SP Energy Networks

Distribution Environmental & Innovation Report

April 2019 – March 2020

SP ENERGY NETWORKS

Contents

Executive summary

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

In 2019/20 COVID-19 began to impact every part of our society and the UK economy. It has changed our ways of working, socialising and living. As the operator of critical national infrastructure, our priority at the beginning of 2020 was to keep the power flowing to our 3.5million customers; in turn keeping us connected to family, friends and work.

Looking to the future, the journey to Net Zero has never been more important. The environmental, social and economic benefits of building a sustainable future and decarbonising various industries, products and services are huge.

We're at the heart of delivering the Green Recovery for the UK, which will act as a stimulus for economic growth across a variety of sectors by helping to create jobs and attract investment.

In 2019 Net Zero targets became even more ambitious, the UK Governments commitment to bring all greenhouse gas emissions to Net Zero was brought forward to 2050 and the Scottish Government introduced an even more ambitious date of 2045. SP Energy Networks will adopt a Science Based target for carbon emission reduction in line with limiting global warming to 1.5°C above pre-industrial temperatures. Our journey to a Net Zero future is already underway.

This report highlights our work to manage the network and its impacts, deliver network improvements and enable the connection of low carbon technologies, whilst demonstrating how our progress is driven by our six Sustainability Drivers.

Last year SP Energy Networks launched the Year of Innovation, kicking off a three-year program to empower and enable employees to get involved in innovation and provide the tools and mechanisms to do so. During the 2019/20 reporting year SPEN registered nine new Network Innovation Allowance (NIA) projects, aimed at preparing the network for low carbon technologies, supporting faster, easier connection, and providing greater network flexibility.

By reporting year 2015/16 we had reached our 2023 target of a 15% reduction in business carbon footprint (excluding losses) against our 13/14 baseline year. This reporting year, our distribution licences have jointly achieved a reduction of 28%, bringing our total reduction to 55% since 2013/14.

In tackling network losses, we have invested in 462 new lower loss transformers since the start of ED1, resulting in estimated cumulative reduced losses of 73,528 MWh equivalent to 26,630 tCO_2e.

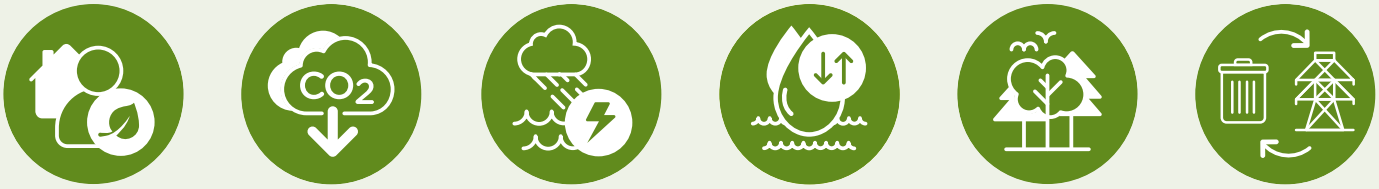
At the start of RIIO-ED1 we committed to reducing oil leaks by 50% through replacement of poorly performing 132kV cable in SP Manweb. As a direct result of strategic repair and targeted asset replacement we have now reduced leaks by 76% since reporting year 2015/16.

We continued to maintain certification of our Environmental Management System (EMS) to ISO14001:2015, continuing work to improve the quality and completeness of our data, allowing us to better report our progress towards our goals.

Involving stakeholders in co-creating projects and initiatives has led to improvements in our processes, a better understanding of the communities we work in and improved environmental outcomes. This year, an assessment by Accountability, owners of the AA1000 Stakeholder Engagement standard, placed us within the top 10% of companies assessed globally, with an engagement maturity score of 78%.

We welcome your feedback on the information presented within this report, which is invaluable as we deliver our vision of a sustainable networks business.

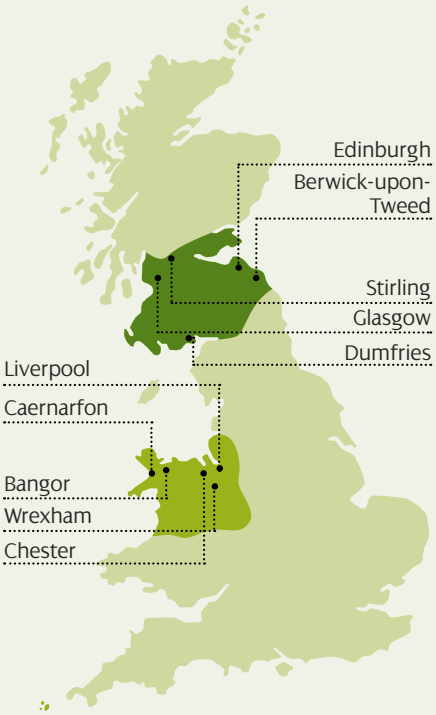
Figure 1 – Our Sustainability Drivers



Who we are

SP Energy Networks (SPEN) 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, whilst the distribution network SPM, in North Wales, Merseyside, Cheshire, and North Shropshire covers approximately 12,000km. 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. 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 towards our vision of sustainability. 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.

Who we are
continued

Figure 3 – Our Business

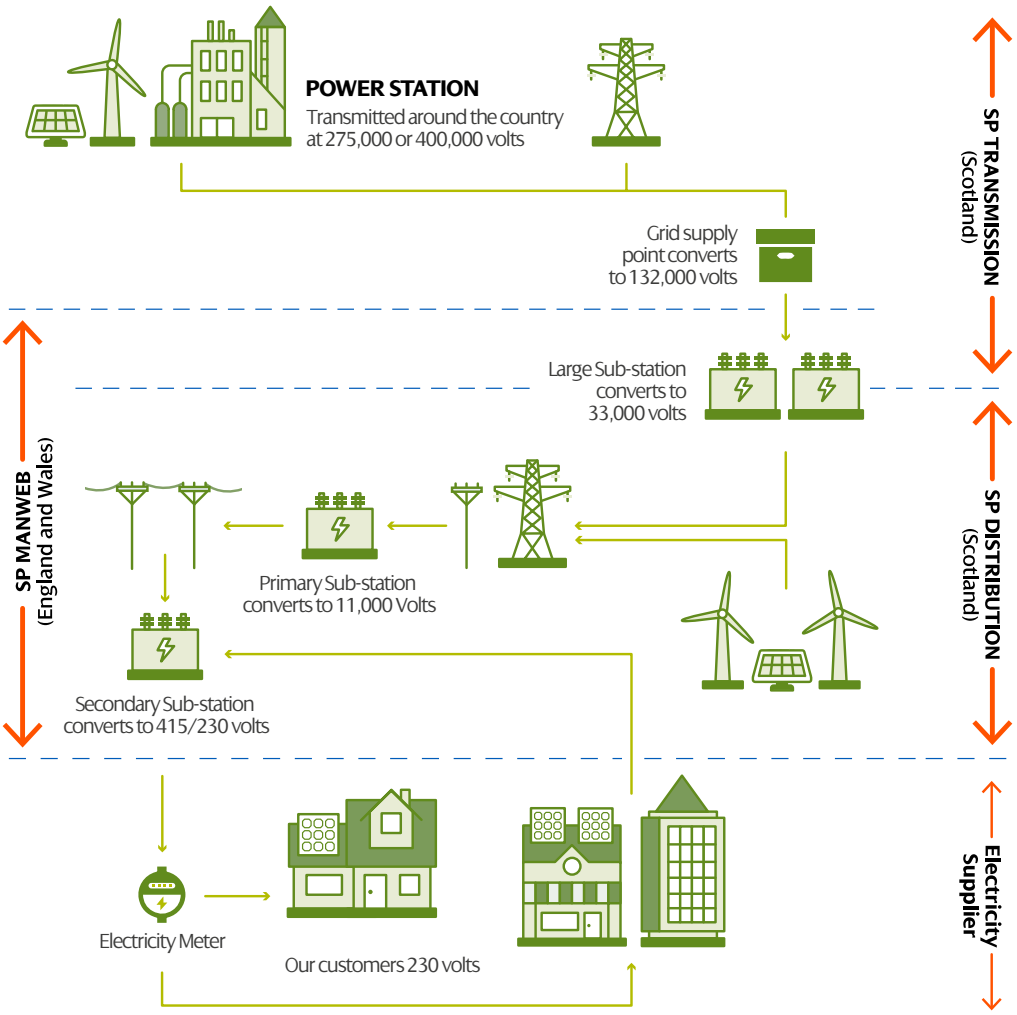


Table 1 – Key Goals and their Rationale

	Carbon and Energy Reduction	Sustainable Resource Use	Water Efficiency and Protection
2023	*-15% carbon footprint**	*Divert 95% of waste from landfill*	*-10% in water use**
2030	*-80% carbon footprint**	*100% waste recycled or re-used*	*-25% in water use**
2050	*Carbon neutral**	*Zero waste*	*-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 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

Our engagement places our stakeholders and customers at the centre of what we do. With a tailored and locally focused approach, we will prioritise their wants and needs in a consistent manner across our business. We will deliver safe, reliable services, sustainable value, and a ***better future***, ***quicker***.

SPEN Stakeholder Engagement Strategy Mission Statement.

It's critical that we engage with our stakeholders to understand their challenges and help them to achieve their aspirations.

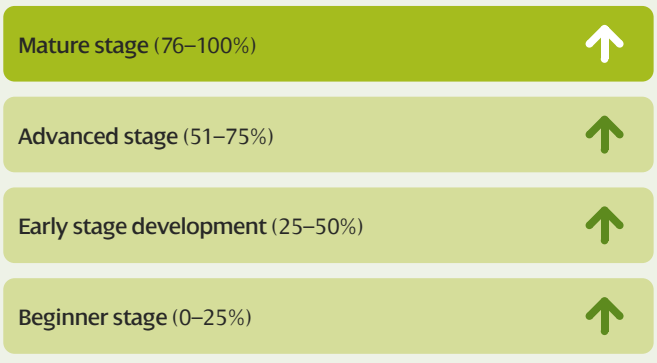
Since 2013, our robust Stakeholder Engagement Strategy has aligned to the globally recognised AA1000SE Stakeholder Engagement Standard. In 2018/19, we implemented a new Stakeholder Engagement Strategy, which makes our mission, principles, approach and processes much easier to understand. Our new strategy embeds at its core, the four principles of the AA1000 stakeholder engagement standard – Inclusivity, Materiality, Responsiveness and Impact.

