Environment and Innovation

Ofgem Report 2016/17

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Executive Summary

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WPD's Environment and Innovation Report aims to provide all of our stakeholders with a transparent and public account of our environmental performance over the last twelve months including our role in low carbon transition through innovation. WPD will use this report to provide an all-inclusive overview whilst providing clear justification for our actions and the benefits to our customers.

Reducing the business' impact on the environment and embracing the increase in low carbon technologies is one of our key business RIIO-ED1 outputs. To this end throughout 2016-2017 we have achieved the following improvements:

Environmental Highlights

- Reduction in tonnage of waste being sent for landfill disposal
- Overall reduction of our Business Carbon Footprint
- Significant reduction in the loss of SF_6
- Continued certification to ISO14001 across the business
- Zero environmental prosecutions or enforcement action across the business from the environmental regulators
- Continued reduction in fluid filled cable losses

Innovation Highlights

- Electric Nation contracted over 270 customers for smart EV charging trial
- A battery solution trialled in our Solar Storage project enabled fast site deployment significantly reducing standard installation time;
- Airborne Inspections project identified the optimal and most cost effective camera for OHL inspections

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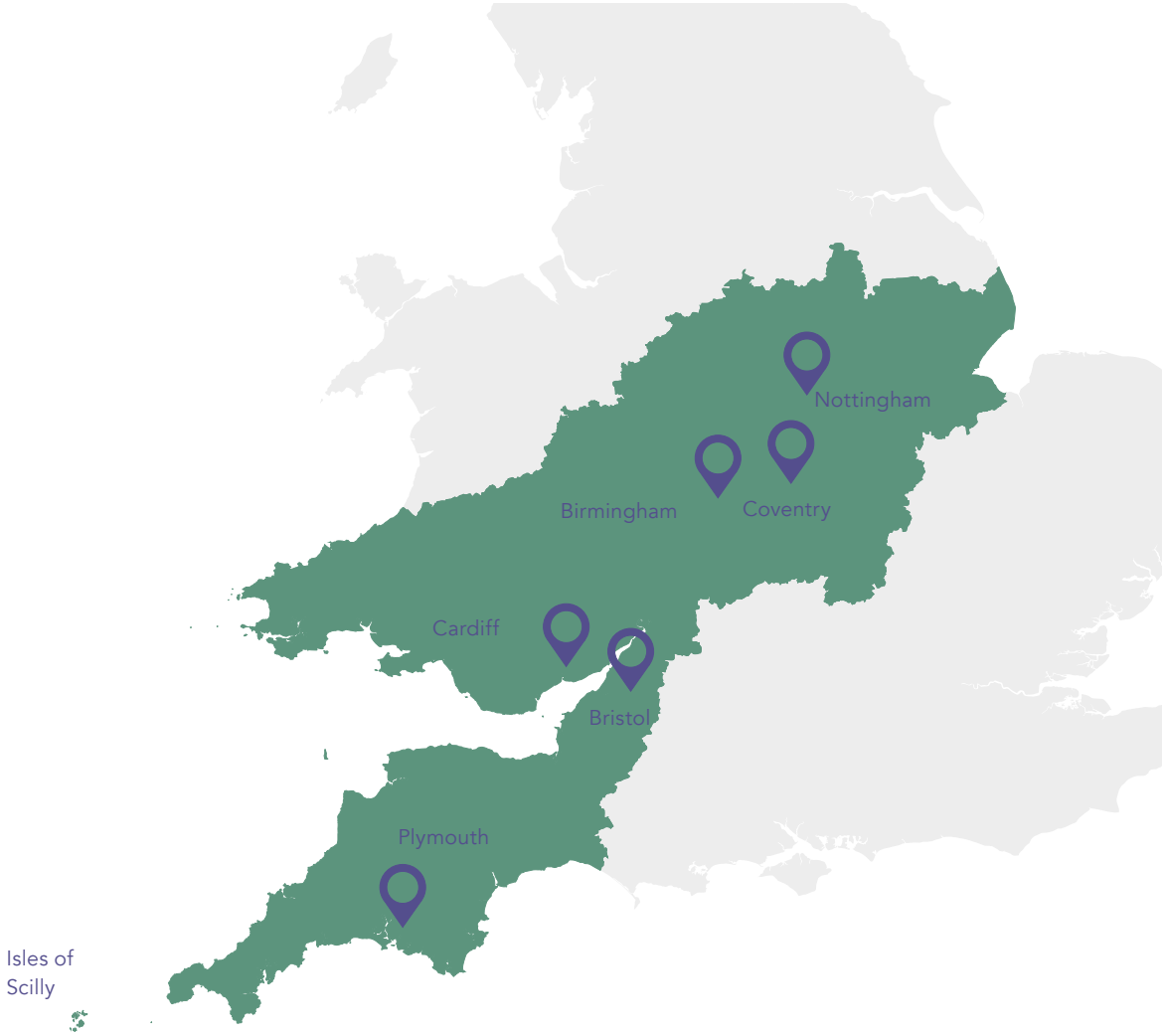
1. Introduction



1.1 Who We Are and What We Do

We are one of six Distribution Network Operators (DNO's) who deliver electricity to homes and businesses across England, Wales and Scotland. Our network, which serves 7.8m customers, is the largest in the UK, operating from the Lincolnshire coast, across the Midlands, South Wales and the South West to the Isles of Scilly.

Our four key business tasks are:

- Operating our network assets to ensure we 'keep the lights on' for all of our customers
- Maintaining the condition and therefore reliability of our assets
- Fixing our assets should they get damaged or if they are faulty
- Upgrading the existing network or building new ones to provide additional electricity supply or capacity to our customers

Our role is simple:

We are not a supplier. We do not buy and sell electricity, or directly bill customers. Our costs account for around 16% of an average annual domestic electricity bill which customers pay to their supplier.

7.8M

Our network, which serves 7.8m customers, is the largest in the UK.

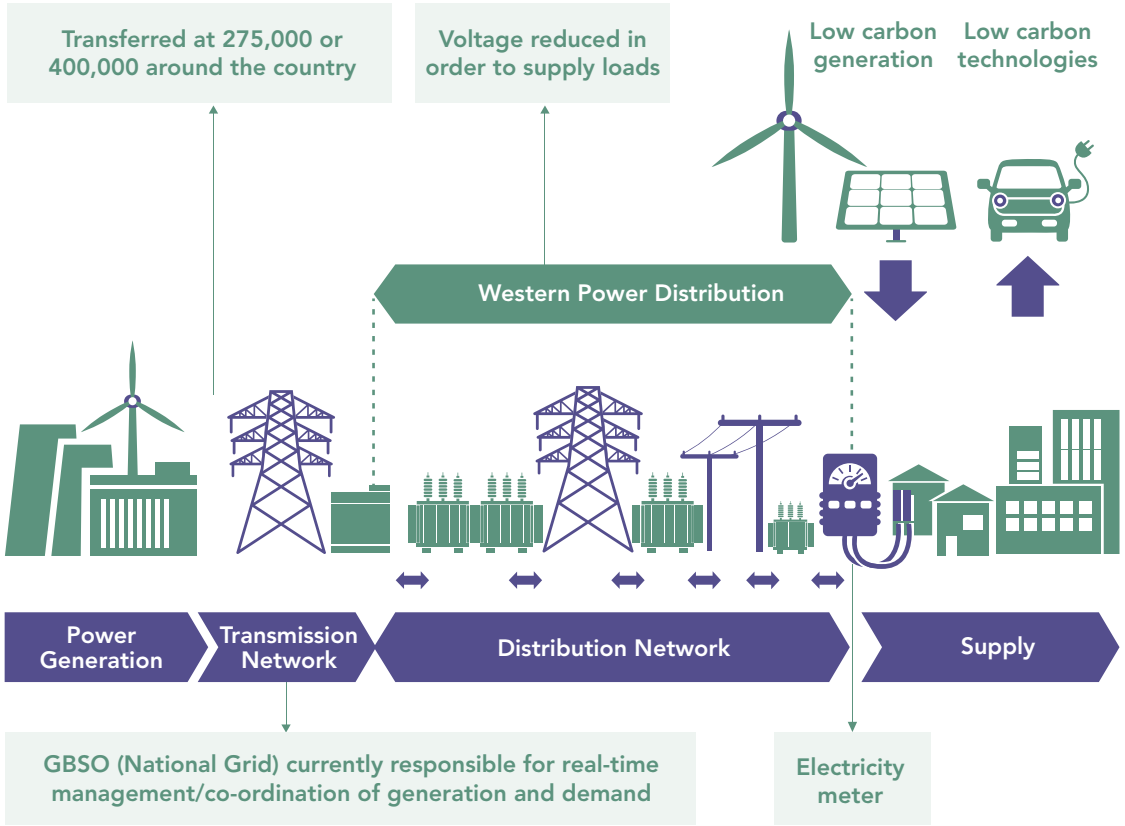
1. Introduction

Our Network

The electricity network we operate includes:

- Transformers that convert electricity from one voltage to another
- Underground cables and overhead lines that carry electricity across long distances
- Switches to turn the electricity on or off, or to alter its route
- Service connections to take the electricity into customers' premises
- Our network sits between the National Grid transmission network and the end customer

Assets – 2016/17	Units	WPD Total
Overhead lines	km	90,000
Underground cable	km	134,000
Transformers	Each	187,000
Switchgear	Each	296,000
Poles	Each	1,375,000
Towers	Each	15,000



1.2 Improvement Opportunities

We are a responsible business committed to ensuring legal compliance and minimising the overall impact our activities have on the environment in which we work and operate. Wherever possible we aim to adopt best practice and continually improve on our environmental performance.

“

ZERO ENVIRONMENTAL PROSECUTIONS OR ENFORCEMENT ACTION ACROSS THE BUSINESS FROM THE ENVIRONMENTAL REGULATORS.

As such during RIIO-ED1 we have committed to achieve the following environmental improvements (outputs) throughout our business:

A Reduction in Technical Network Losses

- Installing oversized transformers when replacing assets at highly loaded locations
- Using larger sized cables when installing new network in Low Carbon Technology (LCT) hotspots
- Undertaking innovation projects specifically related to technical losses

A Reduction in our Carbon Footprint

- All replacement vehicles to have lower CO_2 emissions than those they are replacing
- Ensuring all new or refurbished WPD buildings achieve a minimum rating of ‘Excellent’ or ‘Very Good’ under the BREEAM* rating
- Reducing the amount of waste we produce and send to landfill

Reduction in the Leaks from our Equipment, Specifically:

- The volume of oil lost through leaks from fluid filled cable
- The volume of SF_6 gas that is lost from switchgear
- Installing effective oil containment ‘bunds’ around plant containing high volumes of oil

*Building Research Establishment Environmental Assessment Method

1.3 Stakeholder Engagement

The impact of our actions and decisions is significant. That's why we engage with stakeholders, through a programme of annual stakeholder events to make sure that they influence our decision making; drive us to continually improve and hold us to account for our performance.

The identification of these categories by our stakeholders, and the hierarchical importance bestowed upon them defines our entire business strategy.

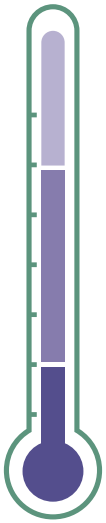
One of the areas we focussed on as part of our 2016/17 stakeholder engagement programme was Environmental Impact, specifically the company Business Carbon Footprint. The programme engaged with around 300 customers and interest groups at six locations across the WPD area. Stakeholders were asked to discuss and rate the importance of some of our environmental conditions. Electronic voting was used to capture the views of stakeholders and provide immediate feedback at the events.

Our stakeholders were asked to rate a range of initiatives which would help us make reductions in areas of our BCF where we have the opportunity to improve progress. Out of the three main areas discussed they rated SF_6 leakage as their most important area followed by vehicle emissions and building energy usage.

The specific interventions that gained the most approval were:

- Supporting Industry Research into SF_6 alternatives
- Installing low energy lighting in depots which have not been upgraded
- Investigating bespoke energy savings measures at depots
- Providing SF_6 detection cameras in each licence area

Rank	2015/16	Category	2016/17
1	(1)	Keeping the lights on	9.20/10
2	(2)	Smart networks	7.46
3	**New**	**Environment & sustainability**	**6.85**
4	(3)	Workforce renewal, skills & training	6.65
5	(5)	Vulnerability	6.64
6	(4)	Government legislation/policy	6.21
7	(6)	Affordability	6.00
8	(7)	Customer information and data	5.90
9	(8)	Customer awareness	4.08



2.0 Managing our Environmental Impact

2.1 Introduction

All of the operational activities which WPD undertakes have the potential to impact upon the environment.

As a certified ISO14001 operating organisation our robust environmental management system ensures that this risk to the environment is minimised and that as a company we continually improve how we manage all environmental aspects associated with our operational activities.

2.2 Visual Amenity

WPD operates 91,000km of overhead lines predominantly in rural locations.

Whilst overhead lines are widely accepted as being part of the countryside, there are a number of National Parks and Areas of Outstanding Natural Beauty (AONBs) across our geographical footprint where the removal of WPD overhead lines would improve the visual amenity. The main method of improving visual amenity whilst maintaining supplies is to replace the overhead lines with underground cables.

Within WPD, we coordinate the undergrounding of overhead lines with established steering groups. These are made up of representatives from AONBs and National Parks who help us identify and prioritise where the work will take place. We provide information and appropriate assistance to stakeholders to help them in scheme selection including budget costing and feasibility assessments. The years in which funds are spent are dependent on the views of the steering group, and the timescales needed to develop and implement the schemes.

As part of the Ofgem-approved voluntary initiative, following stakeholder engagement and feedback, our approved business plan for the regulatory period 2015-2023 includes a total sum of £7.6m for undergrounding of overhead lines in National Parks and AONBs.

