI is the source of truth.

2. Near real-time network connectivity understanding

Scheduled jobs are setup to extract voltage data from smart meters. Risk reporting is provided by identifying networks with the largest voltage variations and high number of smart meter alarms. Within NAVI (Network Analysis and View) we have recently developed several network traces and heatmaps to help with network analysis and visualisation. This includes impedance traces to fault locations, as well as traces to allow users to manipulate the network for analysis relating to faults and new points of connection.

Smart meter voltage profiles used to identify faults on the network.

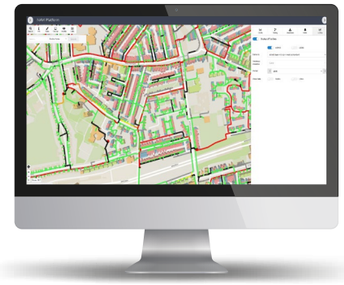
3. Improved LV Network modelling capability

NAVI has formed a key part of many projects including LV connection and scenario analysis, HV tracing to assist earthing studies and has acted as the main feed of pre-analysed GIS data to several other internal projects. One key feature of NAVI is the way in which we have rationalised and backfilled asset data within the network model. The rules have been created for LV and HV assets up to 33kV.

A fully rationalised network model has a multitude of benefits including identification of potential risks on the network and the need for reinforcement and faster identification of suitable points of connection. We have also developed several exports from the platform to various analysis tools including WinDebut, DIgSILENT and IPSA, which is allowing users to model fully annotated circuits and substations within minutes.

4. Scenario analysis of investment requirements for EV penetration

NAVI is also processing and visualising the results of other innovation projects EV-UP and Heat-UP where it analyses the impact to our network of predicted LCT penetrations from now until 2050. This work is being used around the business to help prioritise and plan reinforcement of our assets.



Roll Out of Smart Grids and Innovation into Business as Usual

In ED1 there is increased need to ensure that innovation is embedded into all business functions, as such the role of our Innovation Board is to ensure increased participation from all business functions and to allow innovation projects to be completed and integrated into Business as Usual (BaU).

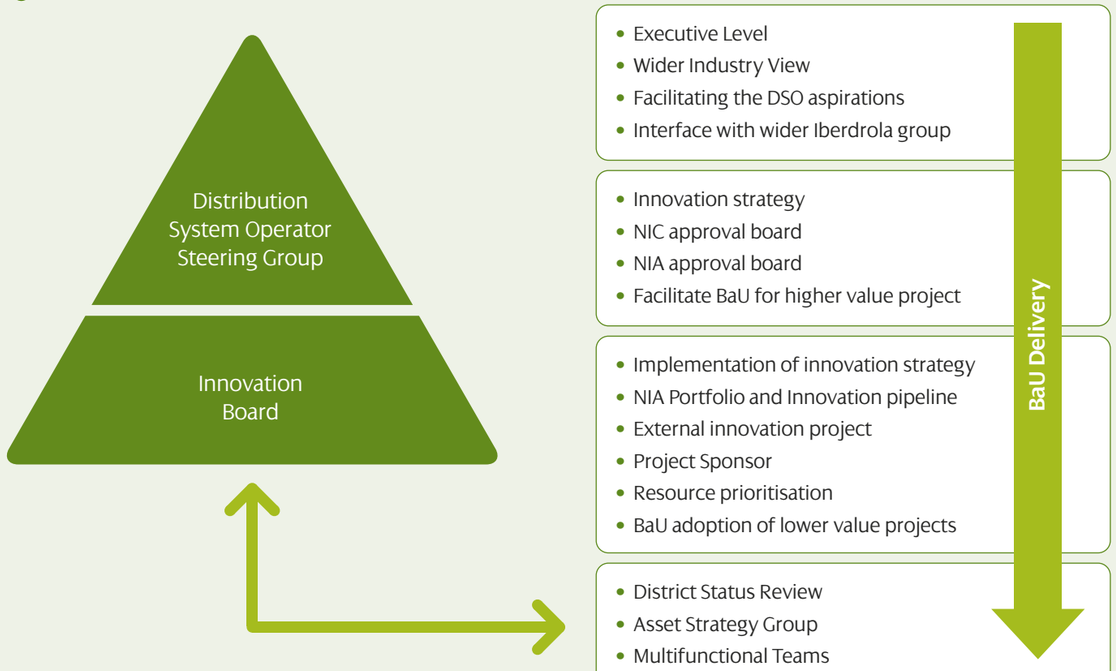
Our Think Big, Start Small, Scale Fast approach to innovation enables us to be at the forefront of innovative practice and is embodied in our guiding values. At SP Energy Networks we believe in the power of innovation to enhance all aspects of our business and improve our service for the benefit of both our internal stakeholders and customers.

Transition into BaU is a process taking place thorough step 4 and 5 of our innovation process.