These principles ensure we engage at all levels, (with a specific focus on those who are hard to reach), determine the most relevant and significant issues for us and our stakeholders, act on the outcomes of our engagement – making the necessary changes to our business – and then measure the results.

Embedding these principles is important to our business, as good engagement with stakeholders helps us to improve impact, reduce inefficiencies, create greater environmental and socio-economic value and reduce risk. Most importantly, effective engagement leads to tangible action in our business and benefits for customers and stakeholders.

The implementation of this engagement strategy, alongside our existing robust engagement approach, has led to a 6% increase in our measured stakeholder engagement maturity this year, achieving 78% maturity, taking us into the 'Mature' stage. This is a massive achievement, placing us within the top 10% of all companies assessed globally.

Figure 4 – Stakeholder Engagement maturity ladder



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

This level of maturity is due to the significant management, staff and system resource we commit to carrying out in-depth engagement and changing our business strategies and plans in response. In 2019/20 we engaged with stakeholders across a wide range of subjects in three key strategic areas:

- **Better – A Sustainable Network**, engaging with 1,495 stakeholders to deliver outcomes on sustainability, electric vehicles and heat.
- **Future – Smart Communities**, engaging with 6,513 stakeholders to deliver outcomes on smart communities, resilience, recruitment, safety, customer service and social obligations.
- **Quicker – An Innovative Network**, engaging with 7,401 stakeholders to deliver outcomes on the future of our networks, transition to distribution system operation, land and planning and connections.

Our robust embedded engagement model means every team in our business has responsibility to identify and engage stakeholders to understand their needs and improve our service. This is underpinned by a strong annual programme of core engagement that looks at the big 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

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 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 2018 we achieved recertification to ISO14001:2015. To achieve this we undertook a revision of our process to identify our Environmental Aspects and improved the methodology used to assess the risks. These measures allow us to continuously improve and meet our targets.

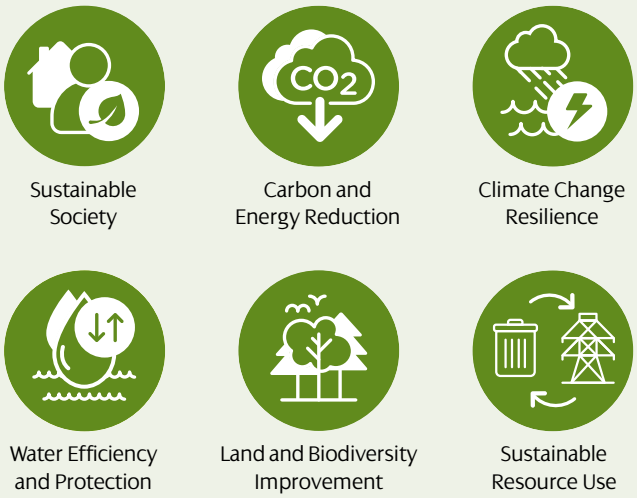
Our Depots are audited annually according to the Aspects and Impacts (A&I) Assessment Matrix and risk scores applied. We continue to use the reporting tool, Cintellate to assist in measuring and driving compliance for Health, Safety and Environmental issues. Cintellate is used to record environmental incidents and to track the actions taken to resolve issues, 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**. As a result of stakeholder engagement, we updated our drivers in early 2019 to combine the Raw Materials Optimisation and Waste Management and Minimisation drivers into a single Sustainable Resource Use driver, in order to recognise resource use and waste as part of the same continuum.

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.

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 users 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 ED1 period, assessing lines in the following locations:

In our SPM licence Area

- Snowdonia National Park
- Shropshire Hills
- Bryniau Clwyd A Dyffryn Dyfrdw
- Llŷn 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 2 SPM projects in 2019/20, 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 & SPD in 2019/20

Location of OHL	Designated Site	Licence Area	Lines removed	Underground lines installed
Bryniau Clwyd A Dyffryn Dyfrdw	Clwydian Range	SPM	1.1km	0.12km
Snowdonia National Park	Snowdonia National Park	SPM	0.20km	0.13km

Visual Amenity
continued

This collaborative activity results in an agreed priority list by the local community. SPEN 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.

Pictures 6 and **7** show before and after OHL were removed in Nant Peris, a village sheltering in the foothills of Mount Snowden. Here we removed 0.20km of overhead line, which crossed over an ever-popular visitor car park. The line removal allows future visitors to further enjoy this remote area.

Pictures 8 and **9** show the views before and after 1.11km of overhead line at Horseshoe Pass were removed. This exposed elevated area now fully benefits from clear views of the Clwydian Range AONB.

Figure 6 – Nant Peris before OHL removed

Figure 7 – Nant Peris after OHL removed

Figure 8 – Horseshoe Pass before OHL removed

Figure 9 – Horseshoe Pass 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.

Though 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 6 SPD sites and at 15 SPM sites listed. Transformer bunding replacement projects may take place over a number of years. The table (right) shows work carried out in 2019/20 reporting year.

Table 4 – Summary of Oil Mitigation Schemes in 2019/20

Site Name	Licence Area
Sherwood Substation	SPD
Bonnybridge Depot	SPD
Barrhead Substation	SPD
Burnpark Substation	SPD
Foxbar Substation	SPD
Crookston Substation	SPD
Aberystwyth Substation	SPM
Pilkingtons Plate Substation	SPM
Marsh Brows Substation	SPM
Buckley Cros Substation	SPM
Stoneycroft Substation	SPM
Nantwich Substation	SPM
Pilkingtons QF Substation	SPM
Caergiliog Substation	SPM
Minffordd Substation	SPM
Coney Green Substation	SPM
Weaver Ind Estate Substation	SPM
Duddon AOP Bund Substation	SPM
Holmes Chape Substation	SPM
Church Lawto Substation	SPM
Brook Bridge Substation	SPM
Total costs	**£866,003.98**

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, non-toxic and nonharmful to aquatic life 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 158.94km 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 tops 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).

In 2019 we took the innovative approach of employing sniffer dogs to locate leaks within our cables. The picture below shows Jack the sniffer dog who, along with his friends successfully located 3 of the 5 leaks in one of our cable in Liverpool. This method is efficient, environmentally friendly and has proved very cost effective.

As a direct result of strategic repair and targeted asset replacement we have reduced leaks by 76% since reporting year 2015/16.

Graph 1 shows the progress of this strategy and resulting leakage.

Graph 1 – Annual litres of leakage from Fluid Filled Cables

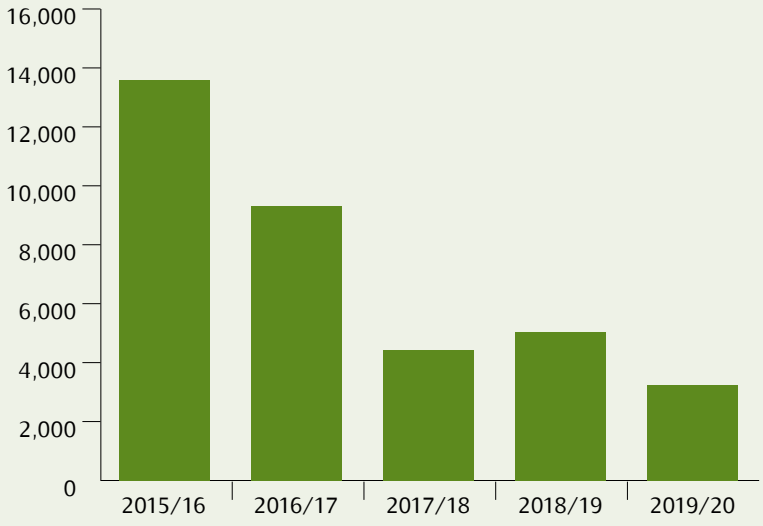


Figure 10 – Jack the sniffer dog

Carbon Impact and Climate Change

Introduction

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

Our ambitious carbon impact and climate change targets support national and international agreements to restrict global temperature increases to less than 1.5°C. Our goal is to reach 15% reduction on 2013/14 levels by 2023, 80% reduction by 2030 and carbon neutrality by 2050. During 2019-20 we started the process of defining science based carbon reduction targets to ensure that our approach continues to align with the latest climate science.

In this section we report on our Business Carbon Footprint (BCF) and Losses. Full details can be found in Appendix 1 SPM, Appendix 2 SPD and Appendix 3 Reporting Table Commentary.

Our carbon footprint considers three levels of data, in line with UK Government greenhouse gas reporting requirements:

- **Scope 1** – Activities owned or controlled by our organisation that release emissions straight into the atmosphere – direct emissions. Our Scope 1 emissions include fleet transport, SF_6 gas emissions and red 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 activities 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 again obtained The Planet Mark™ certification 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.

Our parent company, Iberdrola, has recently set a Science Based Target and we have started the process of agreeing a specific Science Based Target for our network in order to further validate our existing reduction targets.