The £7.6m is the total for our four licence areas for eight years and is split according to Ofgem's allowance caps for each electricity network licence area across England and Wales as follows:

£7.6M
Total for our four licence areas for eight years

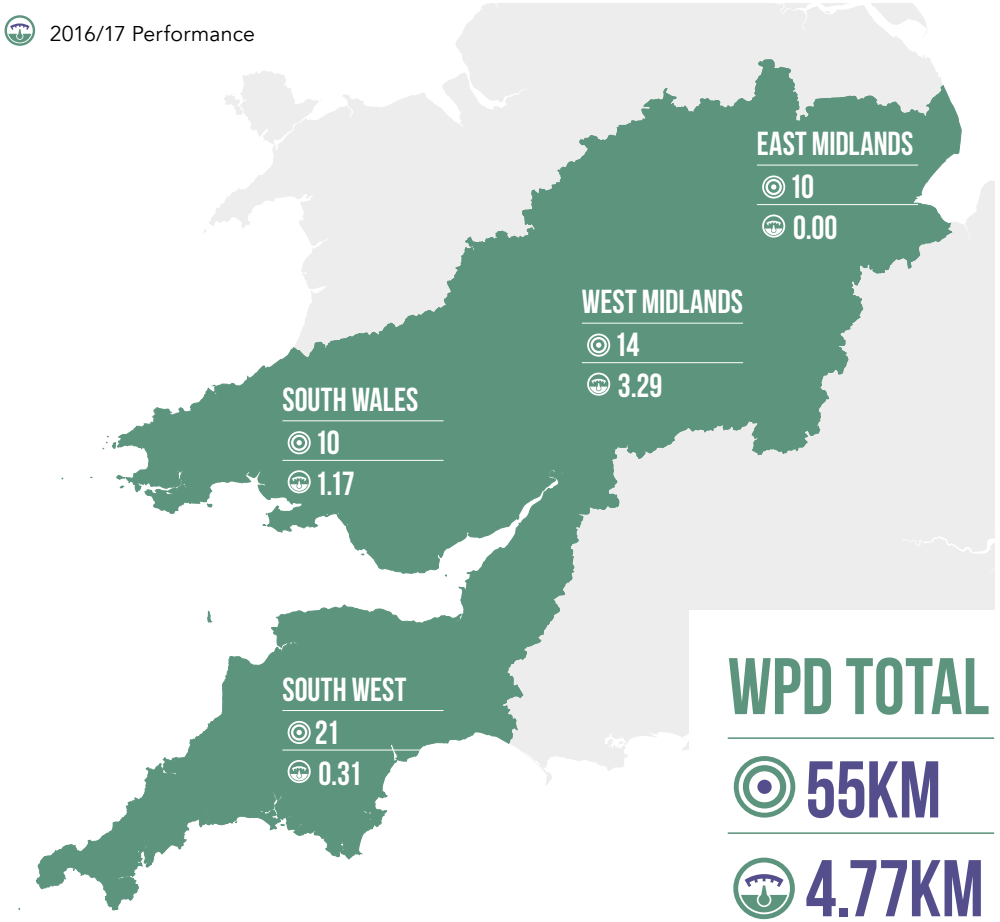
- **£2.3M** West Midlands
- **£3.0M** South West
- **£0.9M** East Midlands
- **£1.4M** South Wales

Undergrounding in National Parks and AONB's (km)

The work carried out by licence area is as follows:

Target for RIIO-ED1

2016/17 Performance



WPD TOTAL

55KM

4.77KM

2.2.1 Scheme Selection and Consultation

- WPD believes that projects should be selected by stakeholders/interest groups. We implement these projects within the regulatory rules and take into account any technical or planning constraints (such as consents or environmental/ planning restrictions)
- The principal groups concerned with project promotion, selection and also stakeholder engagement are the National Parks and AONBs in our area, along with affiliated organisations (for example 'friends of' groups) and other stakeholders/interest groups such as environmental organisations (Council of the Preservation of Rural England, Natural England, Natural Resources Wales)
- Our principal stakeholders select projects and put them forward for consideration
- We rely on principal stakeholders/interest groups to carry out their own engagement and consultation on projects before putting these forward. The degree and type of engagement varies and it is up to these organisations to determine what is appropriate and proportionate
- Our stakeholders consider the best use of the funds available when selecting projects. Usually, but not always, this means focusing on 'iconic' sites
- Steering Groups are encouraged to ensure that National Parks or AONBs which have previously had little or no investment are assisted to bring schemes forward. The Steering Groups may need to decide the level of funds to be allocated to these areas, using a fair and pragmatic approach
- Depending on the location and terrain, the time to implement a project could vary greatly. For example, village projects with low voltage lines or sites with many habitats or archaeological constraints normally take longer
- WPD assists stakeholders as much as possible with information needed to select suitable candidate projects. We work with stakeholders to establish the technical viability of proposed projects and we provide high-level cost estimates to assist in decision-making about which projects may be suitable for consideration
- The selection criteria for projects in each WPD region is discussed and agreed by the Steering Groups for those areas
- The Steering Group discusses and agrees which projects are to be put forward for implementation with reference to a Visual Amenity Impact Assessment Form. WPD employees do not participate in any voting
- Stakeholder feedback, for example comments from parish councils, is encouraged and collated. It is one of the criteria the Steering Groups consider when selecting schemes and allocating funds

During 2016/17, with the agreement of our relevant Steering Group, we have completed nine projects as summarised in the table below. This has resulted in just over 5km of overhead lines being undergrounded.

Across all four of our licence areas, along with our steering groups we are currently assessing a further 43 projects for completion in this eight year regulatory period. Although these pipeline projects are in various stages of development, if they all prove to be viable it will allow us to underground a further 44km of overhead lines over the National Parks and AONBs in our region. Further projects will be added to the list at our Steering Groups' instigation.

WPD Licence Area	Steering Group Area	Project Location	Overhead lines removed 2016/17 (km)
West Midlands	Peak District National Park	Butterton	0.7
	Shropshire Hills AONB	Norbury	1.7
		Crossways	0.6
		Abdon	0.3
South Wales	Pembrokeshire Coast National Park	Dinas Head	0.8
		Treginnis Head	0.4
South West	North Devon Coast AONB	Croyde	0.31

2.3 Oil Leakage

In order to improve insulation properties and enhance cooling, some older styles of electricity cable contain oil.

Leaks from these cables can occur from time to time when equipment is damaged or seals deteriorate so we must take steps to reduce the number of leaks and minimise the environmental impact of them when they occur.

The risks associated with operating fluid filled cable (FFC) and related assets can be reputational, regulatory and financial. The primary risk is associated with leakage of insulation oil into the environment causing pollution, loss of pressure and ultimately cable failure. Leaks typically occur as the cable sheath deteriorates with age, at joint positions or as a result of third-party damage.

To minimise environmental damage we ensure that:

- Fluid levels in all our cables are monitored remotely; the loss of pressure triggers an alarm within our Control Centres. This allows us to react to any leak event
- Leaks are located quickly preferably using perfluorocarbon tracer (PFT) and repaired
- Cables with a history of high leak rates are selected for replacement

Whenever we fully decommission a fluid filled cable we drain the oil from it, flush it and seal. Older types of higher voltage cables (33kV and above) also contain oil-based fluids to assist in the insulation and cooling of the cable. Again these cables sometimes leak due to third-party damage or age-related deterioration. New higher voltage cable designs do not use oil-based fluids and therefore any risks associated with these cables will reduce over time.
All leak rates are recorded and a database of leak and cable information held centrally.

2.3.1 Improving Leak Location

WPD has introduced a tagging system that uses a small amount of perfluorocarbon tracer (PFT) that can be readily detected above ground when a cable leak occurs. This helps to quickly pinpoint the leak location and speeds up the repair process. The use of PFT reduces the environmental impact of the leak by quicker detection, lowers associated costs, avoids inconvenience to customers and minimises the amount of excavation required to locate a leak.

During RIIO-ED1 we have committed to applying PFT to cables with a history of leakage.

2.3.2 WPD Fluid Filled Cable Reported Information

Since 2012/13 we have achieved the following across the WPD business:

Total km of FFC in service reduced by

132 KM OR 15%

Total volume of oil in services reduced by

228,544 L OR 9.83%

Total volume of oil used to top up reduced by

25,872 L OR 60%

2.3.3 WPD FFC Reported Information

Throughout 2016/17 we have developed and put into effect a companywide fluid filled cable database. The purpose of the database is to ensure that all losses are recorded, monitored and mitigated appropriately and that data is accurate and up to date. Fluid filled cable losses continue to decrease year on year in line with our ED1 target.

2.3.4 Oil Mitigation Schemes

In 2016/17 a total of 44 oil mitigation schemes associated with fluid filled cables have been completed across the business. A number of schemes have involved the application of PFT to detect leaks quicker and with minimal disruption to the network.

44
oil mitigation schemes

2.3.3a FFC losses vs. RIIO-ED1 target

WPD FFC Reported Information

	2012/13	2013/14	2014/15	2015/16	2016/17
FFC in service (km)	871	700	785	755	739
Volume of oil in service (litres)	2,325,794	2,167,663	2,106,920	2,024,588	2,097,250
Volume of oil used to top up cables (litres	43,123	22,216	30,950	17,291	17,251

2.4 Carbon Impact and Climate Change

2.4.1 Business Carbon Footprint

WPD's Business Carbon Footprint (BCF) details the impact that our operational activities has on the environment in terms of associated carbon dioxide (CO_2) emissions. We measure and report our BCF using equivalent tonnes of carbon dioxide (tCO_{2e}).

The data compiled and the figures which we report follow a recognised methodology as described within international business carbon footprint standards, the Greenhouse Gas (GHG) reporting protocol and ISO14064-1.

All of our published BCF data has been verified and data assured for accuracy and compliance with the standards detailed above.

The WPD BCF takes account of our energy usage from offices, transport emissions (operational and business), fuel combustion and the release of greenhouse gases (SF_6). The reported data for operational transport (road) and fuel combustion also takes account of a number of our larger contractor emissions as required under the OFGEM reporting requirements.

We publish our annual BCF as part of our company reporting obligations and also to OFGEM as part of our distribution licence requirements.

2.4.1 Annual BCF Reporting

Aspect		Scope	2012/13 Total tCO_{2e}	2013/14 Total tCO_{2e}	2014/15 Total tCO_{2e}	2015/16 Total tCO_{2e}	2016/17 Total tCO_{2e}
Buildings Energy Usage	Buildings – electricity	2	12,098.2	9,979.9	12,454.4	10,997.7	9770.76
	Buildings – Other fuels	1	191.6	260.1	207.6	193.1	192.5
	Substation electricity	2	28,836.7	24,856.9	27,578.7	25,789.3	22,991.57
Operational Transport*	Road	1	33,335.9	35,400.6	40,018.8	37,804.8	34,902.58
	Rail	1	0.0	0.0	0.0	0.0	0.00
	Sea	1	0.1	0.1	2.4	2.4	0.24
	Air	1	1,253.0	1,624.4	1,428.1	1,831.0	2,163.47
Business Transport	Road	3	3,903.7	3,792.9	3,304.0	5,116.2	3,196.53
	Rail	3	10.8	20.8	21.6	20.6	21.97
	Sea	3	0.1	0.1	0.0	0.3	0.97
	Air	3	30.1	53.9	106.4	41.5	92.37
Fugitive Emissions	SF_6	1	6,063.4	7,384.9	8,282.1	9,045.9	5,210.71
Fuel Combustion*	Diesel / Gas oil	1	3653.2	11836.7	8574.1	7100.9	7,041.65
Total Carbon (tCO_{2e})			89,376.7	95,211.1	101,978.1	97,943.7	85,585.7
Network Losses		1	2,384,281.5	1,896,261.7	1,906,640.7	1,687,342.2	1,530,164.6
Total carbon (tCO_{2e}) including losses			2,473,658.2	1,991,472.8	2,008,618.8	1,785,285.9	1,615,750.4

Scope relates to definitions in DEFRA guidance and is detailed in the commentary at Appendix B.

*Includes contractor emissions

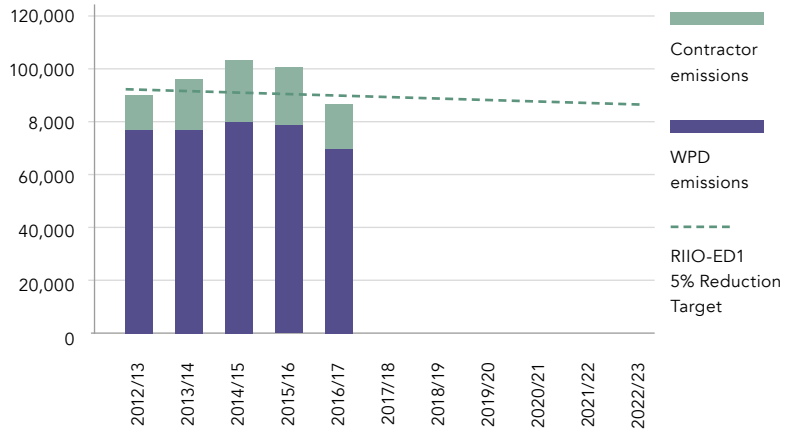
2.0 Managing our Environmental Impact

In 2016/17 WPD achieved a 12.6% reduction in annual BCF (excluding losses) compared with the previous 2015/16 reported figure. In comparison to our baseline year of 2012/13 our annual BCF has reduced by 4.2%.

Small but significant improvements have been made across the business in all aspects of our Business Carbon Footprint contributing to the reduction.

Progress to achieve our 5% reduction target will continue to be challenging throughout the ED1 period.

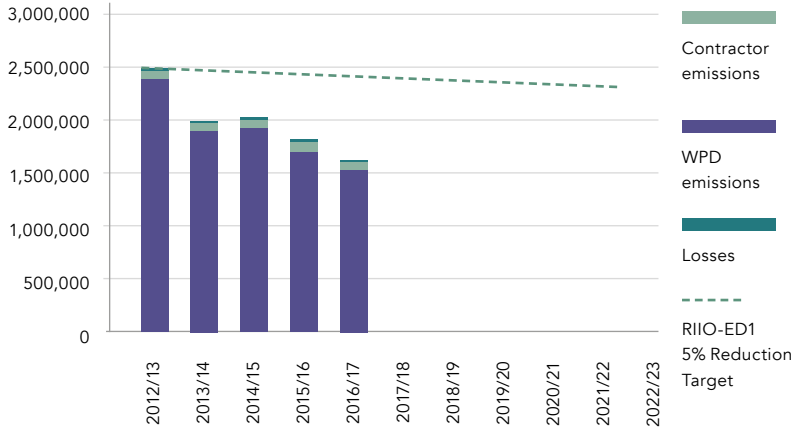
2.4.1a Annual BCF excluding losses tCO_{2e}



10.4%

reduction in tCO_{2e} associated with network losses recorded in 2016/17 compared with 2015/16

2.4.1b Annual BCF including losses tCO_{2e}



12.6%

reduction in annual BCF (excluding losses)

2.4.1.2 Reducing Emissions from Vehicles

WPD's network is spread over an area of 55,000km^2 so we need to operate a significant fleet of vehicles to allow our staff to serve this territory effectively. Emissions are reported as part of our Business Carbon Footprint statements and are calculated based on fuel usage data, in line with the published 2015 DEFRA conversion factors.

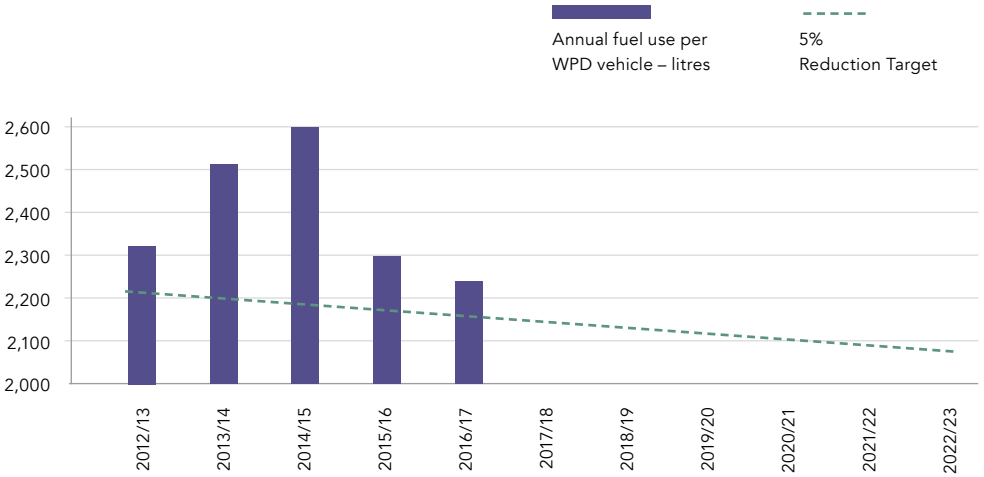
Procurement processes are used to ensure that when our vehicles reach the end of their useful lives, they are replaced with more efficient options. An example of replacements for some of our most commonly used operational vehicles shows this process in practice (data comes from the vehicle registration certificate).