In step 4 – Development and Delivery: A project manager and project team identified for each project to deliver the day-to-day project activities. Business Sponsors help to facilitate the integration of proposed, existing and completed projects into BaU. Projects are monitored through their life cycle and, in the event that anticipated benefits do not arise projects may be terminated. Technology readiness levels and project scale will be used to determine appropriate funding routes, be it NIA, NIC or other funding streams such as research grants.

In step 5 – Application of Learning: Appropriate channels both internal and external will be used to disseminate learning from both successful and unsuccessful projects to a wider audience. We will also seek opportunities to learn from and collaborate, as appropriate, with other DNOs.

Figure 9 – Innovation Governance Structure



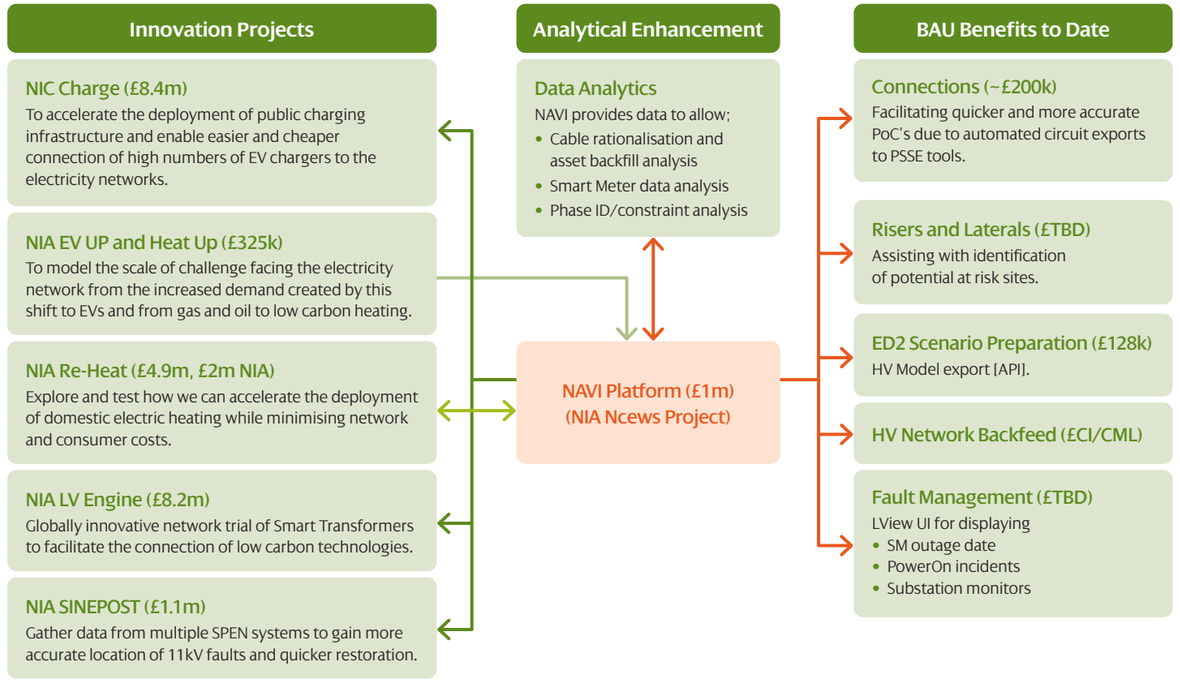
In scheme year 2021/22 we have enhanced the following innovative technology projects to achieve further business as usual benefits:

NCEWS 2

Management of network access for the expected volumes of new and resultant increases in customer energy requirements continue to be the key theme for the Network Constraint Early Warning System phase 2 (NCEWS2) project. The focus within the NCEWS2 project has been to develop a fully connected LV network model that was suitable for supporting detailed analytics and data extracts to identify network issues. To achieve this, the following objectives were identified:

Platform Evolution	EV and DER Management	Business Engagement	HV Analysis
• Platform Enhancements • Data Analytics • Data Improvements • SM Enablement BAU Management	• LV/EV/DG Modelling • EV API Development • Data Analytics	• Stakeholder Engagement • BAU Implementation	• HV Development • Data Analytics • Leverage other project funding