Table 5 – tCO_2e by scope for SPD 2018/19 and 2019/20 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2018/19	3,670.70	347,128.37	4,608.31	355,407.38
2019/20	3,279.47	353,656.24	3,555.91	360,491.61

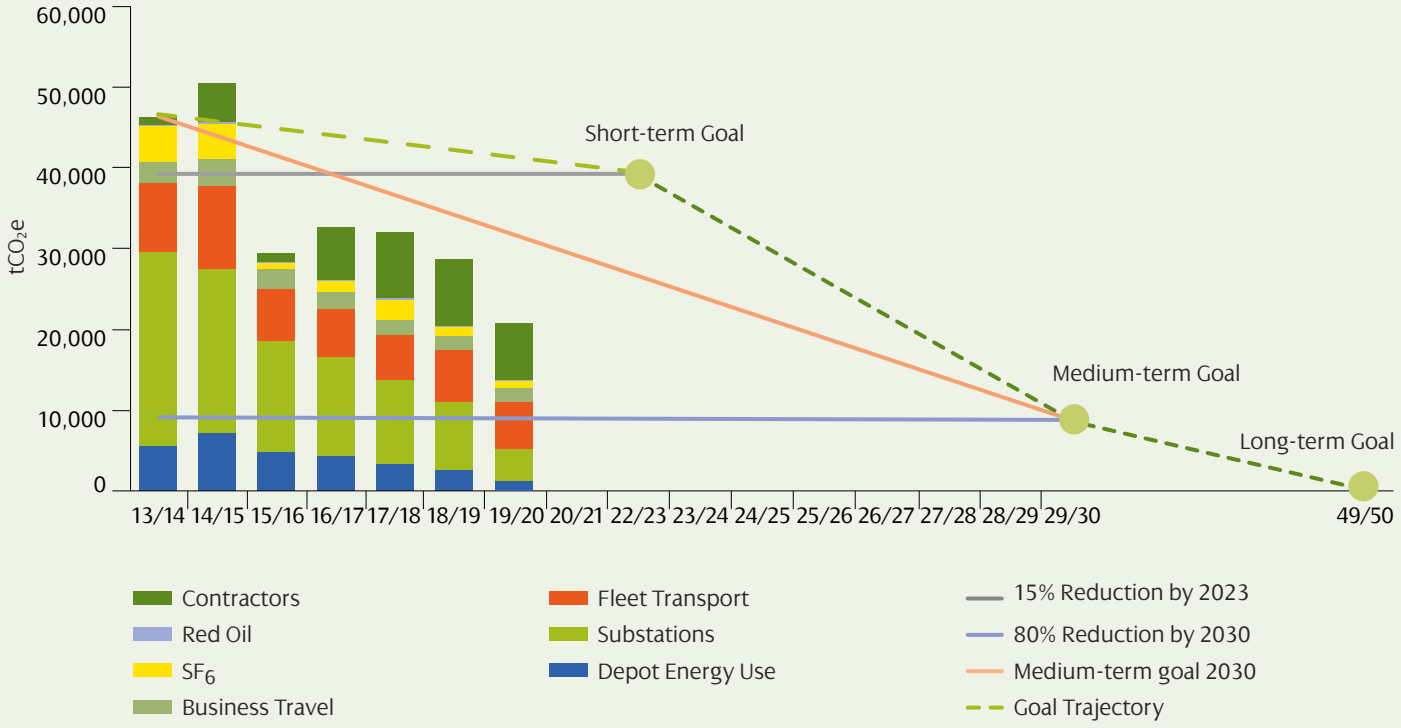
Table 6 – tCO_2e by scope for SPM 2018/19 and 2019/20 including losses

Year	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
2018/19	4,097.26	284,308.24	5,379.09	293,784.59
2019/20	3,676.26	256,772.39	5,065.96	265,514.60

Business Carbon Footprint

Since our 2013/14 baseline year SPD & SPM have jointly achieved a 55% reduction in business carbon footprint excluding losses.

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



By reporting year 2015/16 we had reached our 2013/14 target of a 15% reduction in emissions by 2023 excluding losses. Electricity losses (energy lost or stolen from the network as it travels from source to user), is the largest category of our Business Carbon Footprint, however, it is also the most influenced by external factors. We describe this category in detail in the losses section of this report.

After network losses, our largest carbon footprint comes from the energy used in our buildings and substations, followed by contractor emissions, business transport, Sulphur Hexafluoride (SF_6) and lastly red diesel.

Since September 2019, we have purchased green electricity via a Renewable Energy Guarantees Origin (REGO) tariff. All energy used under this tariff has a carbon emissions factor of zero, significantly reducing the carbon footprint of the energy we use at our depots and substations.

In line with the Greenhouse Gas (GHG) Protocol, the carbon emission related to any electricity use not covered by the REGO tariff (all electricity use between April 1st and September 1st 2019 and unmetered sites, radio base stations and some small substations thereafter) has been calculated using the UK residual mix carbon factor.

The move to the REGO tariff has reduced our recorded emissions from buildings energy use in SPD from 6,067 tCO_2e in 2018/19 to 3,034 tCO_2e in 2019/20 and in SPM from 4,923 tCO_2e in 2018/19 to 2,199 tCO_2e in 2019/20. We expect this to further reduce in 2020/2021 when we have a full year's energy consumption on the REGO tariff.

SPD includes electricity networks below 132kV. SPM includes networks up to and including 132kV. This results in SPM managing larger equipment with higher amounts of SF_6 and therefore differs from SPD in both SF_6 bank, and how much SF_6 is leaked and how these leaks are managed.

SF_6 equipment held by SPD is small and has much of its SF_6 held in sealed containers with no facility to top up. These pieces of equipment must therefore be replaced when SF_6 levels are shown to have dropped below a defined threshold.

This reporting year in SPD our SF_6 leakage volume increased from 124 tCO_2e to 194 tCO_2e. This is primarily as a result of improvements to the completeness of data collected and we have included emissions from the small number of top ups carried out in the reporting year.

Business Carbon Footprint
continued

In 2018/19 we reported a 44% reduction in emissions from our SPM license SF_6 emissions. In 2019/20 we continue to see reductions in this area with a further 13% reduction on 2018/19 figures.

Our Business Travel carbon footprint decreased in SPD from 826 tCO_2e in 2018/19 to 817 tCO_2e in 2019/20 and in SPM increased from 880 tCO_2e in 2018/19 to 907 tCO_2e in 2019/20.

Throughout ED1 business travel carbon footprint has steadily decreased by 40% from 2,417 tCO_2e combined SPM and SPD in 2015/16 to 1,724 tCO_2e in 2019/20.

This overall reduction since 2015/16 is a result of increased staff awareness of carbon emissions from travel, travelling less, competitive rail pricing and more accurate apportionment between our licences. With improved reporting and lessons learned during Covid-19, we will focus on reducing this area further in the coming years.

The carbon impact from operational fuel use has decreased in SPD has decreased from 3,309 tCO_2e in 2018/19 to 2,825 tCO_2e in 19/20 and in SPM from 3,227 tCO_2e in 2018/19 to 2,921 tCO_2e in 2019/20.

Our distribution operational fuel use has reduced by 13% from the start of ED1. In 2015/16 our emissions were 6,476 tCO_2e combined SPM and SPD and in 2019/20 these were 5,746 tCO_2e.

We have maintained these reductions whilst adjusting to the recent focus on nitrogen dioxide and particulates emissions from diesel engines. To ensure we reduce these outputs from our vehicles, we have increased the number of petrol vehicles within our fleet and upgraded to diesel vehicles with Euro Cat 6 engines. Whilst petrol and Euro Cat 6 engines produce cleaner exhaust gases they are slightly less efficient resulting in an increase in fuel use and therefore CO_2 emissions per kilometre travelled.

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. SP Energy networks will be at the forefront of this initiative. In the next 12 to 24 months we will focus our efforts on ensuring we have optimal vehicle charging facilities whilst procuring the most effective vehicles available in the market place.

Data for buildings energy use is supplied with building location and requires apportionment by staff numbers between SP Transmission and SPD as they cover the same geographical area.

In previous years we had measured actual changes in our building's energy use based on Kwh consumed rather than tco_2e equivalent, this was to recognise annual fluctuations in the energy to carbon conversion rate and concentrate on the Kwh consumed in our buildings. We will continue to use this method now that we have updated our tariff to REGO, which as detailed above offers a zero-carbon conversion factor for eligible Kwh.

The energy used at our depots, substations and radio base stations has increased this year in SPD from 21,506,411 2018/19 to 21,691,240 in 2019/20. In SPM we have decreased from 17,399,714Kwh in 2018/19 to 16,819,367Kwh in 2019/20. The SPD increase can be attributed to us taking over an additional floor at our HQ in Glasgow.

In this reporting year we have installed a modern efficient heating, ventilation and air conditioning system at our depot at Cambuslang. We have reviewed the timer settings for our heating, ventilation and air conditioning systems at our depot in Prenton to reduce the times the system is in operation.

SP Energy Networks hold good data on the sustainability and environmental aspects of our business, to consolidate this data and allow additional functionality we have begun our journey to have a sustainability reporting tool where details of all activities within SPEN with an environmental or sustainability impact can be stored and measured. For this first year we are working towards having all our carbon footprint data available in the reporting tool from our base line reporting year of 2013/14 onwards. This will allow yearly comparisons and graph creation to more accurately analyse data trends.

We are also working with our internal corporate general services team to upload to the reporting tool accurate data we currently receive on business travel, fleet transport and buildings energy. This data will be aggregated down to departments within SPEN and the new reporting tool will allow us to thoroughly analyse data trends, highlight where improvements and reductions can be made, and ultimately help to reduce our carbon footprint.

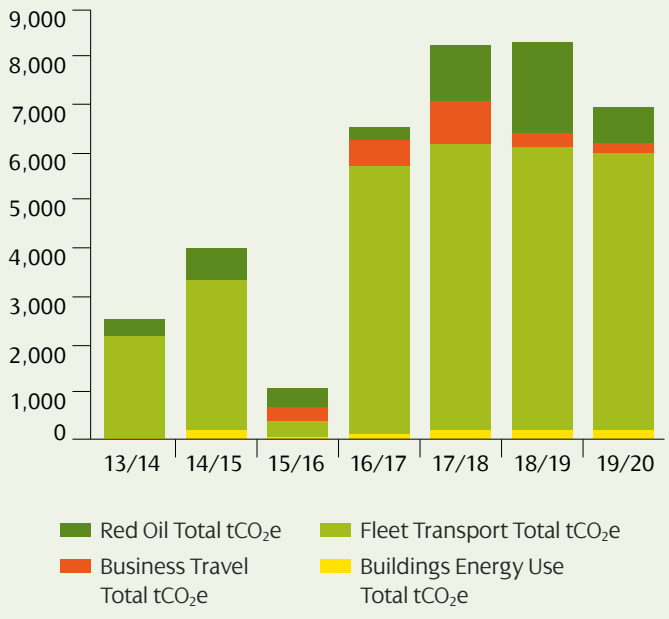
Since forming a Sustainability Team at the start of ED1, the team has worked to improve data collection by moving away from estimations and providing accurate data. Since the start of ED1, we have worked to increase the number of contractors reporting their emissions and continue to target our top 20 contractors for accurate records of data. In this way, we can record the impacts of our supply chain and begin to work with them to reduce their emissions. **Graph 3** opposite shows contractor data from 2013/14 to 2019/20.