2.4.1.2 Emissions – Operational Vehicle Replacements

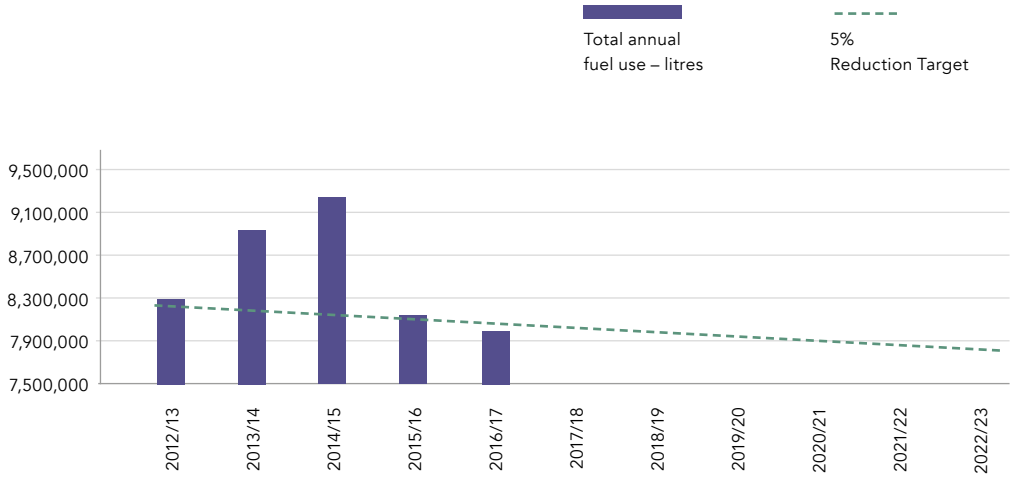
Previous Vehicle	CO2 Emissions (grams per km)	Current Vehicle	CO2 Emissions (grams per km)	Future Vehicles / Versions	CO2 Emissions (grams per km)
Ford Fiesta Van 1.5	98	Ford Fiesta Van 1.5	82	Transit Courier	99
Fiat Doblo SWB	137	Transit Connect SWB	115		
Fiat Doblo LWB Euro 5	137	Transit Connect LWB	115	Transit 310 L1 Custom	165
Landrover 110	295	Isuzu DMAX	196	Isuzu DMAX	183
Landrover 110 MEWP	295	Isuzu DMAX MEWP	196	Isuzu DMAX MEWP	183
Transit 350 MWB RWD	228	Transit 350 MWB RWD	196		
Transit 350 LWB RWD	234	Transit 350 LWB RWD	214		
Transit 350 2.2 E5	228	Transit 350 2.2 E5	214		

2% REDUCTION IN AVERAGE ANNUAL FUEL USE PER WPD VEHICLE SINCE 2015/16.

2.4.1.2a Litres per WPD vehicle



2.4.1.2b Total WPD fuel use (litres) per year



We measure the contribution of vehicle emissions to our overall BCF performance in terms of fuel usage converted to equivalent tonnes of carbon dioxide (tCO_{2e}). Performance during 2016/17 has improved in terms of both total fuel use and litres of fuel used per WPD vehicle – see figures 2.4.1.1a & 2.4.1.1b. (to be amended following RRP data).

We continue to trial vehicles that use alternative fuels. Currently we have three electric operational vehicles in use; the operational value of these will be assessed in 2020.

Elements such as range between charging, payload (the weight capacity of the vehicle) and usage will be reviewed in order to identify how appropriate these vehicles are for future WPD use. At this stage in the project, we have identified some reliability issues with charging, cell failure and limits to range and payload in comparison to diesel equivalents.

Our hydrogen vehicle project is continuing with Swansea University. The project was initiated to trial commercial vans which have been converted to dual fuel usage – hydrogen and diesel. We have purchased and converted two vehicles in partnership with the University of Swansea which will become operational in September 2017. The vehicles will be fitted with wireless data-loggers allowing University researchers to undertake regular fuel analysis to determine vehicle efficiency and operational suitability.

2.4.1.3 Building Energy Use

WPD operates from 59 offices that vary in age and construction. We know that when refurbishment of these buildings takes place, there are opportunities to improve their energy efficiency.

In the West Midlands and East Midlands, many existing offices were refurbished to the BREEAM standard of 'very good' when facilities were being developed for the WPD local team based operational structure. All new builds achieve the BREEAM 'excellent' rating'.

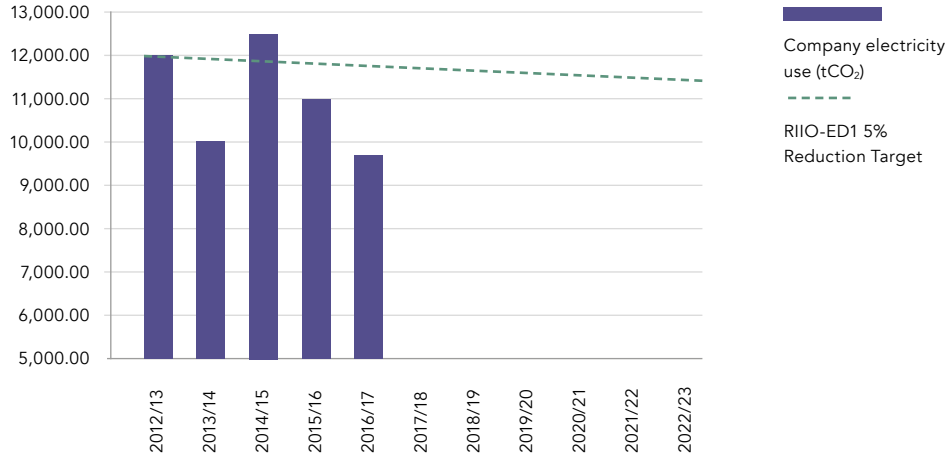
In the South West and South Wales our properties are older, with more scope to implement energy savings measures. Whenever refurbishment work is planned we ensure, where appropriate, that it is carried out to the "very good" standard under BREEAM to reduce energy consumption. The "very good" standard is the highest which can be achieved for a refurbished building.

During 2016/17, we have successfully completed the BREEAM refurbishments / new builds listed in the table below.

Company electricity use has reduced significantly during 2016/17 in comparison with 2015/16 and we continue to meet our RIIO-ED1 5% reduction target.

During 2016/17 we have continued to install reduced energy lighting systems, improved air conditioning and rolled out 'Switch Off' events throughout the business.

2.4.1.3a Company building electricity use (tCO_{2e})



2.4.1.3b BREEAM refurbishments/new builds successfully completed during 2016/17

Non-operational Depot Site	Development	BREEAM Rating
Chesterfield (15/16)	Major refurbishment	Very Good
Boston (15/16)	New build	Excellent
Hereford (15/16)	New build	Excellent
Bude (16/17)	New Build	Excellent

Switch It Off week – July 2016

During July 2016 WPD trialled a 'Switch Off' week where employees were encouraged via posters, emails and reminders to switch off all electrical equipment and heating/ cooling systems, where appropriate, at the end of the working day. Following the trial we compared consumption across the business via our SMART meter management system – STARK Energy.

The results from the 'Switch Off' week are below;

- 4% reduction in overall consumption
- 5% reduction in unoccupied hours consumption
- No significant difference in cooling demand over two weeks therefore reduction very likely due to switch off actions
- £1,169 saved over just one week based on current average tariffs

2.4.2 Sulphur Hexafluoride (SF_6)

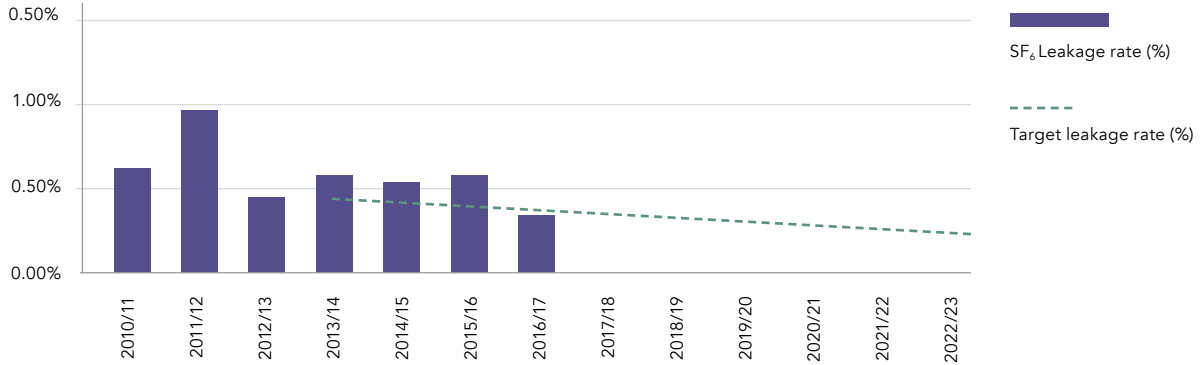
SF_6 gas is used throughout our industry as an insulating medium in switchgear. Although it provides many benefits, it is a potent greenhouse gas (1kg SF_6 is equivalent to 22,800kg CO_{2e}). There are currently no viable alternatives to SF_6 for certain smaller types of switchgear. We will continue to replace older oil filled switchgear with SF_6 insulated switchgear and predict that our total SF_6 bank will be approximately 23,000kg by 2023 – an increase of 10,000kg on our baseline year.

The graph below shows that the volume of SF_6 leaked annually is very small at less than 1%.

When replacing switchgear, we give priority to the switchgear with the highest leak rates. Within RIIO-ED1, we have committed to replacing any 11kV distribution assets that show signs of leakage and any higher voltage assets that have leaked three times. SF_6 leaks are monitored and logged within our asset database – the volume of leaks is determined by the volume of gas required to top-up the asset or the amount taken out of the unit if it is to be replaced. Leaks are identified by either a low gas alarm being triggered via control systems or from a low gas reading on a gauge identified during a switching operation or a routine substation inspection. When a leak becomes apparent, we locate its source so that a strategy can be developed to manage the situation, taking into account the potential for repairs and the lead times for replacement switchgear. During RIIO ED1, we have committed to reducing the rate of leakage of SF_6 by 17%. The amount of SF_6 lost is expressed as a percentage of the overall 'bank' of switchgear containing SF_6 as this will vary over the period of RIIO-ED1. The target is based on a four-year average of emissions between 2009/10 and 2010/11.

We are developing an Innovation project which will investigate the possible alternatives to SF_6. A range of alternative gasses are becoming available and we plan to complete laboratory assessments on them. If they have the characteristics required to be used in switchgear, we will then add them to switchgear and stress them through a full range of electrical testing to assess their resilience.

2.4.2a Actual %age loss of SF_6 vs. ED1 Target



> "ED1 SF6 LEAK RATE ACHIEVED IN 2016/17"

2.4.3 Distribution Losses

2.4.3.1 Introduction to Losses

Distribution losses are the difference between the energy which enters the distribution network and the energy which reaches the customer. The fact that a proportion of the energy generated will not reach the customer, means more power must be produced to meet demand. The carbon emissions caused by this 'wasted' energy account for more than 96% of WPD's carbon footprint. A certain amount of energy is always necessary to deliver electricity from one point to another, but as a company committed to reducing our impact on the environment we must endeavour to reduce losses as much as possible.

In addition to the environmental effect, the financial cost of losses contributes to customer's bills. All of the financial savings that loss reduction produces are passed on to consumers directly. Reducing losses can also effectively increase the capacity of our network, as less power needs to be delivered to produce the same output.

The electricity demand over the next 15 years is likely to increase considerably as technologies such as electric cars and heat pumps become more common. This means loading will increase, which will increase losses, as explained in the variable losses section. Losses may increase further due to the increase in distributed generation. The electricity network was designed for large centralised generators to supply power to the high voltage network and then this would flow through the low voltage network to customers. However, new renewable energy sources tend to be smaller and well spread out; so they are often connected to the low voltage network and the power may then have to flow back to the high voltage network to reach its customers. This setup was not designed for distributed generation, so it may not be the most efficient. Our network is already changing to incorporate distributed generation and losses must be a priority consideration when making these changes.

Causes of Losses

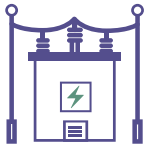
Losses can be categorised into two main types: technical and non-technical losses. Technical losses are where energy is lost in the physical working of the network while non-technical losses are those which do not occur on the network itself, but come from energy being consumed, legally or illegally, but not properly metered.

Variable Losses

Technical losses can be split into fixed losses and variable losses. Variable losses are those which depend on the current going through the system. In most cases, these take the form of energy lost to heating of the cable or transformer. As cables and windings have intrinsic electrical resistance, they will heat up as current is passed through them. This heating process uses up some of the energy being transmitted through the cable. This is one of the largest sources of loss on our network and can only be reduced by installing lower resistance cables (often by manufacturing cables with a larger diameter) or reducing the load on our cables.

Fixed Losses

Fixed losses are those which are not dependent on the current in a system. The most common source of these is the energy cost of maintaining the required magnetic field in a transformer. The energy required to maintain this field is essentially fixed once the transformer has been turned on. Newer transformers use more magnetisable materials in their core, which can reduce these losses considerably.



Under our current losses strategy we will replace all of our pre 1958 transformers

Under our current losses strategy we will reduce the voltage on our LV network by 0.88% to reduce demand

Phase Imbalance

One way to reduce variable losses is to balance the current across all 3 phases. If the current is higher on one phase, because the loss is dependent on the square of the current, it will increase the total loss more than a low current on another phase will decrease it. Current will also start to flow in the neutral conductor, causing further variable losses. Imbalance can be reduced by ensuring the loading on all three phases is roughly equal. To do this, customer's demand at different times of day must be estimated, then customers must be assigned phases so as to keep the load across the phases as even as possible at all times of day.

Power Factor

The other main way losses are increased above their baseline levels is by power electronic devices with poor Power Factors. The Power Factor describes how well a device turns input power into output power. If all the input power is outputted then the device will have a Power Factor of 1. In practice, the Power Factor will always be slightly less than 1. This means that the input current has to increase to produce the required output power, which increases the variable losses. To ensure this effect is kept to a minimum, the Power Factor of customer devices must be kept above a minimum acceptable value.