Figure 10 – Projects benefiting from the NAVI Platform



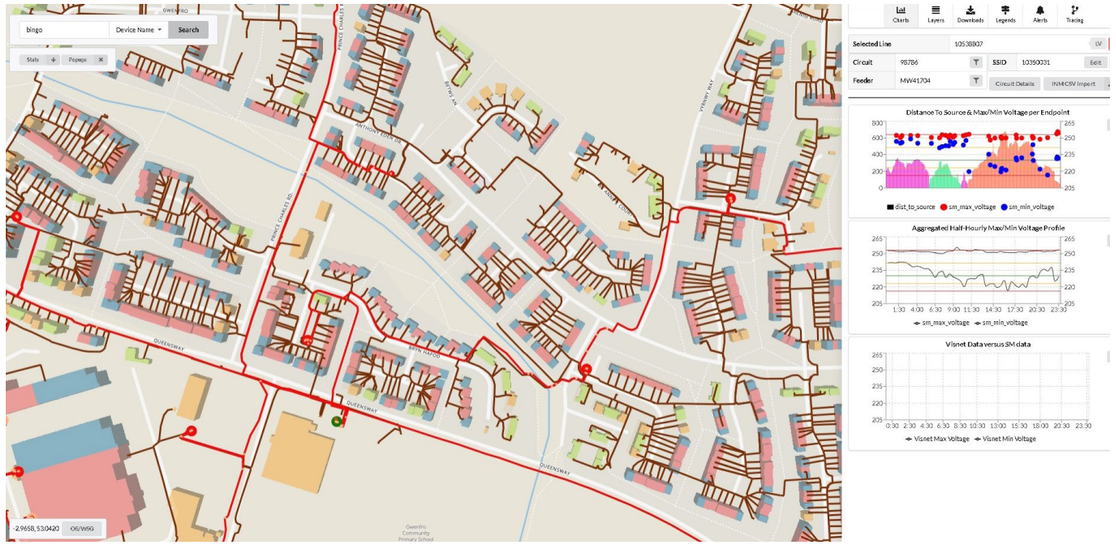
Roll Out of Smart Grids and Innovation into Business as Usual
continued

LView

Within the NCEWS2 project we noticed the potential to extend the NAVI Platform to create a User Interface (UI) closely related to the existing NAVI LV data model for displaying/managing LV fault indications from substation monitors, Smart Meters and PowerOn outage predictions. The intention here is to allow SPEN to internally manage this data and move away from several 3rd Party platforms to display 'our own' data in one place. The trial platform has been developed, named LView, and we have successfully integrated it with EATL Visnet monitors, PowerOn and our Smart Meter data system for near real-time visualising of their LV alarms. We now intend to extend this to include other 3rd party monitors.

Key benefits include enhanced visibility/decision making as all data will be in one place, quicker fault resolutions so customers are back on supply faster, reductions in CI/CML, plus a major step forward towards digitalization and Net Zero Carbon goals.

Figure 11 – Navi platform



NAVI platform visualisation showing circuit connectivity, ADMD (After Diversity Maximum Demand) estimation and building understanding, with Smart Meter voltage data.

Flexible Tower Block

In the reporting year we have concluded work on the desk-based study and made significant progress with the work towards the tower block trial. The initial work comprised a desktop study into the tariffs available to the residents and their ability to access the flexibility market. This desktop study into existing tariff structure and its suitability for networks and customer investigated how benefits for customers and network can be captured.

Connected Response have been engaged by the Glasgow Housing Association (GHA) to supply in-home smart controllers. The smart controllers and monitoring is now installed in the Cartcraigs tower block. The project has delivered its first set of objectives relating to the opportunities that smart control of storage heaters can bring to customer and network.

Project progress has realised the following findings:

- There would be benefits from a flexible smart storage tariff
- Dual-rate tariff most appropriate in next 5-7 years (rather than half-hourly time of use)
- Could enable value from flex market to be shared with customers
- Retailers, Aggregators and control providers all with role to play.
- A number of options available to networks to enable storage heater flexibility
- Revised red band DUoS wrapped into tariff as present situation
- Continue Flex tenders within Constraint Managed Zone (CMZ)
- Arrangement with retailer/aggregator to avoid red band
- Direct overriding signals (ANM)
- Working with local energy market using price signals
- Combination of these approaches
- There is potential for a trial
- Multiple groups of storage heaters across Glasgow
- Each group provided with simulated constraint
- 2-3 retailers per trial
- Electricity Supply Operator (ESO) involvement
- Under a sandbox arrangement
- SP Energy Networks needs to better understand future flexibility at LV level and develop better
- Visibility of future constraints
- Electric vehicles and heat pumps down to street level
- Implement greater monitoring of these assets

In addition to the tariff study a trial will take place at the Cartcraigs tower block in the southside of Glasgow.

The objectives of the trial are listed below, these will be completed during the next reporting period.

- Demonstrate the shifting of demand using thermal storage heaters whilst maintaining customer warmth and comfort in the tower block.
- Show that the storage heating demand shift in the tower block can support local electric vehicle charging requirements.
- Show that the storage heating demand shift can be randomised to support cold load pick up and support use of constrained wind.

Roll Out of Smart Grids and Innovation into Business as Usual
continued

Roll Out of Smart Meters

Installations under the UK's Smart Metering Implementation Programme recovered somewhat during the 2021/22 regulatory year, following significant impact as a result of the Covid-19 pandemic in the previous year. Nevertheless, by 31st March 2022 there were approximately 250k SMETS2 devices in our SP Distribution licence area, with approximately 298k in SP Manweb area.