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 and have instructed the help of SmartWaste.

SmartWaste is an online environmental reporting tool designed to monitor and report on areas such as waste generation and carbon impacts. This online tool will enable us to store and report data on our contractors from early 2021.

Graph 3 – Contractor Business Carbon Footprint data



Business Carbon Footprint
continued

Summary of 2019/20 carbon and climate change impact reduction initiatives:

Produce a sustainable business strategy – In 2017/18 we published our SPEN Sustainability Policy and first Sustainable Business Strategy, following an extensive consultation process with key external and internal stakeholders. The strategy is reviewed each year by key internal and external stakeholders, including the sustainability stakeholder working group and signed off by the SPEN executive team and executive steering group.

Reduce our carbon footprint by 15% on 2013/14 baseline year – This target was achieved in 2015/16. In 2019/20 we have reached a 55% reduction in combined SPD and SPM emissions. Our primary focus is now on reaching our stretching target of 80% reduction by 2030, in line with our target of carbon neutrality by 2050.

Reduce SF_6 on our network – 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 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.

Undertaking planned transformer replacements and installed lower loss Transformers – Since the start of ED1 we have replaced 462 higher loss transformers with lower loss alternatives resulting in estimated cumulative reduced losses of 73,528 MWh equivalent to 26,630 tCO_2e.

Incorporating energy efficiency measures in our buildings – In this reporting year we have installed a modern efficient heating, ventilation and air conditioning system at our depot at Cambuslang. We have reviewed the timer settings for our heating ventilation and air conditioning systems at our depot in Prenton to reduce the times the system is in operation.

Reviewing our data and making improvements where required – This year we began work on a sustainability reporting tool, allowing us to aggregate down to departments within SPEN to thoroughly analyse data trends, highlight where improvements and reductions can be made, and ultimately reduce our carbon emissions.

Encouraging a reduction in business travel – As a combined result of travelling less, competitive rail pricing and increased staff awareness of carbon emissions from travel we have reduced our business travel jointly by 40% since the start of ED1.

Reducing fleet emissions – We have now fully embedded our electronic vehicle management system TrackM8 and have reduced our fleet emissions by 13% since the start of ED1. We will continue to use this valuable tool to reduce emissions from our fleet vehicles, whilst investing in electric vehicles in our fleet.

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 is therefore highly important.

It is also important that we ensure we capture all possible SF_6 leakage scenarios. Our installed base of SF_6 filled switchgear includes designs which are expected to require a top up of SF_6 during their service life. To reduce the risk of leaks during planned maintenance and to improve data quality, we have provided specialist training to operational staff, covering methods for accurately measuring and recording leaks and processes for safe equipment refill.

We are also continuing to drive the supply chain towards developing equipment with reduced SF_6 leakage rates. The International Electro-Technical Commission (IEC), the body responsible for setting international guidance recommends a leakage rate of 0.5% (indoor equipment). Our equipment specifications demand a more stringent maximum leakage rate of 0.1% for all indoor and 1% for all outdoor equipment each year.

There are many challenges involved in the development of solutions utilising alternative gases; as such there are 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 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.

There challenges associated with non-SF_6 alternatives vary by voltage level and application. 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.

Our networks contain SF_6 equipment which can be 'topped-up'. Where this is the case, 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.

In our last report we highlighted the recent discovery of a leak on a single 132kV circuit breaker at Connahs Quay substation. We can now confirm that the leak has been successfully repaired. We have also inspected other similar units and confirmed that no further actions are currently required.

Table 7 – Summary of SF_6 Information

	SF_6 Bank	SF_6 Emitted	Actual Leakage Rate
SPM	19976.825	32.63	0.0016
SPD	15584.724	8.52	0.0005

Distribution Losses

About 6% 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, referred to as technical losses.

In addition, a small amount of energy is illegally abstracted, or lost to inaccuracies in the billing and conveyance process. This is referred to as non-technical losses. More detail on the types of losses is given below. Electricity industry settlement systems charge suppliers for distribution losses that is passed on to consumers as part of their energy 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, we invest in numerous activities that are over and above a return-on-investment basis under our Losses Discretionary Reward programme.

Losses management is complex. Losses are difficult to measure, are influenced by factors outside of DNO control, and must be considered within the Net Zero context. Technical losses will increase with the delivery of Net Zero – 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, and therefore losses.

Technical losses

Our distribution networks convey energy from the interface with the transmission system to the low-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 or 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 the system is electrically energised even if power is not being delivered to customers. 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 but the value of energy also varies with the time of day. The amount of heat losses rises as the square of the current and therefore if the peak current was 10 times the minimum, losses at peak 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 currently chair the Energy Network Association (ENA) Technical Losses Working Group (TLWG), which is aimed at facilitating the sharing of best practice within the industry.

Distribution Losses
continued

Non-technical losses

Non- technical losses primarily relate to unidentified, misallocated and inaccurate energy flows and not to a loss of energy to the environment. The three main types of non-technical losses are:

1. Energy Theft
2. Unmetered Supplies; and,
3. Conveyance.

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

Unmetered Supplies – Not all customer supplies are metered. Typical unmetered loads include street lighting traffic lights and road signs advertising hoardings and lighting in shared occupancy buildings. 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.

Conveyance – Conveyance occurs when electricity is delivered but not accurately recorded in energy settlements. Typical reasons for energy not being accurately recorded include missing/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. We recognise the importance and benefit of collaboration amongst DNOs in this undertaking, and currently chair the Energy Network Association (ENA) Technical Losses Working Group (TLWG), which is aimed at facilitating the sharing of best practice within the industry.

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. We are committed to modifying processes and technical documents to ensure there is a culture of considering losses in every major investment appraisal we take, and to implement investment decisions which are justified after considering losses.

Specific actions include:

- Accelerate replacement of more than 1,000 higher loss transformers that would have otherwise been replaced between 2031 and 2039.
- HV main line new builds throughout the RIIO-ED1 period will be constructed using larger than usual (100 mm^2) conductor.
- Project-specific evaluation of installing larger cross section cables on new circuits and review ongoing studies to inform policy revisions.
- To address transactional theft, increase our Revenue Protection team by 22% and consider the use of HV and LV network metering and smart metering to identify zonal problems.
- Proactively improve the accuracy of records for unmetered supplies by working closely with customers and settlement stakeholders.

Accelerate replacement of higher loss transformers – To reduce losses we have brought forward the replacement of some of our highest loss transformer units, which were manufactured before 1962. Over the last 60 years, advances in materials and manufacturing techniques have resulted in the reduction of fixed losses in transformers. The continuing program has led to the replacement of 162 high-loss transformers in 2019/20 that would otherwise have remained in service for an additional 16 years. This brings the total Distribution Losses benefits of over 73,528MWh or almost 26,630 tCO_2e estimated from this scheme so far in ED1.

In addition to proactively replacing transformers as part of our baseline strategy, following development with manufacturers, we are now procuring amorphous steel core transformers as a matter of course. We revised our internal transformer specification to recognise the total cost of ownership when making procurement decisions which includes an increased £/MW Loss Coefficient, in line with ENA TS 35-1 on Distribution Transformers.

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 encourages 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 Losses Discretionary Reward is managed in three tranches during ED1:

- Tranche one – submissions made in 2016
- Tranche two – submissions made in 2018
- Tranche three – submissions made in 2020

Tranche one

We submitted our application for tranche one of the Losses Discretionary Reward in January 2016 and were awarded £770,000 in July 2016. https://www.spenergynetworks.co.uk/pages/what_are_we_doing_about_network_losses.aspx

For this application we established an ambitious portfolio of initiatives. These initiatives went beyond our Losses Strategy and allowed us to explore methods and processes to help improve our understanding and management of losses. Our initiatives recognised that a stakeholder and holistic approach is required when analysing and managing losses.

- Initiative 1: Smart meter data to reduce non-technical losses
- Initiative 2: Smart meter data to reduce technical losses
- Initiative 3: Voltage optimisation to improve network losses
- Initiative 4: Improved modelling of complex networks to consider losses
- Initiative 5: Improved modelling of rural networks to consider losses
- Initiative 6: Assessment of power factor to improve GB Losses
- Initiative 7: Improved detection of theft through Revenue Protection
- Initiative 8: Improved network loading through Stakeholder Engagement
- Initiative 9: Substation efficiency – waste heat recovery
- Initiative 10: Substation efficiency – monitoring and self-sufficiency

In later tranches, three further initiatives were added as follows:

- Initiative 11 Consider case for Mobile Asset Assessment Vehicle (MAAV)
- Initiative 12 Early viability of Loss Adjustment Factors (LAFs)
- Initiative 13 SCADA based near real-time losses calculations

Tranche two

We submitted our application for tranche two of the Losses Discretionary Reward in February 2018. Ofgem received six submissions for tranche two, one from each of the DNOs. Whilst it was noted that SPENs submission was strong, no DNOs were successful in securing a reward.

Our tranche two submission provided a review of the activities undertaken and their outputs and implementation into the business. The section below provides a summary of our actions. Our full tranche two submission can be found on the SP Energy Networks website here: https://www.spenergynetworks.co.uk/pages/what_are_we_doing_about_network_losses.aspx

Some highlights from the tranche two period are as follows:

Innovative use of smart meter and network data – we extended our understanding of technical losses on networks. We paid particular attention to losses in service cables, which can be calculated using smart meter data combined with our own systems data, through the innovative analysis of smart meter data has included engagement with suppliers via the TRAS Expert Group (TEG). These new developments will continue throughout RIIO-ED1.