Non-technical Losses

Non-technical losses fall into two main categories: Theft in Conveyance and Unmetered Supplies.

Theft in Conveyance is where an illegal connection to the network is made, or where properties do not have a registered supplier. Unmetered supply occurs on equipment such as street lamps and traffic lights, which are impractical to meter, due to the number of units. Instead, their consumption is estimated based on standard power usage figures and the number of units. These estimations can be inaccurate and result in energy not being correctly billed. The extent of unmetered supply losses is relatively small but not insignificant, but theft in conveyance costs us 2.8GWh of energy a year. Both of these types of losses can only be reduced by investigations and audits.

Where Do Most Losses Occur?

The SOHN Losses report [ref], commissioned by WPD and UKPN, used network modelling to determine the extent of the losses on each part of our network. They found that the total losses on our network equate to approximately 7% of the power that enters our network. LV cables account for 25% of our losses and the distribution transformers connected to them account for 22%. The 11kV network accounts for 25% and the higher voltages contribute 28%.

2.4.3.2 Losses Strategy

Our Losses Strategy is updated annually and details our approach to losses and all of the interventions we have planned. This includes both programmes of asset replacement that we are undertaking and innovation projects that aim to provide new solutions for loss reduction in the future.

Highlights of our current strategy include: pro-actively replacing all of our pre-1958 transformers; discontinuing our 16 and 25kVA pole-mounted transformers and our 315kVA ground-mounted transformers; discontinuing the smallest sizes of our service, LV and 11kV cables and reducing the voltage on out LV network by 0.88% to reduce demand.

The Losses Strategy provides an introduction to the theory behind losses and the main ways that they can be produced and descriptions of our approach to loss reduction through asset replacement, improved understanding, stakeholder engagement and revenue protection.

2.4.3.3 Activities Undertaken in the Regulatory Year

In this regulatory year we have undertaken a number of activities which will significantly improve our loss reduction programme. We have hired a losses specialist to improve our losses policies, showing our commitment to this subject.

We have undertaken a survey of all the distribution transformers in the South West region, determining their root mean square load from half-hourly meter data, to determine whether each unit is loaded highly enough to justify uprating based on losses.

We found 249 transformers were worth uprating, which we will uprate when they reach the end of their lives.

To target illegal abstraction of energy, we used the Ordnance Survey Address Point system to identify properties at which there is no registered MPAN. As most properties have an electricity supply, these properties are likely to have an illegal connection. Having produced a list of such properties, we now intend to investigate each of these properties, to determine whether they do have an illegal supply.

We have implemented a new policy to install larger cables on new connections, based on losses calculations. We have calculated the losses each cable size would produce for a number of different demand and generation profiles, to determine the most economically efficient cable size for each type of connection and loading level.

After positive results from a trial of reducing the voltage on our LV network in South Wales, we have now reduced the voltage across our entire LV network. A 0.88% reduction in voltage has produced a 1.16% reduction in load, which reduces variable losses and will save 29GWh a year.

2.4.3.4 The Losses Investment Profile over the RIIO-ED1 Price

Price Control Period

Under our current business plan, we have not allocated any funds specifically for losses. Instead, investments into asset replacement are taken from the network reinforcement budget when it is seen to be economically viable to do so, under the Cost Benefit Analysis (CBA) scheme described in section 2.4.3.5.

We also have a number of innovation projects which aim to help reduce losses. These projects are funded by the Network Innovation Allowance (NIA). Projects such as the Losses Investigation, which is setting up a fully monitored LV network on the Isle of Man, are aimed solely at improving our understanding of losses. Whilst projects such as FALCON, which was aimed at smart-grid related techniques, have other primary aims, their outputs benefit losses as well. NIA funding is provided by Ofgem to all Distribution Network Operators (DNOs) to run technical or innovation projects directly related to their network, which have the potential to deliver financial benefits to the licensee or their customers.

To better understand losses, we need to have more monitoring points on our network to see where losses occur. The largest proportion of our losses occur on the LV network, which is the least monitored part of our network.

Adding smart-meters to our LV network could provide the required monitoring, but the investment cost of doing this across our network would be very high and may not be economically justifiable.

2.4.3.5 Cost Benefit Analysis, Tools and Methodologies

We will only undertake loss reduction activities when a CBA has found them to be economically beneficial. We use the standard Ofgem CBA spreadsheet and financially value losses using the Ofgem agreed figure of £48.42 per MWh. This figure is the average wholesale cost of energy in 2011/12, expressed in 2012/13 prices. It is intended to represent the societal cost of losses.

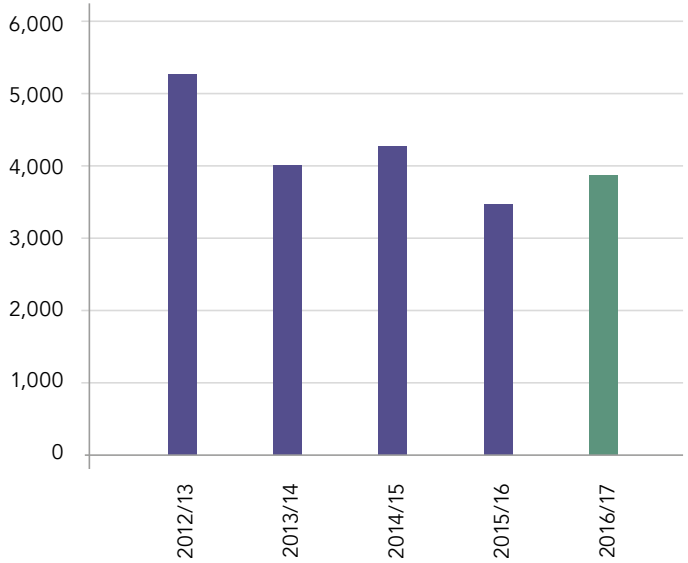
For some analysis, the Ofgem CBA spreadsheet is not sufficient and a bespoke model is constructed. When this is the case, we produce a simplified version in the Ofgem format and publish the bespoke CBA (as we do with all CBAs) to explain our full methodology.
The environmental benefits can be calculated using the agreed equivalent carbon emissions figure of 0.41205 tCO_{2e} per MWh.

> **UNDER OUR CURRENT LOSSES STRATEGY WE WILL DISCONTINUE THE SMALLEST SIZES OF OUR SERVICE, LV AND 11KV CABLES.**

2.4.3.6 Current Assessment of Distribution Losses

Despite a relatively small increase in the total annual losses for 2016/17 the carbon equivalent has reduced as a result of a reduced published conversion factor. Applying the new conversion factor to the annual losses in GWh has a significant effect on the calculated carbon equivalent figure.

2.4.3.6a Total Annual Losses (GWh)



2.4.3.6b Current Assessment of Distribution Losses

	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Total annual losses (GWh)	5,158	4,103	4,125	3,650	3,713
Carbon equivalent (tCO_{2e})	2,384,281	1,896,261	1,906,640	1,687,342	1,530,164

2.4.6.3c Summary of losses and benefits from activities in RIIO-ED1

Progamme / Project Title	Regulatory Reporting Year			RIIO-ED1
	Distribution Losses Justified Costs	Reduced Losses	Reduced Emissions associated with Losses	Cumulative reduced Losses to date
	£m (to one decimal point)	MWh	tCO_{2e}	MWh
Discontinuation of 95mm² 11kV cable	3.3	514	211	976
Discontinuation of 16mm² service cable	6.2	1,322	544	2,354
Discontinuation of 315kVA transformers	1.0	402	165	842
Discontinuation of 315kVA transformers	0.8	302	124	602
Discontinuation of 16kVA transformers	0.5	151	62	297
Discontinuation of 25kVA transformers	0.4	122	50	245
Replacement of pre-1958 transformers	8.2	6,036	2,487	6,063

2.4.6.3d Summary of amount of loss activities 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
Discontinuation of 95mm² 11kV cable	km	257	150
Discontinuation of 95mm² LV cable	km	492	190
Discontinuation of 16mm² service cable	km	402	340
Discontinuation of 315kVA transformers	units	279	260
Discontinuation of 16kVA transformers	units	343	570
Discontinuation of 25kVA transformers	units	7	10
Replacement of pre-1958 transformers	units	457	62

2.5 Other Environment Related Activities

2.5.1 Certification and Transition to ISO14001:2015

Since 2011, WPD has been certified to ISO14001:2004 Environmental Management Systems. However the standard has recently undergone a major revision to ISO14001:2015. WPD's transition and certification of the standard will be implemented in early 2017/18.

There are a number of specific changes to the structure and new requirements for the revised standard which we have been working towards and addressing throughout 2016/17.

In December 2016 our auditors, LRQA undertook a Gap Analysis exercise as part of our surveillance audit to identify potential non-conformances to the new standard requirements, only a few issues were noted and we are confident of a successful certification and transition to the new standard in 2017.

Seven Key Changes for ISO 14001 (2015)

- Organisational context and the needs of interested parties
- Risks and opportunities
- Life cycle perspective - control and influence
- Integration into core business processes
- Environmental sustainability
- Leadership and competence
- Compliance obligations and demonstration of compliance status

2.5.2 Waste Management

We work closely with all of our waste contractors ensuring that where possible waste streams are diverted from landfill and that we always apply the principle of the waste hierarchy.

Redundant cabling and metal work is segregated at our depots and collected by one of two dedicated contractors who we have worked with for many years. We receive monthly revenue for the collected metal/cable and this waste is, in turn, processed and eventually returned to the marketplace for re-use.

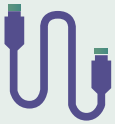
Wooden poles from our networks are collected from many of our non-operational depots. Previously the poles, which are classed as a hazardous waste, would have been disposed of via landfill, but we now dispose of them at a waste to energy plant in the north of England, avoiding expensive landfill costs and complying with the waste hierarchy.

We segregate our waste at all of our depot locations and transport units into the following waste streams;

METAL

WOOD

GENERAL WASTE



CABLE

ORGANICS

HAZARDOUS WASTE
(batteries/contaminated rags/used electrical insulating oil aerosols/ fluorescent tubes)

DRY MIXED RECYCLABLES
(cardboard/paper /plastics)

REDUNDANT WOODPOLES

Waste Management Hierarchy

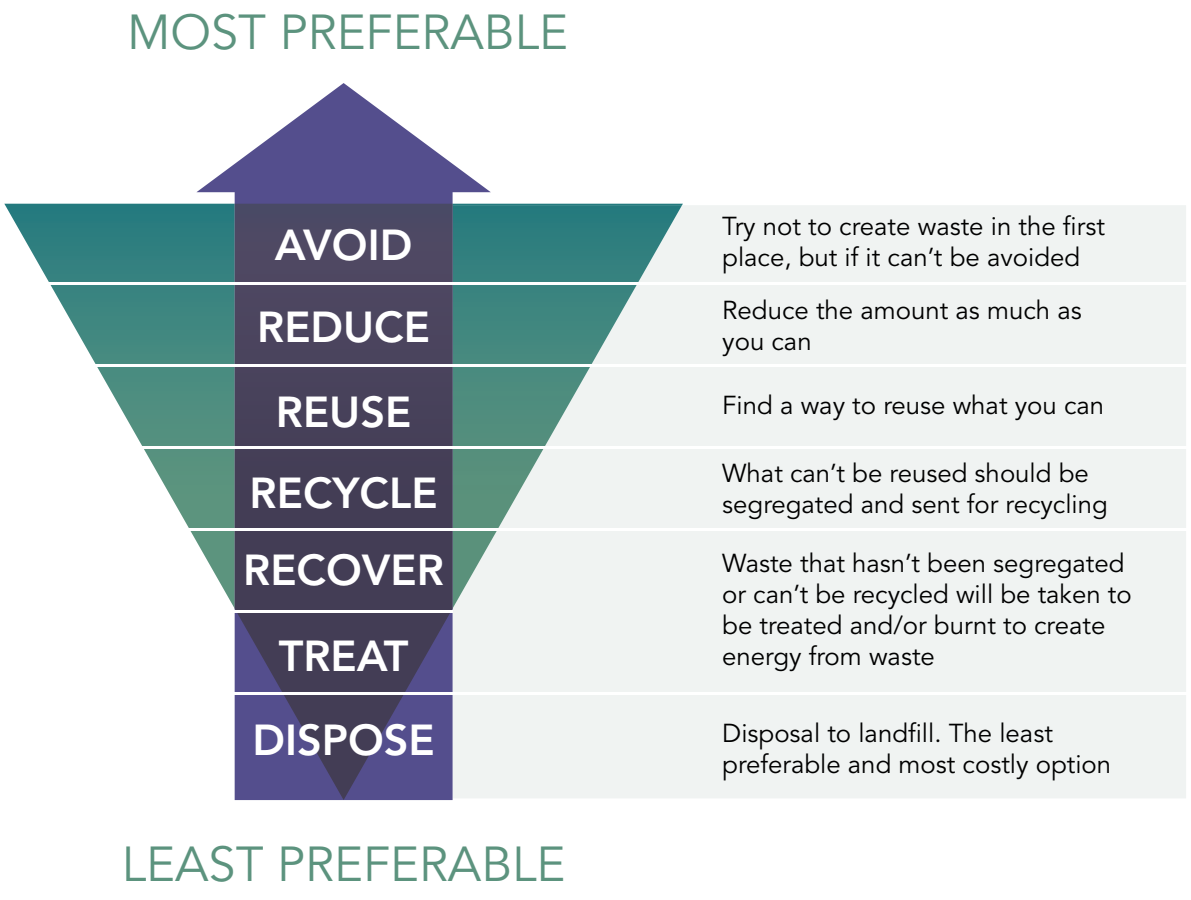
The Waste Hierarchy is a common sense sustainable approach to reducing waste, saving both resources and money.

Waste legislation states that any business that produces collects, transports, recovers or disposes of waste must take all reasonable measures to apply the waste hierarchy throughout their organisation. WPD continues to work with all of our waste producers and waste management contractors to ensure that waste is not only diverted from landfill but is reduced at source and where possible reused or recycled before considering final disposal.

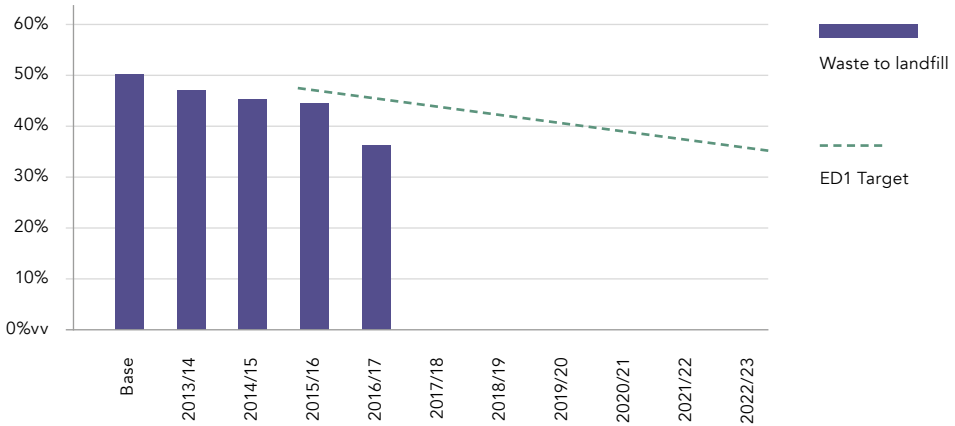
RIIO-ED1 Target – Waste

Our RIIO ED1 Business Plan states that we will reduce the amount of waste sent to landfill by 20% over the first two years of RIIO-ED1 and 5% per annum thereafter. This target does not include the recycling of our scrap metal and cable.