During 2021/22, our systems were enhanced to be compatible with older SMETS1 devices, where previously we could only communicate with SMETS2 meters. However, SMETS1 devices must be enrolled into the UK's Smart DCC infrastructure to ensure we can connect, and the enrolment process is controlled by Electricity Suppliers. By the end of the year, we were able to communicate with 246k SMETS1s in SP Distribution area, and another 241k in SP Manweb.

As a consequence, we were able to retrieve data from 1.1 million smart meters by the end of the year, almost one-third of our customer base.

These growing numbers contributed to increased benefits this year. The roll-out is expected to run until 2024/25, and as the volumes increase, the benefits we anticipate from communication with connectable smart meters include:

- The ability to accurately determine when a customer has lost supply, potentially before the customer themselves has realised.
- Early warning of potential faults through identification of network components under stress.
- Once a loss of supply is identified we believe that smart meters will allow us to react and restore power to customers more quickly.
- Reducing the number of unnecessary site visits made by us each year.
- Smart meters will allow us to identify when an individual customer's power has not been restored, allowing us to ensure we act swiftly to rectify outstanding faults.
- Avoided voltage complaints – in this area SPEN believe we can become proactive in identifying and addressing voltage anomalies before they inconvenience customers.

During 2021/22, SP Energy Networks implemented further refinement to our Smart Metering IT application, introducing new functionality and system enhancements. Further improvement is planned for 2022/23, including the opportunity to quickly identify the location of a fault.

We have continued to make preparations for increased volumes of smart data as and when these become available. We target refinement of our system application, network monitoring and data modelling. In addition, we continue to work with key stakeholders to identify the best opportunity to utilise smart meter data for the benefit of our customers. This practice will continue, ensuring we monitor and enhance our business processes as more customers join the smart metering revolution.

For the 2021/22 regulatory year, we did identify a financial benefit from the smart meters currently installed and enrolled in Smart DCC's infrastructure. This benefit relates to reducing fault costs by avoiding unnecessary visits to premises where the smart meter data confirms the electricity supply to be on.

References

If you would like further information on SP Energy Networks please visit our website:
spenergynetworks.co.uk

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https://www.spenergynetworks.co.uk/pages/stakeholder_reports.aspx

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List of Abbreviations

AC	Alternating Current
ADMD	After Diversity Maximum Demand
ANM	Active Network Management
AONB	Area of Outstanding Natural Beauty
ARC	Accelerating Renewable Connections
BCF	Business Carbon Footprint
CBA	Cost Benefit Analysis
CO_2	Carbon Dioxide
dBA	A-Weighted Decibels
DC	Direct Current
Defra	Department of Environment, Farming and Rural Affairs
DIgSILENT	Software and consulting company providing engineering service
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EA	Environment Agency
ED1	Electricity Distribution Period 1
EHV	Extra-High Voltage (33kV)
ENA	Energy Network Association
FITS	Feed in Tariff
GIS	Geographic Information System
G83	Domestic LCT's
GB	Great Britain
GWh	Gigawatt Hours
HV	High Voltage (11kV)
IPSA	Interactive Power System Analysis
kV	Kilovolt
LCNI	Low Carbon Network & Innovation Conference
LCNF	Low Carbon Networks Fund
LCT	Low Carbon Technologies
LV	Low Voltage (230/415V)
MVDC	Medium Voltage Direct Current
MW	Megawatts
MWh	Megawatt Hours
NAVI	Network Analysis and View
NCEWS	Network Constraint Early Warning Systems
NGET	National Grid Electricity Transmission
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NRW	Natural Resources Wales
NSA	National Scenic Area
OHL	Overhead Line(s)
PSSE	Power System State Estimation
PV	Photovoltaic
REGO	Renewable Energy Guarantees Origin
RIIO-ED1	Revenue Incentives, Innovation and Outputs – Electricity Distribution Period 1
RSPB	Royal Society for the Protection of Birds
USEF	Universal Smart Energy Framework
SCADA	Supervisory control and Data Acquisition
SEPA	Scottish Environment Protection Agency
SF_6	Sulphur Hexafluoride
SMETS	Smart Meter Equipment Technical Specification
SPD	SP Distribution Licence Area
SPEN	ScottishPower Energy Networks
SPM	SP Manweb Licence Area
SPT	SP Transmission Licence
SSSI	Site of Special Scientific Interest
tCO_2e	Tonnes of Carbon Dioxide Equivalent
UK	United Kingdom
WANDA	Weather Normalised Demand Analytics
WIN	Debut-load flow package used for LV network design

List of Figures, Tables and Graphs

SP ENERGY NETWORKS

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