Improve substation efficiency – we continued our work on understanding the scale and profile of energy required to operate our substations. We explored recovery waste heat from transformers to reduce substation heating demand, and although no economically viable schemes are currently available, we continue to engage with stakeholders on heat recovery and remain open to proposals where a demonstrable financial and safety benefit to the customers can be realised.

Improved detection of theft through revenue protection – our revenue protection team initiated and hosted a number of awareness sessions for stakeholders who may encounter meter tampering and safety issues during their work. We now have a permanently embedded member of staff with the Merseyside Police force resulting in a significant increase in the detection of energy theft.

Distribution Losses
continued

HV phase imbalance – Phase imbalance on long rural overhead 11kV circuits is a major contributor to 11kV network losses. We have developed a modelling tool to assess the extent and location of phase imbalance. This modelling tool utilises readily available network metrics to identify feeders which are likely to exhibit high imbalance. This has reduced the need monitoring and informed our understanding of this source of losses.

Tranche three

We submitted our application for tranche three of the Losses Discretionary Reward in March 2020. Ofgem received five submissions for tranche three, with one DNO choosing not to submit. Although no rewards were given again, it was noted that progress had been made from tranches one and two, as shown by the outputs delivered by both completed and ongoing projects and collaboration with various stakeholders.

Our full tranche three submission can be found on the SP Energy Networks website here: https://www.spenergynetworks.co.uk/pages/what_are_we_doing_about_network_losses.aspx

This submission was a look back over the activities undertaken and successes achieved under our LDR programme of initiatives. In accordance with Ofgem's requirements, we demonstrated progress in the following four areas, a summary of headline activity for which is described below:

- Understanding losses
- Customer and stakeholder engagement, and sharing best practice
- Processes to manage Losses and plans for RIIO-ED2
- Innovation and incorporation as Business As Usual (BAU)

Understanding losses – since the start of the LDR period, 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. In tranche three, we have used this new learning to further investigate the effects of Low Carbon Technologies (LCTs) on our own network losses. Our understanding of theft in our network has also continued to improve: through engagement with Smart suppliers, including British Gas and Utilita, we are improving the accuracy of alerts that require further investigation.

Customer and stakeholder engagement, and sharing best practice – by convening and chairing the TLWG since 2016 we have provided an ongoing platform for DNOs to discuss and share best practice. In our revenue protection area, our industry leading approach to working with law enforcement agencies has continued, and wide stakeholder engagement and awareness sessions are ongoing. This has led to higher detection of cannabis farms in our licence areas and is now stretching beyond on own licenced areas with awareness sessions undertaken in Greater Manchester, as shown in **Table 11**. We continue to engage with specific customers to assist them in understanding their usage patterns and their impacts on losses. Examples include our on-going work with Flintshire County, their supplier and the Welsh Assembly.

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. Finally, we have continued international engagement and share best practice through presenting at international conferences (including CIRED), which has led to the sharing of best practice with international operators.

Processes to manage losses – one of the key process improvements developed over the LDR programme is work on our network modelling techniques. Prior to the LDR, our losses modelling traditionally used a 'top-down' approach to quantify losses across voltage levels (Losses = Energy In – Energy Out) as described above, which is prone to significant inaccuracies. The 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 and operated with tighter operating margins, leading to opportunities for improved loss management.

As a result, we now have losses information by network group and at an individual asset level. Our ability to consider our planned network throughout all operating periods in a year is delivering a reduction in network losses through our ability to optimise how we operate our assets. This tool is now being used to support the following processes as BAU:

- Reinforcement Schemes: Assessing reinforcement scheme designs
- Load Growth Management: Selection of appropriate solutions to manage load growth whilst considering losses impact.
- Customer Connections: Enabling detailed consideration of losses in customer connection design (load and generation)

Losses innovation and incorporation as BAU – we are committed to being a fast follower of innovation to reduce losses. Over the course of the LDR we have transitioned innovation from our LDR Initiatives into BAU: e.g. innovative LV losses modelling techniques have been incorporated into our new LV analysis tool. We have also reviewed wider industry innovations ready for adoption in RIIO-ED2: e.g. we have investigated the MAAV, an innovative technology being used by UKPN, to understand the benefit in our own network. Finally, we continue to seek new innovations: e.g. we are in early discussions with OEMs and generators to investigate power factor correction at the point of connection through innovative new reactive power control technology.

Distribution Losses
continued

Figure 11 – 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 transition distribution network losses will increase as a result of the electrification of heat and transport, and the increase of low-carbon distributed generation. Furthermore, these additional losses are considered 'green' or low-carbon losses, because they are derived from renewable generation. Therefore, whilst they still have a cost implication to the customer through energy charges, the societal cost of losses is changing. 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.

In our role as chair of the ENA TLWG we are working collaboratively with the other DNOs and NGET (National Grid electricity transmission) to provide recommendations for a regulatory approach in RIIO-ED2. We continue our optioneering, stress-testing and modelling exercises to identify effective and practical potential options. We have led the TLWG to commission independent reports, comparing international regulatory approaches for managing network losses and proposing potential future incentive mechanisms in the context of the low carbon transition.

The tranche three LDR submission also outlined a number of areas where the LDR programme will shape both our Losses Strategy and plans for enhanced losses consideration in RIIO-ED2.

Some examples include:

- use our complex modelling tools to go beyond what is currently BAU. We will identify the network assets with disproportionately high losses and deliver proactive replacement programmes where they are in our customers' interests.
- continue to assess the cost-effectiveness of using network management and nearer-real-time information to improve real-time understanding of losses (levels and locations) 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 data becomes available. 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 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.

Continue to observe the business case for the MAAV and report to the business if this becomes a viable investment.

Keep abreast of national and international 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 and reactive power control technology for distributed generators.

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.

Table 8 – Assessment of Losses (Technical and Non-Technical) 2019/20

	SPD	SPM	Distribution Total
Units Entering (GWh)	18,178	15,374	33,552
Units Exiting (GWh)	16,291	14,378	30,669
Losses (GWh)	1,257	996	2,883
Losses (%)	6.91%	6.48%	8.59%

Distribution Losses
continued

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

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2019/20	Reduced Emissions Associated with Losses	Cumulative reduced losses to date
Replace high loss transformers	£7.73m	6,210 MWh	10,112 tCO_2e	27,612 MWh
Internal and External Revenue protection inspections	£0.04m	4,960 MWh	12,444 tCO_2e	33,981 MWh
Theft in conveyance	£0.00m	104 MWh	529 tCO_2e	1,444 MWh
Totals	**£7.77m**	**11,004 MWh**	**23,084 tCO_2e**	**63,037 MWh**

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

Programme/Project	Distributed Losses – Justified Costs	Reduced Losses 2019/20	Reduced Emissions Associated with Losses	Cumulative reduced losses to date
Replace high loss transformers	£7.39m	19,580 MWh	16,518 MWh	45,916 MWh
Internal and External Revenue protection inspections	£0.06m	5,409 MWh	12,204 MWh	33,325 MWh
Theft in conveyance	£0.00m	143 MWh	208 MWh	569 MWh
Totals	**£7.45m**	**50,658 MWh**	**28,930 MWh**	**105,336 MWh**

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	39	88
Revenue protection inspections	Visits made by revenue protection (metered supplies)	16,341 visits were conducted resulting in 1,338 irregularity cases	10,032 visits, 1,354 irregularity cases
Theft in conveyance	Investigations	77	46

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	123	136
Revenue protection inspections	Visits made by revenue protection (metered supplies)	9,065 visits were conducted resulting in 881 irregularity cases	5,528 visits 1,710 irregularity cases
Theft in conveyance	Investigations	63	37

Other Environment Related Activities

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**). This includes waste management noise and air emissions, climate change adaption ecological enhancement and stakeholder engagement with communities, staff and other key groups to deliver this ambition.

Waste 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 businesses.

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 waste management – where we value resources both financially and environmentally – is key element of our vision of sustainability. To drive this vision, we have set ourselves the challenging goals to divert 95% of waste from landfill by 2023, to recycle or use 100% waste by 2030, then move to zero waste by 2050.