The percentage of WPD waste disposed of to landfill has decreased by approximately 14% in the last 12 months. Much of this reduction can be attributed to treated wood poles being diverted from landfill, improvements in office recycling and greater employee and contractor waste management awareness.

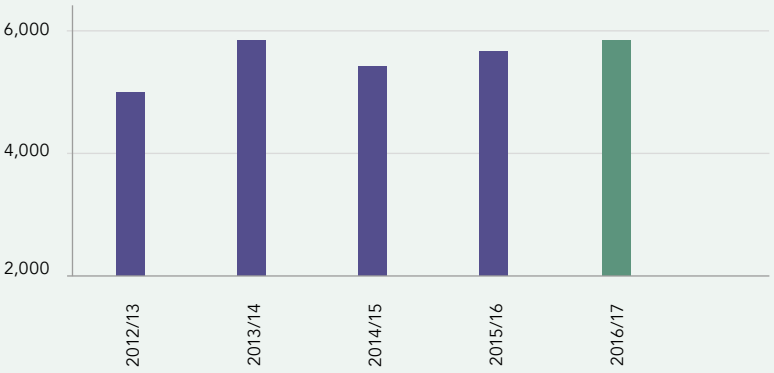


2.5.2.a Percentage of waste to landfill

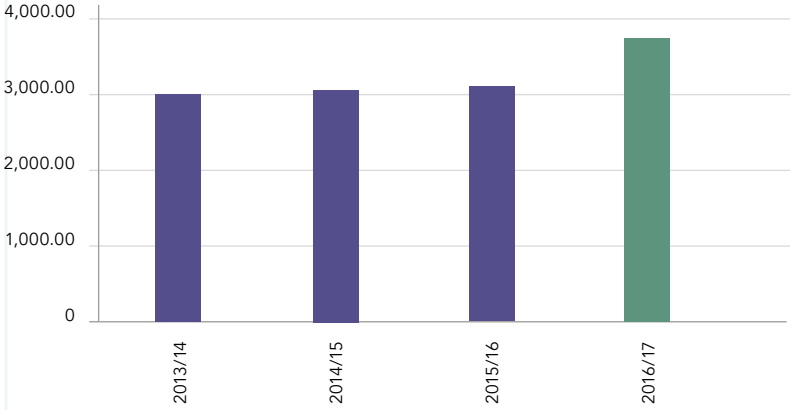


2.5.2.b Annual percentage waste to landfill vs. non-landfill

2.5.2.c Annual tonnes of total waste



2.5.2.d Tonnage of waste recovered (non-landfill)



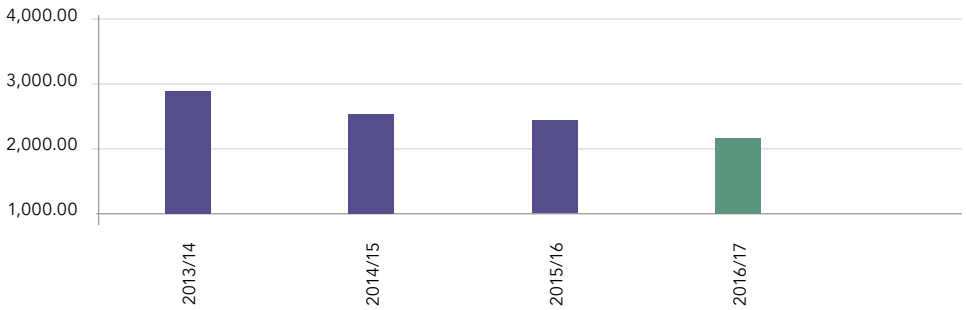
Waste Management

During 2017/18 we will continue to target the disposal of recyclables and strive to further reduce the amount sent to landfill. During this time we will specifically:

- Work closely with our waste contractors to identify innovative ways to segregate waste at source
- Aim to further decrease the actual tonnage of waste that we produce as a business and further investigate innovative ways, alongside suppliers and manufacturers, to reduce the amount of packaging waste and improve the reuse/recyclability of items we purchase
- Investigate with manufacturers the opportunities to reduce the amount of embedded waste, via improved design and life cycle analysis of the products that we routinely purchase, i.e. electrical equipment, operational vehicles and information technology equipment

Throughout 2018/19 we would also hope to see a continued increase in the proportion of dry mixed recyclables being produced at our office locations.

2.5.2e Tonnage of waste to landfill



SIGNIFICANT IMPROVEMENT IN THE AMOUNT OF WASTE DIVERTED FROM LANDFILL DESPITE A 4% INCREASE IN THE AMOUNT OF WASTE PRODUCED ACROSS THE BUSINESS.

ADDITIONAL 553 TONNES OF WASTE DIVERTED FROM LANDFILL COMPARED TO 2015/16.

Telford waste management case study

Over 12 months the WPD Telford team achieved a 30% increase in the amount of waste that it recycles. Previously it recycled just four per cent, with waste removal costing around £2,500 every month.

Increased recycling has not only reduced removal costs by two thirds, but also resulted in a significantly lower landfill tax bill. The improvement in recycling can be attributed to a combination of concerted team efforts, appointing a recycling champion and initiatives to make waste segregation easier.

Skips and waste containers were repositioned near the car park, so that the site itself resembles a recycling centre. Plus new signage was made up for the skips, large waste containers removed to discourage their over use and recycling facilities for batteries, tubes and cans introduced.

"It's been very encouraging to see the difference that the changes have brought about and everyone here is very pleased to see such a marked improvement. Ultimately though, there is still more that can be done and we want to reduce the amount of waste to landfill even more." Local Distribution Manager, Andy Barton.

Telford's success, supported by the WPD Environment team, illustrates the significant improvements that can be made at a local level.

Encouraging waste to be diverted from landfill is an excellent example of what can be achieved, the appointment of local recycling champions, maximising site layouts and local management support make waste management a much easier process whilst reducing our environmental impact.

Going forward WPD will take the positive actions and creative solutions demonstrated at Telford and apply them at other appropriate WPD non-operational depot locations. The WPD Environment Team continues to work with colleagues at every WPD depot to help maximise their potential for better waste management.

Hard Plastic Recycling – South Wales

Since February 2017 and in partnership with our waste contractor, we have trialled a hard plastic waste collection scheme in two of our South Wales depots. The trial targets difficult hard plastic waste of which we dispose a significant amount of each year; for example traffic cones, traffic barriers, hard hats, ducting and uncontaminated resin buckets. The plastics collected are processed (pelletized) and recycled to produce other hard plastic products. Whilst the trial is still at a very early stage we have to date collected in excess of 350kg from just the two locations. It is hoped that during 2017/18 we will be in a position to roll-out the hard plastic collection scheme to many, if not all, WPD non-operational depot sites.

2.5.3 Pollution Reduction Activities and Strategy

WPD's assets and the activities which we undertake pose a potential risk to the environment. This means we have a responsibility to:

- Implement and improve control measures to minimise these risks
- Minimise the risk of pollution
- Ensure we deal with incidents appropriately and responsibly

2.5.3.1 Installation of Equipment Bunds

Large transformers and some items of switchgear pose a risk of oil contamination should a leak arise, especially where the equipment is near water courses, water tables or drainage ditches.

During RIIO-ED1 WPD have committed to ensuring that all 33kV transformers and above and any bulk storage sites (those with equipment containing oil in excess of 1,500 litres) would have either a new bund installed or an existing bund refurbished to ensure effectiveness. The bunds are designed to contain the full volume of oil that is in the equipment. Bund pumps are installed to keep the bunds clear of water.

These pumps can discriminate between oil and water and stop pumping when oil is detected. We are also undertaking site surveys to assess the requirement for either the repair of an existing bund or the establishment of a new bund.

BoxSep Installation – Restricted Space Pollution Prevention

WPD have been working with their contractor Adler and Allan on the installation of BoxSeps. The BoxSep has all the features of a normal oil separator but works in areas where space is restricted, where there is a risk of ground contamination and site space will not allow for a standard separator installation.

Although still being trialled WPD have installed BoxSep units at two operational sites with promising results and hope to install more units over the next twelve months.

What Does the BoxSep do?

- Prevents hazardous oil pollution working in conjunction with a bund water control unit
- Incorporates a high oil probe to detect oil, allowing the system to be isolated
- Does not require extensive underground civil engineering as per a normal separator

2.5.3.2 Spill Prevention During Maintenance Work

In 2016/17 we purchased a portable bund for use when transporting used oil from operational sites. The bund folds out to accommodate 4 drums and is designed to withstand vehicles or forklift trucks driving onto it to offload oil drums into it. Strong plastic rigid grating further supports and levels the drums within the bund. Once the drums are in position on the base of the bund the construction is then completed by erecting the sides with the help of a support frame, thereby providing the containment should a spill occur. The bund is currently being trialled in the West Midlands to evaluate its ease of use and durability. Early indications are encouraging and the trial will continue throughout 2017.

2.5.3.3 Storage of Generators

In the East Midlands a newly opened transport workshop has a bespoke storage space equipped with suitable ventilation systems to accommodate lorry mounted and towable generators. Rather than external storage the generators are now kept secure and on a concrete base preventing any potential leaks from them escaping into the environment. The relocation of the generators will help the depot create more space to store materials more efficiently and install further waste segregation facilities within the yard area now vacated.

Where appropriate this storage method will be adopted at other WPD non-operational locations.

> "ENSURE WE DEAL WITH INCIDENTS APPROPRIATELY AND RESPONSIBLY.

2.5.4 WPD Depot Environmental Permits

Under the European Waste Directive, the UK Environmental Regulators have declared that all used oil drained from plant or used plant containing oil which is to be removed from site be classed as a hazardous waste. This means that the WPD depots in England that store in excess of 3,000 litres of used oil (1,000 litres for WPD depots in Wales), in drums or within redundant plant, now require an environmental permit to store the used transformer oil prior to final disposal by a third party contractor or via a WPD Plant Centre.

Since 2014 we have successfully applied for 23 environmental permits with the Environment Agency / Natural Resources Wales. As part of the application process, our permitted sites must be able to demonstrate to the Environmental Regulator that all pollution prevention measures are robust, fit for purpose and legally compliant. We have also demonstrated a thorough approach in terms of oil storage, risk minimisation and the management of the environmental permits.

Throughout 2016/17 we have had a number of planned and unplanned visits by the Environment Agency / Natural Resources Wales at our permitted sites, to date we have had no major non-conformances issued at any of the sites visited and any minor non-conformances identified have been addressed promptly and closed by the Regulator.

During 2017/18 we will continue to manage our permitted sites in line with Environment Agency / Natural Resources Wales guidance and legislation. We will also be applying for new permits at locations in South Wales and the West Midlands.

WAMITAB Competency Assessment

In order for us to maintain and comply with our depot environmental permits for the storage of used electrical insulating oil, the Environmental Regulator needs assurance that our employees are competent and responsible for the safe and secure management of the site.

One way to demonstrate competency in terms of waste management is to complete the Waste Management Industry Training and Advisory Board (WAMITAB) competency assessment. The process assesses an individual's competency in terms of environmental compliance, pollution prevention and risk minimisation, as well as health and safety. Staff should also operate in line with all company policy.

To date, 20 selected WPD employees based at our non-operational depot sites have successfully completed the assessment and have been issued with their WAMITAB certification. An additional 45 employees are now in the process of completing the competency assessment and will be certified during 2017/18. Of these 45, 13 are new candidates registered in 2016/17.

20 employees based at our sites have successfully completed the assessment and have been issued with their WAMITAB certification

45 employees are now in the process of completing the competency assessment and will be certified during 2017/18

2.5.5 Environmental Improvement Case Study: Capture Green

As part of our commitment to minimise our environmental impact WPD have been working with Capture Green to install a variety of creosote removal systems into sites around WPD's estate. Some sites have been entirely new 'turnkey' installations on brownfield sites and others have been retrofitted into existing pole storage areas. The technology inside the Green Rhino Water Remediation system enables contaminated surface water to be processed on site, mitigating the requirement for vacuum tankering from within bunded areas. This has helped to reduce cost, time on site and offers a highly efficient environmental solution.

Willenhall Grid Site

Willenhall Grid site is a strategic pole storage point for the Midlands, where in excess of 400 poles are stored. Capture Green designed and implemented a new stillage system on the site which enables poles to be racked individually, reducing health and safety risk to operatives. Storing poles individually means they can be 'slung and chained' without the need to leaver poles apart from each other and risk entrapment. The containment area is over 600m^2 and utilises a 4 bay Water Remediation Chamber system that processes surface water, removing the contaminants typically found in creosote and allowing the water to drain away to compliant levels. The only concrete utilised on the site was for the stillage foundations with the main containment area being made of geotextile and liner based materials. This method eliminated the extensive volumes of concrete and more intrusive construction methods that are traditionally used to create an equivalent containment area.

Hanham, Bristol

WPD utilised a pre-fabricated Green Rhino Steel secondary containment system for a distribution transformer at Hanham, Bristol. This system is designed to be installed within a day. The system is prefabricated and certified off-site, meaning that it can be quickly mobilised. A prefabricated bund offers less disruption on site with reduced health and safety risk, network disruption and overall cost. The system utilises a Green Rhino Hydrocarbon Removal Cartridge (HRC) which is capable of allowing filtered bund water to drain to acceptable discharge levels. This means that the bund will not fill up with contaminated water and does not require vacuum tankering.

WPD is also utilising a variety of Green Rhino Oil and Sediment Filtration systems that can be used to overpump contaminated excavations and bunded areas. The systems are utilised with existing pump media and prevent the requirement for vacuum tinkering and overall costs. In addition to filters, Green Rhino Oil Retention Pillows have been used to collect excess oil from contaminated water. This technology removes and solidifies the contaminant hydrocarbon, encapsulating it so it cannot leak out. This means that the filtered water can be over pumped to a suitable point of drainage.

Capture Greens's Green Rhino Filtration products are now also being utilised by other WPD main contractors, such as Adler and Allen and Morgan Sindall.

> WILLENHALL GRID IS A STRATEGIC POLE STORAGE POINT FOR THE MIDLANDS, WHERE IN EXCESS OF 400 POLES ARE STORED.

2.5.6 Environmental Employee Awareness

Environmental awareness / training sessions are undertaken throughout WPD at various levels within the organisation.

> FOR THE PAST 5 YEARS, THE KEEN TO BE GREEN GUIDE HAS BEEN ISSUED TO ALL NEW APPRENTICES AS PART OF THEIR INDUCTION.

2.5.6.1 Apprentice Inductions

All of our apprentices attend a mandatory dedicated environmental awareness session which specifically considers the following environmental aspects;

- Environmental Sustainability
- Carbon Awareness
- ISO14001
- WPD Environmental Aspects
- Pollution Prevention
- Ecology
- Waste Management
- Employee Responsibility

2.5.6.2 General Environmental Awareness

As an ISO14001 certified organisation we ensure that all of our employees maintain a good general awareness of any environmental issues concerning the business. We do this by running environmental awareness sessions throughout the organisation.

We have continued to improve environmental awareness amongst employees using various poster campaigns, environmental bulletins, leaflets, briefing sessions and awareness training videos.

2.5.6.3 Environmental Key Performance Indicators

Following the publication of the RIIO-ED1 WPD Business Plan and in line with our commitment to achieving our environmental outputs during the ED1 period, throughout 2016/17 we have continued to produce quarterly environmental key performance indicators (KPIs).

The KPIs are published across the business and report on our performance at a company, licence area and local level. Specifically the KPIs monitor the following environmental outputs:

- Waste management (total tonnage, percentage waste to landfill vs. non-landfill)
- Building energy use (kWh)
- Operational vehicle fuel use (litres)
- Fluid filled cable losses
- Reportable environmental incidents
- SF_6 emissions and bank

2.5.7 Community Awareness

WPD has a focussed approach to its community support, all of which sit under one of three main areas:

- Education
- Safety
- Environment

Wherever possible, for all our environmental activities, we work with established organisations to maximise the outputs for beneficiaries including the Wildlife Trusts who operate in our network areas. The aim of these projects is to provide children with hands-on nature experiences to help improve their awareness of nature and the important role it plays in all our lives.

Where possible we support activities like Forest Schools which equip young people with practical skills like wood-working while improving confidence and communication skills.

A successful project with Gloucester Wildlife Trust gave young people who can often be overwhelmed in a traditional classroom setting, the opportunity to learn new skills, feel more relaxed and increase their self-esteem and confidence in an outdoor setting at Lower Woods Nature Reserve. This project was an extension of the original project set up to help long-term unemployed and disadvantaged groups develop employability skills as well as improve health and well-being.

In Devon, 5 schools participated in a Wildlife Champions Bat Project which concentrated on raising awareness that bats face in the current environment, for example habitat loss and climate change. Sessions included building bat boxes and locating them in suitable places to help conserve their population.

We also have a native tree-planting scheme open to schools and communities in our network areas. Working with regional conservation groups who manage this scheme on our behalf, purchasing the native trees and helping with the planting schemes so that the beneficiaries know how to look after them not only until established, but well into the future.

We also support ad-hoc individual requests from small charities or not for profit groups to purchase tools or equipment that will be used in environmental projects. In 2016, we launched another round of our successful Community Chest Energy Efficiency Scheme. The Community Chest awarded 32 grants to eligible groups, enabling them to carry out simple but effective energy saving measures on their community buildings.

£

32 community groups received a grant from the energy saving scheme Community Chest in 2016

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

3.1 Introduction

Innovation is core to WPD's business strategy. Improving the services we deliver to customers and driving the network to be more efficient through better ways of working has always been fundamental to WPD's business strategy.

We have facilitated the transition to a de-centralised energy system by re-engineering our networks, which were designed for 14GW of demand, to enable them to accommodate 20GW of generation. Accommodating the increased intermittency, variability and volatility of the energy flowing around our assets has only been achieved through innovation of our design and construction methods. We have adopted new technology to make our networks more sophisticated and responsive, forged new relationships with customers and developed our operational practices.

Making our networks smarter, integrating outputs from innovation projects as they develop and enhancing our existing datasets with information from smart meter datastreams will further our ability to increase capacity and security at a lower cost.

By carrying out a wide portfolio of innovative projects which build upon what we have already learnt and incorporating successful developments from other DNOs, we can ensure the network will meet all future needs and we will maintain our position as the leading performer in network availability and customer service.

We look for innovative developments across five broad areas;

- Network performance and efficiency - searching out better processes, equipment and technology that ensure we continue to be efficient
- Low carbon networks – supporting future electricity demand and generation requirements
- Smart grids and meters – developing new techniques and utilising enhanced data to help develop more dynamic network control
- Environment – reducing our business impact on the environment
- Customer service – developing smarter ways of delivering better customer service

Key Challenges

The energy system is changing and distribution network operators will continue to have a greater need to actively manage energy flows on a real time basis in order to develop an efficient, coordinated and economic network that accommodates emerging system needs and delivers benefits and savings for customers.

The way electricity is generated and consumed is changing at an unprecedented rate and further integration of low carbon technologies and the electrification of transport and heat will continue this trend into the future. Greater flexibility of the networks will be required to manage the impacts of the varying patterns and levels of loads locally and nationally.

Smart energy technology and processes have the potential to deliver lower bills and allow customers to connect low carbon technologies quicker, cheaper and more efficiently. By prioritising these principles for implementation, we aim to deliver benefits for our customers sooner.

Our Five Key Areas for Prioritisation are:

1. Understand historic and real time energy flows

2. Forecast future energy volumes across the network

3. Actively reconfiguring the system dependent on need

4. Commercial arrangements to contract services eg. DG, active demand, storage

5. Coordinate DSO operations with National Grid (SO) and potentially provide services

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

We have made demonstrable progress towards embedding this capability within our business under the following innovation projects:

- **'Local Energy Market'**: Development of a 'visibility' platform working jointly with Centrica.
- **Long term strategic studies**
- **Alternative Connections** Solutions developed from the LCH and other innovation projects.
- **Demand response projects:** Including 'FALCON', 'SINC' and 'ENTIRE'.
- **CarConnect** is Branded as "Electric Nation". It is evaluating the implications on the distribution network from electric car charging behaviour and providing remote control to prevent overload.
- **The ENA** led DNO to DSO project is developing new processes to ensure local and national grids are optimised in the best interests of customers.
- **Regional development program** being developed jointly with National Grid

During this year we have engaged with our stakeholders on our plans for implementing smart grid technologies on our network and also our key priority areas for DSO readiness.

Our Role

Our response to the energy trilemma is based on our Innovation Strategy and our Stakeholder Engagement Strategy, as well as our environmental policies and statements.

We have a number of publicly available documents that set out our plans and policies and have agreed actions and measures in place to deliver results. Our innovation projects specifically support this and are now influencing our day to day business operations.

As part of our Strategy, we continue to explore ways we can help the UK transition to a low carbon future. As a Distribution Network Operator, we can take a leading role in informing customers of the local performance of the network. We already publish a series of capacity heatmaps for generation, storage and demand customers outlining thermal, voltage and fault level related issues. We are continuing to develop these to better meet the changing needs of our stakeholders, expanding the published content to include storage and demand heatmaps at a more granular level.

The next stage of development will be to offer access to the back end data so that other websites and organisations can merge our data with theirs.

3.2 Progress of the Innovation Strategy

No material changes to the principles behind the strategy. The detail has changed substantially though.

We have completed a number of projects since the submission plus LV Network Templates and now FlexDGrid (SoLa Bristol, FALCON and Low Carbon Hub at Tier 2) and have added additional projects. We remain on target with all of our projects.

Since the Innovation Strategy within the RIIO-ED1 Business Plan was written, we have added a Tier 2 Low Carbon Network Fund (LCNF) project Network Equilibrium, which is focused on balancing voltage and power flows across the network using three innovative methods of configuring the network. In 2016 we were awarded funding for our first NIC project, OpenLV. The project will develop a distribution substation operating system and software to allow third party "Apps" which can analyse network conditions and make available information in a variety of formats.

The intention of the new project is to better integrate additional distributed generation and Low Carbon Technologies within the network.

In addition, we are progressing with a number of the smaller initiatives that formed the basis of the business plan, for example, Project FREEDOM which is looking at how the natural gas grid could be used in unison with electricity

to heat customer homes with minimum disruption whilst reducing carbon emissions.

Several of our domestic demand side response projects have demonstrated the relative difficulty in achieving a suitable reduction in energy usage at peak times in demand. The projects concluded that home automation is key and that future Low Carbon Technologies such as Electric Cars may be more suited than today's appliances. Our Innovation Strategy is underpinned by the three themes of Assets, Operations and Customers and is focused on trialling and testing innovative ways of making the job that we do both better and more cost effective whilst remaining focused on the environmental impact. Our Innovation Strategy is updated annually.

www.westernpower.co.uk/Innovation-Strategy.aspx

3.2.1 Key Themes of the Trials

The table summarises the themes of the trials that have been undertaken this year.

Project	Fund / Tier	Theme / Pillar	Summary of Trial
FlexDGrid	LCNF Tier 2	Assets / Operations	Larger investigation in fault level management in a large urban environment to see if new solutions can enable the connection of more DG.
Equilibrium	LCNF Tier 2	Customers / Operations	Larger project that seeks to better balance voltage and power flows, with the potential benefit of better configuration.
OpenLV	NIC	Customers / Operations	This project will facilitate non-traditional business models by opening up network data to third parties to understand the network and deploy solutions.
Local Energy Market	EU Funding	Customers	WPD are participating in a much larger EU initiative led by Centrica. The project will develop a platform to enable suppliers, aggregators and communities to inform the network operator of planned changes to assumed electricity profiles.
Smart Energy Isles	EU Funding	Customers / Operations	WPD are part of a Hitachi led consortium awarded EU funding to build and operate a renewable energy mircogrid on the Isles of Scilly.
Solar Storage	NIA	Operations	Identifying viable incentive arrangements with stored solar providers during peak demand periods.
LVPlus	NIA	Operations	Trial of increased local phase voltage to 400V. Potential benefits include increase network capacity and optimised connections for emerging EV charging, DG and energy storage.
Industrial & Commercial Storage	NIA	Customers / Operations	Battery energy storage will be trialled in multiple configurations to ascertain the potential for improvements in cost efficiency, customer service, reliability, and the environment.
Time Series Data Tools	NIA	Assets	The Project will look at the feasibility of developing an integrated Time Series Database for mainly analogue data gathered by the WPD IT systems.
Superconducting Cables	NIA	Assets	In this project, a feasibility study will be performed to determine if superconducting cables are an attractive solution for connecting new equipment to the physically remote networks that require the additional capacity.
Common Information Model	NIA	Customers / Operations	This project will create a comprehensive, accurate and portable network model in the international standard Common Information Model (CIM) format.
Nexus – Global Analysis Of Telecoms	NIA	Assets / Operations	This project will seek to analyse current and proposed Smart Grid Telecommunications solutions and deployments to assess suitability for integration within the UK DNO's, taking a holistic view rather than the current incremental approach.
EV Emissions Testing	NIA	Assets	This project will assess the harmonic disturbance of EVs by carrying out repeated charge and discharge tests for a range of vehicles and charging levels on monitored EV Chargepoints.
Time Series Data Analysis	NIA	Assets	Project is developing a methodology to assess the magnitude, frequency and duration of future capacity excursions.
Project Sync	NIA	Customers / Operations	Use of DSR to increase demand and reduce DG at times where output exceeds network capability.
Losses Investigations	NIA	Customers / Assets	This project is looking into the minimum level of information required to better assess losses.
Airborne Inspections	NIA	Assets	Project looked at more integrated ways of inspecting lines via helicopters and assessing results.
Carconnect (Electric Nation)	NIA	Customers / Operations	Project will enable DNOs to identify which parts of their network are likely to be affected by PIV/ vehicle to grid (V2G) uptake, and whether PIV demand control services are a cost effective solution to avoiding or deferring reinforcement on vulnerable parts of their networks.
ENTIRE	NIA	Customers	Developing new systems and contracts with commercial customers to allow WPD to fulfil its requirements whilst also enabling it to sell the aggregated capacity into other DSR schemes when not required for the DNO.
FREEDOM	NIA	Customers	Investigate the feasibility of the use of heat pumps on both Western Power Distribution's & Wales & West Utilities' network in order to better understand if hybrid heating systems are technically capable, affordable and attractive to customers as a way of heating homes.
LV Connect and Manage Carbon Tracing	NIA	Customers / Operations	This project will demonstrate and prove that LV ANM can be used as a short-term measure, whilst network reinforcement takes place, to facilitate the timely connection of customers.
Improved Statistical Ratings for Overhead Lines	NIA	Assets	New techniques explored to assign ratings to lines including better weather and other contributory factors.

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

Major Low Carbon and Smart Grid Projects

We have been successful in receiving funding for seven projects through the Ofgem network innovation competitions, three of which are still active. We are also project partners in two major innovation projects funded through national and EU innovation mechanisms. The projects investigate a range of network issues from 132kV active network management to rewiring of customer homes with DC systems.

FlexDGrid

The connection of generation to urban HV networks can lead to fault levels that exceed the rated capability of existing networks. Traditionally, higher rated assets would need to be installed to enable the generation to connect, which are often expensive and time consuming, however, this project investigated alternatives to accommodate the connection of generation faster and cheaper. The FlexDGrid project was based in Birmingham and sought to explore the potential benefits from three complimentary methods;

- Enhanced fault level assessment
- Real-time measurement of fault level
- Fault level mitigation technologies

The project, completed in March 2017, provided significant learning in the three project method areas, specifically regarding the enhanced network models required to reduce assumptions to most accurately understand how to connect additional customers to the network; how varying loads on the network effect fault levels; the value of real-time fault level data that has been gathered from the 10 Fault Level Monitor (FLM) installations, which has principally enabled a Fault Level Soft-Intertrip scheme to be added to our existing suite of Alternative Connection offerings, and the installation of three Fault Current Limiters (FCL), which has created the network capacity of over 50MW of new generation to be connected.

Network Equilibrium

The focus of Network Equilibrium is to balance voltages and power flows across the distribution system to better optimise the existing network. This project will help to integrate additional distributed generation and load within electricity networks more efficiently and deliver major benefits to distribution customers.

It is developing solutions that are being demonstrated across Somerset and Devon.

The project uses three methods:

- **Enhanced Voltage Assessment (EVA)**
  This develops a new network modelling tool for 33kV and 11kV networks. It will allow greater visibility of time series power flows and voltage profiles, not just the extreme scenarios. It will improve contingency planning, modelling, and forecasting of both demand and generation profiles

- **System Voltage Optimisation (SVO)**
  SVO will dynamically adjust 33kV and 11kV voltage profiles across eight Bulk Supply Points (BSP) and eight primary substations within the trial area. It will overcome the issue of fixed voltage points at key substations, being a limiting factor for new connections, by using advanced voltage control relays and centralised network management software

- **Flexible Power Links (FPL)**
  The project will trial the use of novel power electronics to optimise the power flows between two different 33kV networks. A Flexible Power Link will be used for the first time by a UK distribution network operator and will transfer of both real and reactive power flows, on a dynamic basis, between previously unconnected networks

WPD expects to unlock an additional 344MW of additional generation capacity across the trial area. The EVA work is now complete and being used to assess the capabilities of the project area and the wider WPD network. The SVO development work is in progress with installation work happening at the 16 sites and the centralised optimisation system is currently being built and tested by Siemens. The FPL contract has been awarded to ABB and this is currently being built, after completing the design activities and is planned for installation in quarter one 2018.