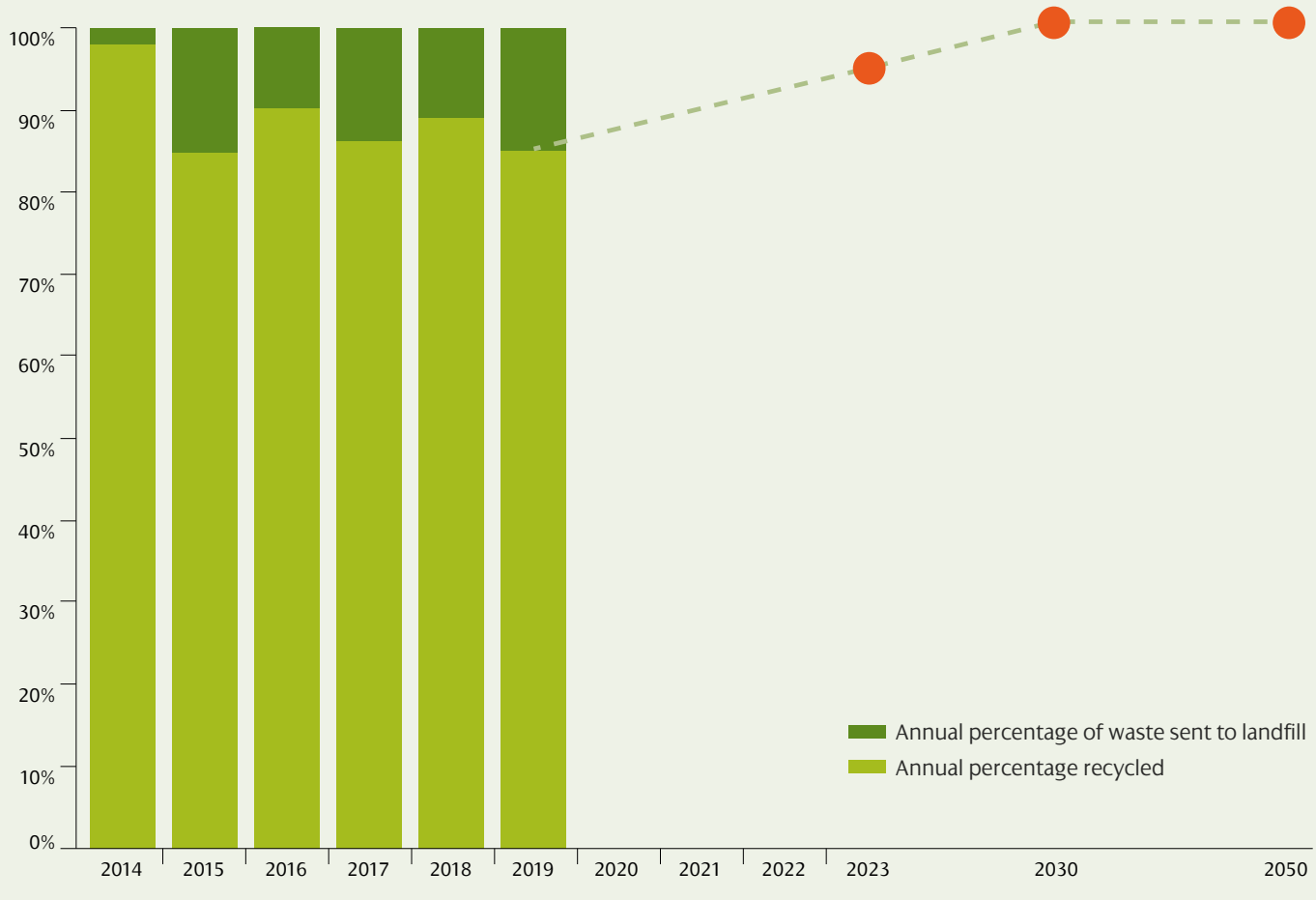
To meet these targets, we are focusing on ways to avoid, reduce, reuse and recycle our waste. Key to this is ensuring that the many inputs of data required become more robust year on year. Our approach is therefore twofold:- working with our own staff and supply chain to gain better insights into the 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.

Since 2014, we have consistently achieved over 85% of our waste diverted from landfill. We continue to work with our contractors and employees to make the final 10% push and reach our 95% landfill diversion goal by 2023.

Key to this is further improvement of the data received from our contractors, which has led us to implement the use of the SmartWaste tool.

SmartWaste is an online environmental reporting tool designed to monitor and report on areas such as waste generation and carbon impacts. This online tool will enable us to store and report data on our contractors from early 2021.

Graph 4 – Waste to Landfill Reduction



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.

One enquiry related to a rattling noise coming from bird deviator discs on our overhead lines. The discs were replaced, and no further noise was reported. The second related to a high-pitched noise coming from our substation. On inspection the noise was coming from a faulty fan, the fan was replaced, and no further noise was reported.

This reporting year we have received five enquiries in SPM in relation to noise from our equipment.

Two enquiries were a result of loose brackets on an overhead power line. The brackets were quickly replaced, and no further noise was reported. Two complaints related to noise from pole mounted transformers. In both cases the transformers were old, and a decision was made to replace them, alleviating the noise. One enquiry related to a vibration noise emitting from our substation. Anti-vibration pads were installed, and no further noise was reported.

In each of these cases an inspector promptly visited the location and conducted a full investigation. Our customer services and field teams worked together to keep customers fully informed at each stage of the process.

Climate Change Resilience

In June 2015, SPEN published a Climate Change Adaptation Report to provide updates on our adaptation to climate change. This was in response to the UK Government's second call to report under the Adaptation Reporting Power.

We are currently working with other network companies at the Energy Networks Association (ENA) to produce an industry-wide response with scheduled publication in Spring 2021. This industry-wide report will serve a good baseline for our response which we aim to provide updates on the climate change risks, uncertainties and adaptation progresses since the second report.

Key Risks

The following are the three most highly-ranked risks in our second report due to high relative likelihood and impacts.

AR10: Substation affected by river flooding due to increased winter rainfall, with loss or inability to function leading to reduced security of supply.

AR11: Substations affected by flash flooding due to severe rainfall, with loss or inability to function leading to reduced security of supply.

AR12: There is a risk that due to extreme sea flooding a substation may be lost or unable to function leading to reduced system security of supply. A number of sites may be at risk from sea level rise/coastal erosion.

For the third report scheduled Spring 2021, SPEN is working with the ENA to finalise the identification of climate change risks based on the latest UK Climate Projection 2018 (UKCP18). Met Office, author of UKCP18, has been tasked with undertaking an electricity and gas network specific analysis based on UKCP18 with final reports due end of September 2020. The top risks identified so far from Met Office analysis and stakeholder engagement with network companies are:

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

SPEN Operational Risks

Risk SP1: Impact of increased temperatures on the network with warmer winters and hotter summers potentially shifting peak annual loads from the winter season into the summer months, therefore limiting the flexibility of the network and windows for undertaking maintenance work.

Risk SP2: Extreme weather events may have led to a failure on the network, with repair and maintenance teams unable to reach the site, for example where it and or access roads are flooded. This could result in extended periods of interruptions for customers.

Risk SP3: Flooding impacts upon communication and control infrastructure affecting the ability to control and operate the network remotely.

From the above, flooding was and still will be the principal risk. SPEN have since attained compliance with existing flood resilience standards through adoption of flood protection barriers, "tank-lining" civil assets and raising substation doors. Flood resilient doors have also been installed in areas defined as flood plains by flood surveys. The underlying resilience standard has been augmented in 2018 (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 floods at grid and primary substations in England, Scotland and Wales due to coastal, river and surface water flooding. We will also engage with the environmental agencies (EA, SEPA and 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 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. Besides that, ahead of RIIO-ED2, we are reviewing our wider inspection, repair and maintenance strategies to integrate condition and criticality of assets as well as new technologies to ensure we continue to operate a safe, resilient and sustainable network.

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.

In recognition of the importance of biodiversity, we have identified land and biodiversity improvements as one of our six Sustainability Drivers. We have set ambitious objectives within our 2020 Sustainable Business Strategy including the implementation of a methodology to measure biodiversity and make relevant business decisions to deliver biodiversity net gain.

We consult regularly on biodiversity with informed stakeholders to share best practice and steer strategy, activity and reporting. NatureScot (previously Scottish Natural Heritage), Scottish Wildlife Trust, Scottish Environment Protection Agency and Keep Scotland Beautiful are members of our quarterly Sustainability Stakeholder Working Group (SSWG). Engaging directly with this level of expertise drives our biodiversity ambitions.

The following case study provides an example of our approach to mitigating biodiversity loss and implementing biodiversity enhancements in the environments in which we operate.

North Shropshire Electricity Distribution Network Improvements Project

We are working with the Shropshire Wildlife Trust, Canal and Rivers Trust and the Environment Agency's biodiversity officer to identify locations for habitat enhancement works as part of a Habitat Improvement Scheme. Opportunities to create and enhance connecting habitat for threatened invertebrates, water vole and otter are being developed in partnership with these organisations.

This process followed the accepted 'Mitigation Hierarchy' approach, seeking first to avoid or minimise habitat loss or damage, particularly in higher value habitat features such as woodlands, ponds, mature trees, species-rich hedgerows before considering the need to provide compensation or offset habitats. Enhancements, as part of a Habitat Improvement Scheme have also been identified in partnership with the agencies involved.

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 includes:

- Consideration of environmental, social and economic costs and benefits in decision making;
- Collaboration with stakeholders;
- Transparency in decision-making processes and reporting of performance;
- Faster, easier network connection;
- Preparing the Network for Low Carbon Technologies; and
- Enhancing network flexibility and communications.

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. By raising awareness of sustainability and environment impacts and opportunities for innovation, our employees 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.

In 2019/20, we have engaged with employees of all levels through a wide range of channels, including:

Training – Courses developed and rolled out to staff in 2019/20 include Managing Environmental Risk in Project Management and Managing Environmental Risk for Field Operatives. 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 environmentalcompliance. In the reporting year 106 e-learning courses were completed by SPD staff and 169 by SPM, covering a range of subjects including environmental awareness, spillage control, resource management, SF_6 awareness and wildlife and countryside.

Environment Call – Launched in October 2019, the SPM Environment Call, sponsored by the Director of SPM, discusses sustainability and environmental initiatives, shares observations, highlights processes/procedures, and strengthens responsibilities in controlling and reducing our environmental risks and impacts. Leadership of the monthly all-staff call rotates through each district and business function to encourage shared ownership and ensure that environmental compliance and action is driven by all business teams. Topics in the reporting year included reduction of single use plastics, hazardous waste, Duty of Care, environmental considerations in project design, SF_6 alternative technology, electric vehicles and electric powered generators.

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 2019/20 we installed a total of 2,343 Low Carbon Technologies (equivalent to 132.5MW). This includes the facilitation of Heat Pumps, PV and Electric vehicles.

New G98 PV connections continue, however at significantly lower levels than previous years. Volumes remain impacted by the change in FITs tariffs in December 2015 and remain significantly below our initial ED1 forecast.

The uptake of heat pumps remains slow in comparison to ED1 forecasts, despite the Renewable Heat Initiative which has not been hugely successful in driving the uptake of domestic Heat Pumps.

Whilst the volume of recorded new EV charge points (slow and fast charge) continues to increase, year on year, it remains lower than ED1 forecasts. We are concerned that this data is not fully reflective of the actual numbers of EV charge points connecting to our networks.

The volume of other LCT DG connections during 2019/20 fell marginally below ED1 forecasts with some changes between the volume of primary and secondary connections

The optimisation of existing assets over construction of new network infrastructure, will help us to deliver the required capacity to support this transition at a lower cost, in a reduced timeframe, using reduced quantities of raw materials and reducing environmental impact. In the context of ensuring quicker connections at lower cost, consideration of this approach is essential.