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

> A COMPONENT OF THE OPENLV PROJECT WILL BE A SECURE PLATFORM THAT ENABLES THE INTELLIGENT SUBSTATION DEVICES TO BE REMOTELY MANAGED.

OpenLV

The decarbonisation of heat and transport through the wide scale customer adoption of heat pumps and electric vehicles will increase demand on LV networks. Under current business practice this would result in a large amount of conventional LV reinforcement, at significant cost and disruption to customers, to accommodate this increase in demand. New solutions are becoming available, but each delivered on separate, proprietary platforms.

OpenLV will create a Common Application software platform which enables enhanced real time assessment and visibility of low voltage network capacity. This improved visibility will allow the distribution network companies to more actively manage this level of the network, which is necessary as more generation and demand is connected locally. Such an approach would ensure the available capacity is used more effectively, minimising the costs of reinforcement.

The functionality delivered by the OpenLV Solution will be proven via three complementary Methods:

- Method 1: LV Network Capacity Uplift
- Method 2: Community Engagement
- Method 3: OpenLV Extensibility to 3rd parties

The OpenLV Solution includes the following key components:

- Intelligent substation devices that can support software
- Applications or 'Apps' from multiple vendors on a single device. Providing a low cost hub that, once deployed, can act as a hub for many more functions
- A secure platform that enables the intelligent substation devices to be remotely managed
- A secure platform that provides LV network data to community groups and third party organisations

This will facilitate non-traditional business models by opening up network data to third parties to understand the network and deploy solutions.

The roll out of the overall Solution proposed across the UK will support the Low Carbon Plan and uptake scenarios presented in the UK Government's Fifth Carbon Budget by minimising the impacts of low carbon heating and transport on the LV network, therefore removing this as a barrier to customer adoption where it is applied. This has significant potential to deliver environmental benefits and cost savings to future and existing customers by negating and/or deferring the need to reinforce the LV network.

Local Energy Market

A key conclusion of the Smart Grid Forum Workstream 6 was for market participants and network operators to have visibility of each other's proposed DSR actions and requirements. Our DSR Plug and Socket project will support a much larger EU funded initiative led by Centrica in Cornwall to create a local energy market. The visibility of the Plug and Socket project will develop a platform to enable suppliers, aggregators and communities to inform the network operator of planned changes to assumed electricity profiles (either DG or demand). It will allow the network operator to post information about potential congestion, enabling a market solution to them. Any requirements for residual balancing and direct DSO schemes would thus be minimised.

Smart Energy Isles

WPD are part of a Hitachi led consortium awarded EU funding to build and operate a renewable energy mircogrid on the Isles of Scilly. In addition to the integration of renewable generation the project will install energy efficiency measures and control system in homes and businesses.

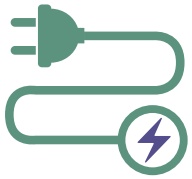
3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

Low Carbon and Smart Grid Smaller Project Portfolio

In addition to the large projects, WPD is continuing to deliver a portfolio of smaller low carbon projects.

We publish an Annual Summary Report which outlines details on these projects.

www.westernpowerinnovation.co.uk/NetworkInnovationAllowance.aspx



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customers contract to take part in The Electric Nation smart EV Charging Trial

	Safety Improvement	Cost Efficiency Improvement	Customer Service Improvement	Reliability Improvement	Environmental Improvement
Solar Storage		✓		✓	✓
LV Plus	✓	✓	✓		
Industrial & Commercial Storage		✓	✓	✓	✓
Time Series Data Tools		✓		✓	
Superconducting Cables	✓	✓		✓	✓
Common Information Model		✓	✓		
Nexus – Global Analysis Of Telecoms		✓	✓	✓	
EV Emissions Testing	✓		✓	✓	
Time Series Data Analysis	✓	✓		✓	
Project Sync		✓	✓		✓
Losses Investigations		✓			✓
Airborne Inspections		✓	✓		
CarConnect (Electric Nation)		✓	✓		✓
ENTIRE		✓	✓		✓
FREEDOM		✓	✓		✓
LV Connect and Manage	✓	✓	✓	✓	
Carbon Tracing			✓		✓

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

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

We deliver innovation through an in-sourced model with a small team of specialists using academic and supply chain partners as appropriate. The Innovation Team works alongside the company's Policy department where they interact with equipment specifiers and technical experts of the wider business. Once trials are successfully completed, the outputs are taken forward and replicated across our network.

As outputs are delivered, they are developed into new learning that can be taken forward and developed as business as usual. Outputs obtained from other DNO projects are fed into this process to ensure that we gain maximum benefit from innovation projects.

All solutions rolled out from innovation follow the same route as our other policies and techniques introduced into the company. Policies are reviewed by the senior network managers before they are introduced. The roll-out process includes implementation plans and, where appropriate, training and dissemination sessions. We monitor all the projects as they develop and make use of learning and outcomes as they are reported.

Our RPZ1 project developed a practical application for Dynamic Line Ratings (DLR) on our 132kV overhead lines. The project results have been embedded into business as usual and are documented in a dynamic line rating policy. Our Lincolnshire Low Carbon Hub project developed a practical application of Active Network Management which is part of our Alternative Connections policy suite. Alternative Connections are available to all generation customers seeking a connection where significant reinforcement is required.

Export limitation devices have been developed by manufacturers to locally balance generation and demand, however due to the lack of an industry standard, the variance in the quality and method of operation of these devices is wide. We developed a policy for acceptance of these schemes which outlines the minimum requirements to achieve compliance with a new WPD policy. This policy was circulated to the other DNOs and following further refinement was developed in conjunction with manufacturers to form a new UK standard, ENA Engineering Recommendation G100.

All projects produce new or revised WPD policies for use during the project lifetime. These policies are always written in such a way that they can be extended to apply beyond the project and in a larger geographic area if the solutions trialled turn out to be successful.

3.3.1 Roll-out Strategy

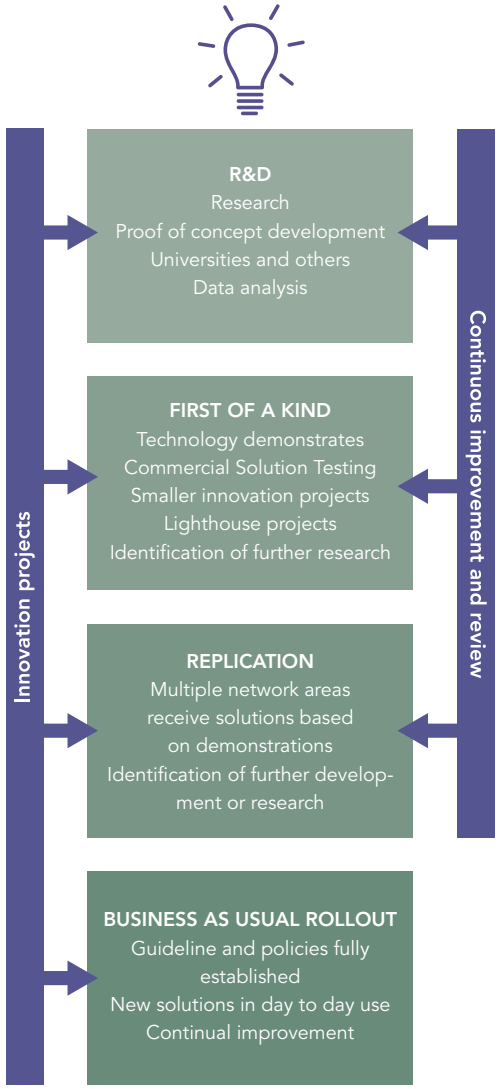
Stages of Innovation

Projects will continue to deliver additional knowledge across all output areas. The project portfolio will remain balanced across multiple areas:

- working at various stages of development spanning higher Technology Readiness Levels (TRL) 3 to 8
- exploring both technology and commercial solutions
- covering the whole range of asset types and network voltages
- assessing risk, with no projects carrying unnecessary risk
- utilising a variety of external funding mechanisms to supplement our own R&D budget

Lower TRL projects will generally be carried out by external research partners under supervision of WPD engineers. Higher TRL projects which, in the shorter term, are more likely to produce a solution for our network or processes will mostly be delivered in-house using business as usual teams.

The full 'research to implementation' timescale can often take 5 to 10 years. That is why we focus internal teams on higher TRL stages, building on knowledge from earlier studies.



3.3.2 Innovation Process

Our innovation process starts with project ideas which often come from within our engineering teams. Our innovation team scopes them out and develops them with, in some cases, academic or industry partners. Projects are then delivered in conjunction with the engineering teams. A detailed description of the process is contained within Section 8 of our Innovation Strategy. This includes how we work with other DNOs and our plans for business roll out in the following year.

Approach to Innovation

The way that we approach innovation is fundamental to delivering the objectives efficiently. WPD's innovation strategy is to:

- actively involve staff from across the business in the generation of ideas, development of solutions and implementation of projects
- work with our stakeholders to understand their needs
- make use of innovation incentives and funding provided by the government, the regulator and other funding organisations
- use a small core team to coordinate innovation projects
- define clear objectives for each project so that delivery can be focused and progress can be tracked
- avoid theoretical research or innovation which does not have clear objectives
- incorporate innovative solutions into existing equipment and processes
- share what we learn with other organisations and learn from others

3.3.3 Benefit and Impacts of roll-out

The innovation solutions we have rolled out have provided a series of benefits both to our customers and to our business. The details of those benefits can be found further within this document in section 3.3.10.

3.3.4 Innovation Roll-Out Mechanism

The Innovation Roll-Out Mechanism is provided to promote the adoption of innovative solutions that do not provide an immediate benefit. All of WPD's solutions provide immediate benefits, so we have not used the mechanism. The Innovation Roll-Out Mechanism is shown in Appendix A.

3.3.5 Maximising the Benefits of Smart Meter Roll-out

Smart Meters have the potential to provide data to enhance WPD's existing core business activities such as fault management, network planning and asset management. There are also potential benefits which could lead to future applications that would help the deployment of low carbon technologies and the move to actively managed networks. With many of these applications, the benefits increase as the density of smart meters on the system increases.

Fault Management

Smart metering will provide a number of functions to support fault restoration and reporting activities. For example when there is a power cut, 'last gasp' functionality will trigger a message to notify a loss of supply. This will provide a level of visibility down to the individual premises that has not been available before.

Additional functionality will allow the 'energisation status' of meters to be checked remotely, giving us a clearer understanding of which customers are off supply and allowing us to determine what kind of fault has occurred (blown fuse, open circuit fault, single premises). This will help ensure that we respond in the right way first time and improve our restoration times. In the case of a call regarding a 'single premises', it will also help to remotely identify if the issue is on the network or on the customer's own equipment.

On completion of any restoration work, it will be possible to check that all supplies have been restored. This is particularly useful in storm scenarios where faults at High Voltage (HV) can mask additional issues at Low Voltage (LV).

The ability to check will reduce the possibility of teams leaving the area whilst customers may still be off supply. As smart meters record interruption and restoration times, fault management applications will become more effective over time as the density of installed smart meters increases and more information becomes available to provide a comprehensive view of the network.

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

Network Planning
Existing network planning assumptions are already being challenged due to the volume and type of distributed generation on the LV network.

At present, the majority of load data is derived from measurements at source 11kV circuit breakers at primary substations. At LV, maximum demand indicators provide us with a limited view of load at distribution substations but no load duration is collected. Smart meter data can provide increased visibility on the aspects of network activity that can subsequently inform load-related investment decisions. Data on half-hourly power flows (real, reactive, import, export) and maximum demand (both for individual meters and aggregated for network sections) allow us to determine load profiles, which can be used to:

- Check that loading is within operational and thermal capacities of network components
- Determine thermal capacity headroom to gauge the scope for accommodating additional (LCT) loads
- Inform the prioritisation of load-related network investments
- Avoid unnecessary reinforcements or network issues from demand over or underestimation
- Identify reverse power flows, which might require us to take measures
- Identify where power factor correction is necessary or can act as an alternative to network reinforcement
- Identify areas where network losses are highest

The data collected will provide us with a more comprehensive understanding of where there are issues on the network and where there is adequate capacity to accommodate additional connections or more LCTs without the need for network reinforcement.

Connections:
As with load-related network investment, increased visibility of voltage levels and power flows can help us reduce the time to connect new loads and generation. It can also provide benefits to new connectees via lower connection charges and the ability to assess options for the use of smart solutions to reduce or avoid upstream reinforcement.

Asset Management:
A wide range of data will be available from smart meters to support asset management activity. Each meter will be able to act as a voltage monitoring point and be capable of issuing alarms relating to voltage anomalies (under voltage, over voltage).

Aggregated load data will create a more detailed profile of the loads experienced at points on the network. This can support the identification of overloaded sections of network and aid in the prioritisation of network reinforcement where load issues have been identified.

Aggregated load data can also ensure that network reinforcement is avoided where it is not necessary. For example, maximum demand indicators may suggest that a substation is overloaded based on a momentary high load, whereas aggregated metering data may demonstrate that this was of very short duration and in line with design parameters requiring no intervention.

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

3.3.6 Smart Meter Penetration

The percentage penetration of smart meters is outlined in the table on the right.

The Smart Meter Rollout is being managed by Electricity Suppliers in the UK and is due to be completed by 2020.

3.3.7 Status of IT and Communications Investments

The current status of IT and communications investments which are required to maximise the benefits of smart metering data – See Worksheet E5 – Smart Metering (published as an appendix to the Report) and accompanying commentary.