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	5497	145	146
2016/17	45	226	0	468	139	438
2017/18	132	73	553	671	178	88
2018/19	63	42	327	1164	227	34
2019/20	79	30	968	287	111	17

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		7,966	120	98
2016/17	70	229		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

Progress of the Innovation Strategy

2020 has been a year of unprecedented challenges – at SP Energy Network's we have adapted and grown to meet these challenges and seen our drive for sustained progress continue unabated.

We have continued in earnest to build on the work started in 2019 towards strengthen our company's culture of innovation – recognising that change of this magnitude has to be reinforced.

At SP Energy Networks we seek to lead the way on issues that really matter. As a business, we have the ambition and capacity to lead the industry into this new decade: a critical decade in the battle against climate change. We are working to innovate in the best interests of our environment, our customers and our wider stakeholders to reduce costs and facilitate the transition to a low carbon economy whilst continuing to ensure our costs are fair and equitable for all.

Everything we do in energy innovation is underpinned by the urgency of the challenge presented to us in climate change. The targets for achieving Net Zero have focussed our minds – even as electricity demand increases, we strive to enable a zero-carbon energy network and we will rise to the challenge by continuing to think differently, explore novel solutions and introduce innovative approaches in our day-to-day business operations.

DRIVE

Last year SP Energy Networks launched the Year of Innovation, which we have subsequently transitioned to DRIVE, a three-year program to strengthen a culture of innovation and to make innovation relevant for everyone across the business. The focus of the initiative remains to empower and enable employees to get involved in innovation and provide the tools and mechanisms to do so.

Our 'DRIVE' highlights from 2020 include:

- Continued use of our digital innovation platform to allow collaboration and engagement on business challenges aligned to our innovation strategy. To date, over 1,000 colleagues have used our platform across 8 innovation campaigns aligned to our three strategic innovation areas (Deliver Value to Customers, A Smarter Flexible Network and Sustainable Networks). This has resulted in the generation of over 200 ideas and has helped support colleagues in developing and implementing innovative ideas within the business.

We are currently developing and delivering over 50 of the ideas generated through the innovation platform, with the support of our network of 102 Innovation Champions.

NIA PMO Developments

Within the last year we have built a robust and rigorous process for the development of projects from ideation, through development and trials, to business as usual implementation. Integral to this process is the standing NIA Project Management Office. The PMO is composed of experienced project engineers and portfolio managers who ensure that proposals are aligned with strategic objectives; projects meet all governance requirements; and outcomes are best positioned to transition seamlessly into our core business practices. All projects are now subject to enhanced internal reporting, with a dedicated project contact on the PMO working hand-in-glove with the project manager towards reliable milestone programming, financial forecasts and risk management logs. This detail focused approach ensures that we have the flexibility to augment our portfolio to get as much benefit returned from our yearly spend as possible. The PMO also help facilitate the development of stakeholder and communication plans for all projects – ensuring the wider business has visibility of the positive changes SP Energy Networks are making.

SPEN Electricity Distribution Strategy

Since we laid out our strategy, we have cemented our position as leaders in innovation, delivering a broad and diverse portfolio of projects to deliver significant customer value.

With the energy landscape evolving at pace, we worked with stakeholders to refresh our strategy in order to continue to lead the transformation of the energy system.

This ensured our strategy would:

- become more accessible and understandable;
- enable greater collaboration from a wider range of partners;
- take a holistic view of challenges and opportunities;
- take an agnostic view of technologies and solutions; and to
- provide a clear plan for implementation with timelines.

We sought to understand stakeholders' network needs and expectations in ED1, ED2 and beyond. In parallel significant engagement was undertaken with each function of SPEN to identify new challenges and opportunities faced by the business. Through this engagement we identified three priority areas for innovation.

Progress of the Innovation Strategy
continued

Delivering Value to Customers
This priority area focusses on maximizing the performance efficiency and benefits delivered through our core business activities.

This area identifies 20 specific opportunities and challenges split across four themes:

- Managing an ageing network
- Reducing the number and length of power cuts
- Network Control and Management
- Maximising benefits of data.

Projects like WaNDA,(weather Weather Normalised Demand Analytics) which, using historic SCADA, generation and discretized weather data allow us to conduct better network planning and avoid costly reinforcement – savings which are passed on to our customers.

A Smarter Flexible Network
The inclusion of this priority area clearly demonstrates that the thoughts of our stakeholders and the challenges faced by our business have shifted considerably in recent years. The connection of Low Carbon Technology (LCTs) was only covered in two themes of the original strategy and the provision of flexibility was completely absent as it was not a priority of our stakeholders. Throughout our engagement, this priority area proved to be the closest to our stakeholders' current thinking and needs. Given this level of interest and input we were able to identify 16 specific opportunities and challenges identified split across three themes against this new priority area, namely:

- Faster, Easier Connection.
- Preparing the Network for Low Carbon Technologies.
- Network Flexibility and Communications.

Sustainable Networks
Similarly, to the previous priority area, aspects of this were included as themes in our previous strategy but as a result of the feedback from our stakeholder and internal consultation it is now more prominent, featuring four themes:

- Socially Responsible member of the Communities we serve.
- Minimising the Environmental Impact of our Activities and Assets.
- Working Practices and Business Systems.
- Our People – Skills and Resources.

Accessibility
As well as refocussing the Priority Areas; Themes, Opportunities and Challenges contained within our Innovation Strategy have been rewritten in full and are in a new format. This new format and content has been written to make it accessible to all stakeholders. It aims to educate readers on who we are, the changing energy landscape and our changing electricity network.

Our Innovation Process
We have placed particular emphasis on our open-door policy for innovators, including a transparent breakdown of how we innovate and how they can get involved. Each element of our innovation process is described in detail:

- **Inception –** The generation of ideas and their alignment with our Innovation Strategy.
- **Creation –** The creation of unique projects aimed at
- **Delivery –** The application of professional project management practices.
- **Transition –** The Business as Usual adoption and dissemination of the project.
- **Tracking –** The multiyear tracking benefits realised by the project.

The current SPEN Distribution Innovation Strategy is available here: https://indd.adobe.com/view/7e04a310-b61e-4a56-8dd8-2b4c2d014b36

Portfolio Update
During the 2019/20 reporting year SPEN has registered 7 new Network Innovation Allowance (NIA) projects, along with 34 ongoing projects. The new projects broad spectrum of development areas includes artificially intelligent image recognition, state of the art communication networks and the use of green hydrogen as part of a multi-vector grid balancing solution. This diversity is critical for us to remain leaders in our field, but fundamental to each of these nascent projects was their internal approval based on their intrinsic alignment to the Innovation Strategy:

- Faster, Easier Connection
- Preparing the Network for Low Carbon Technologies
- Network Flexibility and Communications.

Full details of SPEN led projects can be found in the NIA Annual Report [distribution] from 2019/20: https://www.spenergynetworks.co.uk/userfiles/file/SP_Distrbution_NIA_Annual_Report_1920.pdf

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 function, 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.

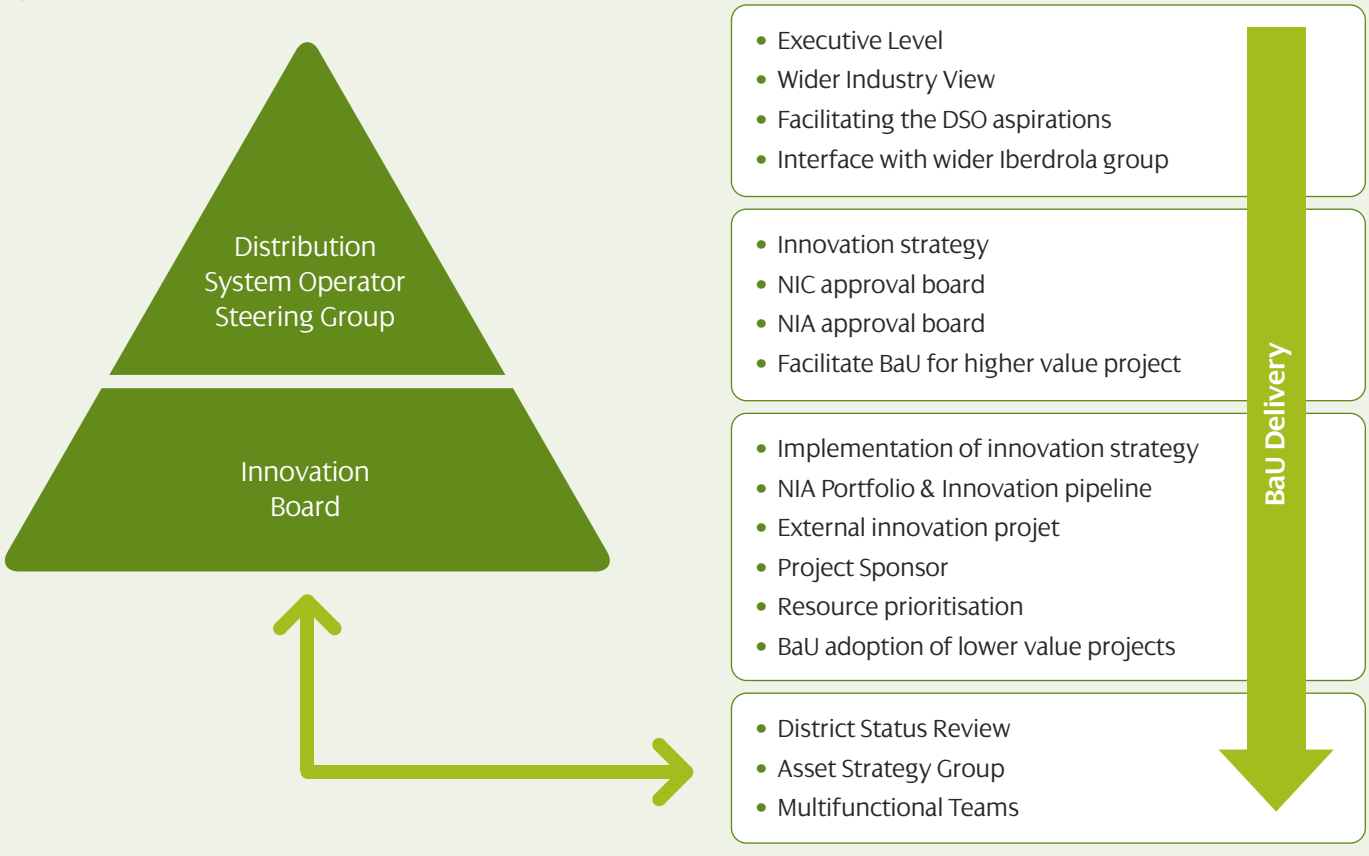
Transition into BaU is a process taking place thorough step 4 and 5 of our innovation process.

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 project 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 route, be it NIA, NIC or other funding steams 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.

There is a need to ensure that innovation is embedded into all business function as such the role of the innovation board is to ensure increased participation from all business functions and to allow innovation projects to be completed and integrated into BaU.

Figure 12 – Innovation Governance Structure



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

In scheme year 2019/20 we have deployed the following innovative technologies into business as usual:

Network Constraint Early Warning Systems NCEWS (phase 1)/ NCEWS2 (phase 2) and NAVI
These projects are all part of multi-phase investigation requirement into the benefit of Smart Meters (SM) data in LV network Design and Planning. Full SM coverage is realistically expected to take between 3–5years (2017–20 or beyond if deployment delayed). It has been started by the industry that operational benefit will not be achieved from SM's until 60% penetration. Within the early years of SM Penetration (2017–18) it is hoped to utilise pockets of high-level SM penetration to carry out fundamental research and try to derive early benefit from SM data. Visibility and control in the network is being addressed.

NCEWS (phase 1)
The core aim of this research project was to investigate the initial integration of the Smart Meter data to deliver operational benefits to the network and customers. The project developed adaptive and scalable methodologies for future data analytical system and modelling requirements, enabling better visibility of network capacity for new developments.

To solve the stated problems the focus of this Phase 1 SM research project was on the adaptation of existing customer connectivity systems and analysis of the integration requirements for SM monitoring data. This project utilised the Innovate UK Knowledge Transfer Partnership (KTP) programme with Heriot Watt University to jointly fund a Data Science/Data Analytical researcher to carry out the main research requirement.

The specific stakeholder priorities that this project addressed fall under all three categories:

"Delivering Value to Customers": Maximising the Benefit of Data, "A Smarter Flexible Network": Faster, easier, Accurate Connections and Preparing the network for Low Carbon Technologies (LCT) and "Sustainable Networks": Modernisation of Work Practices and Business Systems.

Transition into BaU
Completion of module 1 was a Proof of Concept (PoC) data analytical LV network node and edge modelling platform. This analytical methodology and asset GIS data transformation IT system has already generated significant interest in the wider business.

NCEWS (phase 2)
NCEWS2 build on the LV Connectivity Platform developed through the NCEWS1 project, adding a range of functionality, as well as increasing the geographical scope of the analysis. Initially, Business-as-Usual investigation of NCEWS1 Platform will be carried out and once the development and data analytics are completed WP 6: Stakeholder Engagement/Dissemination and Plan for transition to BaU.

In phase 2 the project has had to adjust the research priorities. Focus was therefore placed upon using data science techniques for data improvement of the currently available network asset data in GIS. This utilises the underlying capability of the modelling platform to understand archetype LV circuit make up and use pattern analysis algorithms to backfill missing asset information. This will be based on the principle that all circuits are designed using DNO design rules for distribution over a given length, load and number of connected customers. This work lead to better global impedance and rating understanding that feeds into the constraint analysis work once the energy use data is available from smart meters.

Figure 13 – NCEWS2 Revised Project Structure

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

NAVI – Network Analysis and View
Particular focus within NCEWS2 is to develop the use of the NAVI platform to assist with network modelling, the development of scenarios of growing LCT penetration, and to integrate the platform data analytical functionality within other ongoing innovation projects within SP Energy Networks. We have now developed several exports from the platform to various computer modelling tools including PSSE(power system state estimation), WinDebut, (load flow package) DIgSILENT– (software system) and IPSA (Interactive Power System Analysis), which is allowing trial users to model fully annotated circuits and LV substations within minutes. By annotating numerous related data sets to the platform, we are providing users with a complete view of the network in one place, helping us move towards the goal of being a central data management tool. Through stakeholder engagement and tracking of benefits during this project we hope to prove the value of the NAVI platform and thus role it out to the wider business.

Transition into BaU
Taking output of NCEWS1 into Business-as-Usual Implementation of Innovation Platform for 20 users of NCEWS Platform and Web Portal, demonstrating the scale and complexity of a BaU implementation, but without the need to deploy full Enterprise Solution.

Weather Normalised Demand Analytics (WANDA)
This study project involved a desktop exercise using historic SCADA, generation and discretised weather data used to build and evaluate models which disaggregate electrical demand into load driven by weather conditions and load driven by other customer behaviour. In addition, an analysis of the underlying trends was taken. The study included all SPD primary substations across the central belt of Scotland and the output from the project is used in network planning and the completion of regulatory reports.

Weather patterns and customer behaviour are two key drivers in electricity demand. By undertaking this project, it has become possible to better understand how these have changed historically within a given licence area and will provide invaluable insights into future demand scenarios. It will also highlight their relative significance and current trends. This will allow asset managers to develop better and more targeted investment strategies. Furthermore, accurate demand models will provide more realistic data for investment risk and cost-benefit analysis and subsequently lead to better returns for customers.

The specific stakeholder priorities that this project addressed all fall under the "A Smarter Flexible Network" category: Faster, easier, Accurate Connections; Network Flexibility and Communications; Preparing the network for Low Carbon Technologies (LCT).

Figure 14 – Navi platform

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

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

Transition to BaU – WaNDA and SIA Rollout

WaNDA and SIA network data projects' rollout has recently gained approval at IRG meeting for an authorised value of £650K. The rollout is a combination of these two projects into a single web-based engine/ platform which will be used by design and control engineers, estimated at making a total of –£600K gross benefits per annum. The £200K WaNDA trial has realised benefits of £2.3m to date in the SPD ED1 load budget and will be continued for up to 10 years through analysis of weather patterns and customer behaviours by network planning.

Amongst the reasons for this BaU investment are the requirement for a long-term forecasting tool for investment, price control and flexibility purposes. In addition, there is a requirement to monitor constraints on operational timescales within the control room. However, the current tools do not offer weather correction on a localised basis. This is a requirement for the DSO transition.

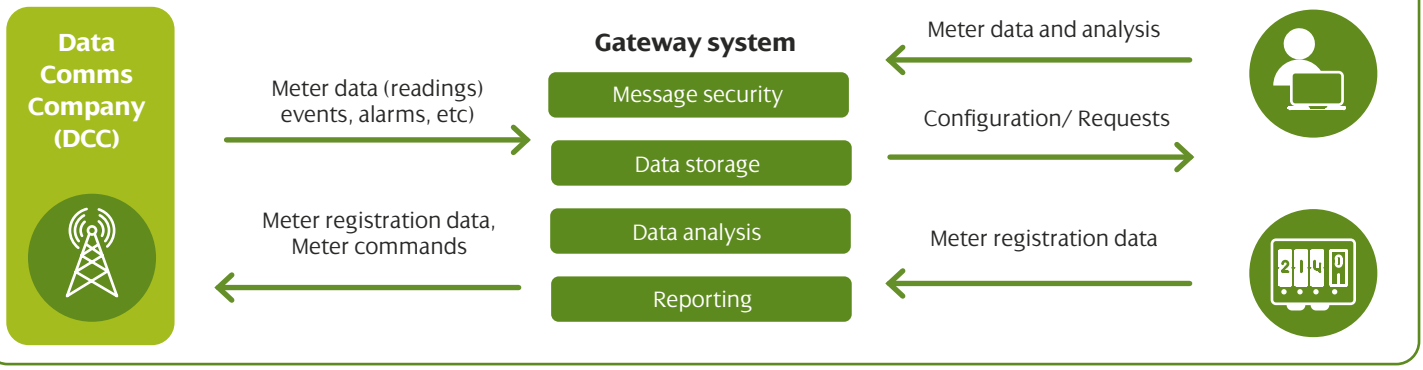
Roll Out of Smart Meters

The rollout of SMETS2 meters continued during the 2019/20 regulatory year, albeit at lower volumes than anticipated. BEIS (UK Government department for business energy and industrial strategy) also announced a four-year extension to the meter deployment programme, which is now scheduled for completion by the end of 2024. On a positive note, there was a significant increase in the volume of SMETS2 installations in our network areas. By 31st March 2020, there were approximately 70k SMETS2 devices in our SP Distribution licence area (3.5% of our customer base), and approximately 120k in SP Manweb area (8.6%). We did record smart meter financial benefits in 2019/20, but as we cannot as yet communicate with the high volumes of SMETS1 meters deployed in our networks, the value of these benefits remains low. As the volumes increase and we bring SMETS1 meters online, the benefits we anticipate from communication with smart meters include:

- The ability to accurately determine when a customer has lost supply, potentially before the customer contacts us.
- Once a loss of supply is identified we believe that smart meters will allow us to identify the location and nature of faults on the network with a much greater degree of accuracy, restoring power to customers more quickly.
- After a fault repair, we can communicate with smart meters again, allowing us to identify when an individual customer's power has not been restored. We can then act swiftly to rectify any remaining outstanding faults.
- Avoided voltage complaints – in this area we believe we can become proactive in identifying and addressing voltage anomalies before they inconvenience customers.
- Understanding network status – using power quality measurements from smart meters we can better understand the ongoing operation of our network and take proactive steps to maintain supplies to our customers.

We continue our preparations to use smart meter data at volume. We do this through early development of our systems and data modelling at current lower scales of data. In addition, we work with key stakeholders to identify the best opportunity to utilise smart meter data for the benefit of our customers. This practice will continue, and we will monitor and refine our business processes as meter installations increase in volume.

Figure 15 – Gateway system



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
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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