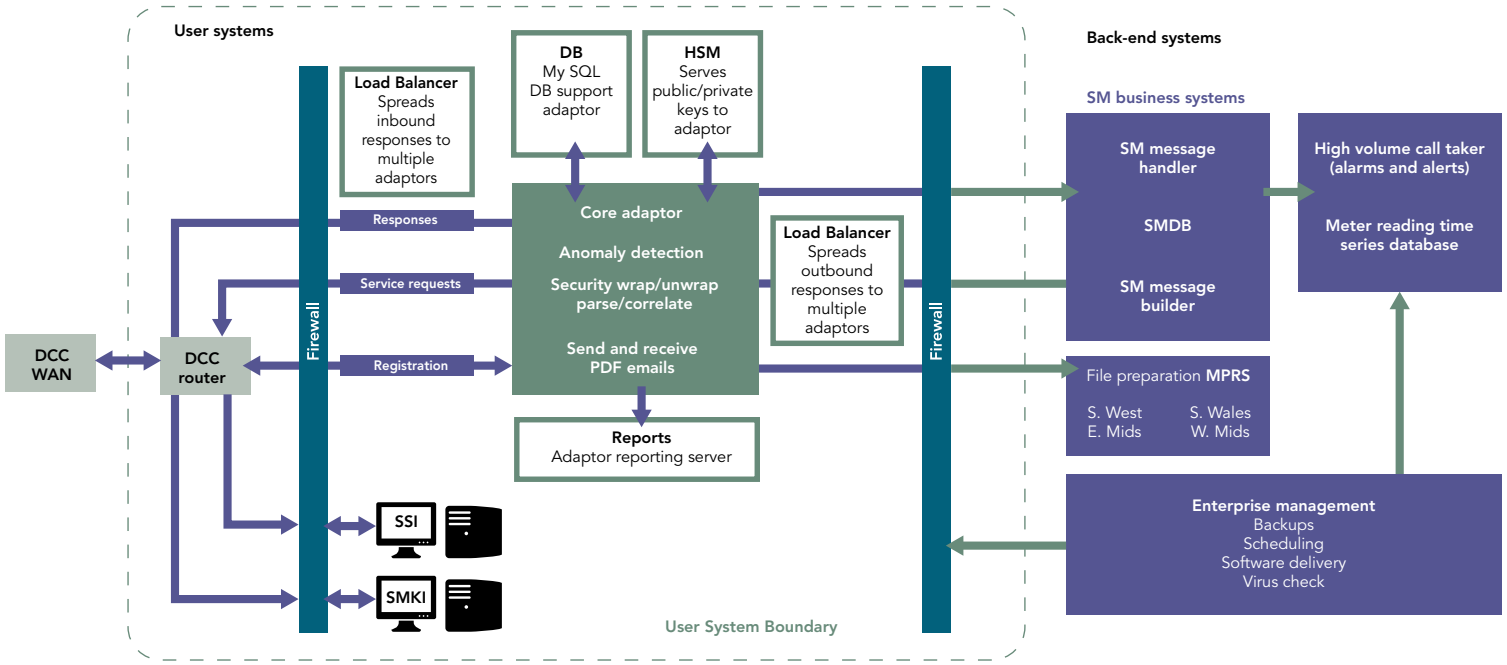
All these systems are now built and nearing the completion of national systems tests as required by the Data Communications Company.
In addition to proving system functionality we have successfully passed an independent audit to ensure WPD security architecture and environment meets the security requirements of the overall National programme.

WPD will be implementing our systems against Release 1.3 functionality provided by the DCC which is currently planned for Q2 2017.

3.3.6 The Percentage Penetration of Smart Meters in each of the DNO's Distribution Services Area at the end of 2016/17 period

Licence Area	East Midlands	West Midlands	South Wales	South West
No. MPANs	2,660,104	2,477,870	1,126,529	1,619,690
No. Smart Meters Installed to Date	327,455	303,743	126,530	165,048
Total Penetration	12.3%	12.3%	11.2%	10.2%

Smart Metering – User System Environment



3.3.8 Maximising the Value of Smart Meter Data

Whilst suppliers have been installing smart meters in the WPD Distribution Services Area these are not compatible with the national infrastructure. As such no smart metering data has been received and consequently no benefit has been realised as yet.

This will continue to be the case until SMETS2 type smart meters start to be installed, which is currently anticipated to be during Q2/Q3 2017.

3.3.9 Smart Meter Data

At present our innovative connections solutions are targeted at large scale customers. Soft Intertrip and Active Network Management (ANM) require real-time links so do not use smart meter data. We can use smart meter data to complete retrospective checks on Timed Connections. As our innovation continues and smaller customers are focused for solutions, smart meter data will become a key dataset for us.

3.3.10 Estimated Actual Benefits

The estimated actual benefit of using smart metering data during the current price control period was forecast in our RIIO-ED1 Business Plan and was as follows;

Smart Metering Benefits for Business as Usual Activities (£m)

	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Efficiency saving on load-related reinforcement	0.00	0.00	0.00	0.00	0.00	0.43	0.70	0.85
Efficiency saving on connections-related reinforcement	0.00	0.00	0.00	0.00	0.00	0.50	0.80	0.98
Savings from last gap functionality	0.00	0.00	0.08	0.23	0.38	0.60	0.75	0.75
Savings from restoration confirmation	0.00	0.00	0.01	0.04	0.06	0.09	0.11	0.11
Total per annum	0.00	0.00	0.09	0.26	0.43	1.62	2.36	2.69

Smart Metering Benefits for Demand Side Response and Active Network Management (£m)

	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23
Total per annum	0.00	0.00	0.00	0.00	0.00	0.5-1.5	0.5-1.5	0.5-1.5

The level of estimated actual benefit declared in the WPD Business Plan was based on a number of assumptions which are either no longer valid or have the potential to be no longer valid, for example:

- Commencement of mass rollout of smart meters was not delayed
- Penetration of SMETS1 meters was very low
- Customers numbers with no Smart Meter WAN coverage was very low
- Consumption data was able to be used in disaggregated form
- Power outage/restoration alerts are received in a timely manner
- Smart Meter voltage measurement has a high and known accuracy

Consequently the level of estimated actual benefit will need to be reviewed once the outcome of the aforementioned becomes clearer.

3.3.11 Forecast Actions

The delays to the DCC Live date and the anticipated introduction of SMETS2 meters during the 2017/18 regulatory year means that the actions we expect to take will be limited.

During the early part of mass roll-out, including the 2017/18 regulatory year, we will be in 'evaluation mode' whereby the smart metering data we receive will be assessed, but our existing business processes and systems will largely continue as before. The majority of the benefit will only start to be realised once a critical mass of meters has been installed, and all parties forecast that this is around the 60% penetration level. Consequently we do not expect any substantive benefit to be realised in the short term.

The actions we intend to take are as follows:

Avoided Losses to Network Operators

This benefit depends on:

- A high penetration of smart meters
- The availability of Supplier Time of Use (TOU) tariffs
- Significant numbers of customers taking up these tariffs
- The TOU tariffs incentivising a customer response which reduces the maximum demand
- The In Home Display driving changes in customers' consumption behaviour

We intend to monitor developments in this area as smart meter roll out continues.

Reduction in Customer Minutes Lost (CML)

This benefit depends on sufficient penetration of smart meters to allow for rapid identification of fault type/position and thus quicker responses and repairs. This benefit has not been realised during the 2016/17 regulatory year. We intend to evaluate the outage and restoration alerts that we receive during the 2017/18 period.

Reduction in Operational Costs to Fix Faults

Whilst there is the potential for us to benefit from avoiding unnecessary site visits for single outage calls as soon as the very first meter is enrolled into the DCC, in practice this depends on:

- SMETS2 meters being installed
- The meter being connected at a premises where a single outage call occurs

This benefit has not been realised during the 2016/17 regulatory year. We intend to evaluate the outage and restoration alerts that we receive during the 2017/18 period. Savings for other faults requires sufficient SMETS2 smart meters on faulted circuits to allow rapid identification of fault type/position and thus quicker response and repair.

Reduction in Calls to Faults and Emergency Lines

This benefit depends on:

- A high penetration of SMETS2 smart meters
- Supply outage and restoration alerts being received in a prompt manner from the CSP systems
- Customers being familiar with smart meter capabilities and having sufficient trust to rely on the meter to notify us about power loss

This benefit has not been realised during the 2016/17 regulatory year. We intend to evaluate the outage and restoration alerts that we receive during the 2017/18 period.

Better Informed Investment Decisions for Electricity Network Enforcement

This benefit depends on:

- Data privacy plans being approved
- A high penetration of SMETS2 smart meters
- Sufficiently detailed customer connectivity models
- Access to sufficiently granular consumption information

This benefit has not been realised during the 2016/17 regulatory year. During the 2016/17 year we have completed our Data Privacy Plan and Privacy Impact Assessment.

Avoided Cost of Investigation of Customer Complaints About Voltage Quality of Supply

Any voltage quality of supply benefit is limited by undefined accuracy of meter voltage measuring elements.

Whilst there is the potential for this benefit to start being realised from the very first meter enrolled into the DCC, in practice it depends on:

- SMETS2 meters being installed
- The meter being connected on sub-optimally performing parts of the distribution network

This benefit has not been realised during the 2016/17 regulatory year. We intend to evaluate any over/under voltage alerts that we receive during this period.

Network Capacity Investment Savings from Electricity Demand Shift

This benefit depends on:

- A high penetration of smart meters
- The availability of Supplier TOU tariffs
- Significant numbers of customers taking up these tariffs
- The TOU tariffs incentivising a customer response which reduces the maximum demand

This benefit has not been realised during the 2016/17 regulatory year. We intend to monitor developments in this area as smart meter roll out continues.

3.0 Smart Grids, Innovation and our Role in the Low Carbon Transition

3.3.12 Innovative Solutions to New Connections

The uptake of generation over the last ten years has far outstripped that forecast, the outcome of which is that the availability of network capacity to enable new DG connections is becoming increasingly scarce. The network can be reinforced to add capacity but it can sometimes be cost prohibitive and introduce lengthy delays whilst the work is undertaken. New and changing forms of generation such as battery storage that may have equivalent demand requirements have further compounded the issue.

Our strategy to overcome these bottlenecks is to develop alternative, more flexible connections that avoid the need for network reinforcement thus reducing connection time and costs. By deferring investment in new capacity, the risk of creating stranded assets may be avoided and connection times sped up. To deliver these efficiencies we have developed a suite of Innovation Solutions (see 3.3.14) that together provide a viable connection option for most generation developers who are prepared to accept a level of curtailment.

These Innovative Solutions now have a proven track record. We will however, continue to develop and refine them and add new innovations as they arise as part of our commitment to move from DNO to DSO. This is becoming increasingly important as we consider how we can make more effective use of existing network capacity by monitoring it in real-time and offering innovative commercial arrangements.

Our goal is to ensure that Innovative Solutions, and access arrangements more broadly, meet the needs of our customers and function in a way which supports the efficient use and development of the network as a whole.

You can find out more about our use of Innovative Solutions by visiting our Alternative Connections page on our website.

www.westernpower.co.uk/Alternative-Connections.aspx

3.3.13 Benefits for Using Innovative Connections

Below, we have summarised the benefits that innovative solutions have delivered for new connections.

This shows that significant capacity has been released across the WPD service territory. Roll-out of these techniques across the whole network continues and we anticipate gaining further benefits as we roll out additional techniques.

	MVA Released	Avoided Costs (£m)	
		Cust	DNO
ANM	39.5	2.35	0.29
Soft Intertrip	51.0	3.05	0.33
Timed	22.6	1.37	0.15
Totals	113.1	6.77	0.77

Our innovative solutions enable connections to be made more quickly at a reduced cost (£6.77m reduction to customers connection costs)

3.3.14 Innovative Solutions Descriptions

Our innovative alternative connection solutions allow customers to make connections at reduced cost, with quicker timescales but will contain some form of curtailment to avoid expensive reinforcement costs.

Soft Intertrip

Some networks are constrained due to a single upstream asset requiring reinforcement, or a single limit being infringed under certain conditions. This solution has an on-site soft-intertrip Remote Terminal Unit which provides two normally open contacts for the customer's control system to monitor; Stage 1 and Stage 2.

When both sets are open, the connection will be free of constraints. The levels of curtailment corresponding to the operation of the Stage 1 and Stage 2 contacts will be defined at the planning stage.

Active Network Management (ANM)

This solution is the most complex and used mainly with larger new connections and primarily generation. Customer control equipment is installed into a WPD control solution which allows for full dynamic control of the network, generation and demand.

Timed Connection

This solution is a simple timer-based device that monitors the connection agreement with the customer, which will include some form of curtailment based on times of day.

The customer's connection agreement will include an operating schedule which will define the times and levels of capacity available to them. The solution is supplied by the customers equipment and does not require any additional investment from WPD to implement.

Export Limiting

This solution measures the apparent power at the customer's exit point and uses that information to restrict generator output when the customer agreed export capacity is about to be exceeded. This solution is suitable for all capacities and voltage levels but fault level assessment still needs to be completed.

3.3.15 RIIO Outputs that Innovative Solutions Facilitate

Our innovative solutions cover a number of our RIIO outputs. The outputs of each project are detailed in our Innovation Strategy. At a high level these solutions cover:

- Connections and customer satisfaction: Providing a faster service and engagement with major connections customers
- Reliability and safety: Enhancing network resilience and doing so in a safe manner
- Environment: Increasing the uptake of LCTs

By allowing more DG customers and other major customers to connect to the network in a way that is more cost-effective and does not impact on other users, we are changing the way the business operates (with new policies and procedures) and facilitating the connection of new customers with LCTs. The rapid adoption of these solutions show how successful these changes have been.

3.3.16 Benefits and Impacts

Our innovative solutions give a number of clear benefits and impacts:

- They allow the connections to the network that in the past would have required significant reinforcement
- They enable connections to be made more quickly
- They do this at reduced cost (£6.77m reduction to customers connection costs)
- They do not require significant change to our business and so are able to be rolled out in a structured way
- They release significant capacity (113.1MW for the last Regulatory Year)

3.3.17 Forecast for roll-out of ANM

GSP Group	Active BSP Group	Quoting from	Building during
Bicker Fen	Skegness	Active	Active
Grendon	Corby Northampton	Active	Active
Bridgwater	Bridgwater Street	Active	Active
West Burton	Horncastle	Active	Active
Indian Queens	Truro	Active	Active
Swansea North	Swansea	Active	November 2017
Pembroke	Pembroke	Active	November 2017
Cellarhead	Meaford	April 2017	April 2018
Rassau	Abergavenny	November 2017	November 2018
Feckenham	Feckenham	April 2018	April 2019
Berkswell	Warwick	April 2019	April 2020
Bishops Wood	Hereford	November 2019	November 2020
Pyle	Pyle	April 2020	April 2021
Remaining GSPs requiring ANM		January 2021	November 2021

We are releasing new ANM zones every six months. The full roll-out table is on the left.

Timed Connections do not require any actions on our part and are therefore available to customers as needed. Soft Intertrip and Export Limiting is available in a discrete set of circumstances so is available to all relevant customers.

The number of deployments and related capacity released through the roll out of all our innovative solutions will of course be dictated by customer demand. However, we expect to see similar or slightly increased deployments to those in recent years.

3.3.18 Trials Deriving Solutions

The most successful innovative solution to come through specific trials was ANM. We trialled our ANM solution on the Tier 2 Low Carbon Hub project.

The solution was further developed on equipment specification using shared best practice (with other DNOs in particular).

Following a tender exercise in January 2016, we awarded ANM supply contracts to multiple vendors. By using multiple vendors we keep competition active in this particular market, thereby keeping costs to customers and our business at their most competitive.

In addition to other innovation project successes WPD also derives innovative solutions through business as usual development.

Appendix

Appendix A

East Midlands RRP Environmental Innovation 2016/17
South Wales RRP Environmental Innovation 2016/17
South West RRP Environmental Innovation 2016/17
West Midlands RRP Environmental Innovation 2016/17

Appendix B

RRP Environmental Innovation Commentary 2016/17

Western Power Distribution (East Midlands) plc No2366923
Western Power Distribution (West Midlands) plc No3600574
Western Power Distribution (South West) plc No2366894
Western Power Distribution (South Wales) plc No2366985

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