

Environment Report

2016-17



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1. Introduction

1.1 Executive summary

We are dedicated to achieving the highest standards of environmental performance, not only by minimising the risks created by our activities, but also through targeted investment in outputs that deliver a positive environmental impact.

We are also determined to play our part in enabling the UK's transition to a low carbon future and the environmental benefits this will bring. This influences both our asset investment plans and our investment in measures to reduce our own carbon footprint.

To reflect our environmental ambitions we included four environmental commitments in our business plan for the RIIO-ED1 period.

Table 1: RIIO-ED1 Environment commitments

Commitment	Measurement	Target	Target date
Reduce losses	Annual gigawatt hours (GWh) saved	11	2021
Reduce carbon footprint	Tonnes of Carbon Dioxide Equivalent (tCO2e)	10%	2020
Reduce oil lost from cables	Litres lost	<30,000 per year	2023
Undergrounding overhead lines	Km removed	80	2023

In the second year of the RIIO-ED1 period we made further progress against our commitments, achieving:

- Reduced losses of 8.7 GWh;
- 14% reduction in our business carbon footprint;
- 11 km of overhead line removed to enhance visual amenity;
- 21,096 litres of oil lost from cables.

We have also continued to connect new low carbon generation, develop new innovation to accommodate smart grids and prepare for the roll out of smart metering by:

- Connecting over 5,000 units of low carbon technologies with a combined capacity of 174 MW.
- Avoiding interruptions to over 17,100 customers and 1.5m customer minutes lost through the use of new innovative technologies.
- £4.4m invested in enabling smart meter roll-out.



1.2 Our business / who we are

As a company with a workforce of 1800 people, a large contractor workforce, an electricity distribution network serving 5m customers with 13,000 km of overhead lines, over 44,000 km of underground cables, almost 86,000 items of switchgear and more than 34,000 transformers, a fleet of over 600 commercial vehicles and 15 depot and office sites, our activities create both risks and opportunities in regard to the environment.

The environmental risks we encounter include those associated with holdings of electrical insulating oil, waste management, vehicle emissions, holdings of sulphur hexafluoride gas (SF₆) and work in environmentally sensitive areas.

We have opportunities to minimise resource use and reduce waste to landfill. As the electricity distribution network operator for the north west of England we also have a key role to play in enabling the transition of our region to low carbon energy supporting the UK as a whole in meeting its climate change targets.

Recognition of these obligations is reflected in our environment and energy management policy.

1.2.1 Environment and energy management policy

Electricity North West is committed to achieving excellence in environmental and energy management performance, minimising any adverse impacts our operations might have and fulfilling our obligation to manage energy and improve the environment that we operate in.

We will:

- Identify the environmental and energy using aspects associated with our activities, minimising those with any adverse impact whilst promoting those with beneficial impact.
- Comply with all applicable environmental and energy management law, and other relevant requirements and, where possible, exceed them.
- Integrate environmental performance and energy management considerations into business as usual processes including the setting and reviewing of objectives and targets.
- Operate and maintain systems of work that minimise adverse environmental impacts and seek to minimise energy usage whilst delivering beneficial impacts.
- Fully inform, instruct, train, supervise and equip people to identify and minimise adverse environmental impacts, maximise energy management opportunities and deliver beneficial impacts.
- Make environmental and energy management performance a significant factor in the selection of suppliers of goods and services.
- Implement and maintain a robust environmental management system that is certified to the ISO 14001 standard and an energy management system which is certified to ISO 50001.
- Manage the waste generated by our activities according to the principles of reduction, re-use and recycling.

- Minimise the carbon footprint of our business and actively contribute to the low carbon economy.
- Manage our business operations to prevent pollution and wasteful use of energy.
- Maximise the sustainability of natural resources used in our activities.
- Develop and promote a culture of continuous improvement with regard to environmental and energy management performance.

To deliver this policy commitment we work to an environment strategy that is based on:

- A clear understanding and visibility throughout the business of environmental issues and impacts
- Targeted investment and expenditure in environmental control measures
- Strong corporate governance and performance management
- Continuous learning and improvement
- A systematic approach to environmental management

To support our drive for excellence in environmental performance we have implemented an environment and energy management system that is certificated to the ISO 14001 Environmental Management and ISO 50001 Energy Management standards.

1.2.2 Role of stakeholders in environmental management

We have a stakeholder engagement strategy that includes advisory panels composed of stakeholders who are subject experts. One such panel focuses on sustainability, ensuring our network can adapt to future challenges such as a low carbon economy and climate change, whilst keeping bills affordable. We also meet regularly with our regional partners in relation to visual amenity in designated areas. Through this process our stakeholders play a key role in shaping our environmental strategy.

1.3 Purpose of the report

The purpose of this report is to provide the detail on the progress we have made in the second year of the RIIO-ED1 (2015-2023) period in terms of our overall strategic environmental objectives and meeting the environment targets we set out in our RIIO-ED1 business plan.

2. Managing our environmental impact

2.1 Introduction

This section provides detail on the progress we have made in 2016-17 in regard to the environmental risks and opportunities we encounter including those for which we have set targets in our RIIO-ED1 business plan. These are visual amenity, oil leakage, business carbon footprint, sulphur hexafluoride (SF₆) emissions and distribution losses.

2.2 Visual amenity

We have three National Parks and four Areas of Outstanding Natural Beauty, collectively known as Designated Areas, either wholly or partially within our region. These are:

- Arndale and Silverdale (Cumbria)
- Forest of Bowland (Lancashire)
- Lake District
- Yorkshire Dales
- North Pennines
- Solway Coast
- Peak District

In 2016-17 there was an expansion of the Lake District and Yorkshire Dales National Parks by 70 km² and 417km² respectively. This increased the reported length of lines within these Designated Areas in 2016-17 onwards. The entirety of both of these increases lies within our operating region.

We have a programme for undergrounding overhead lines for visual amenity and since its inception we have worked with regional partners to ensure its success. As part of our wider stakeholder engagement plan we meet quarterly with representatives from the above Designated Areas.

In our RIIO-ED1 business plan we have planned to invest £9m in undergrounding 80km of existing overhead lines by 2023 (although the exact length will depend on the nature of the sites proposed by our regional partners). In 2016-17 we removed a further 11.23km of overhead line and installed 12.21km of underground cable inside Designated Areas.

In the first two years of RIIO-ED1 we have now removed a total of 15.02km (19%) of the 80km we have committed to remove in the regulatory period.

Table 2: Visual amenity activity summary 2016-17

	Designated Area	O/head Line Removed (km)	U/ground Cable Installed (km)	Expenditure (£m)	Benefit
Forest of Bowland	<ul style="list-style-type: none"> • Deep Clough-Winder Roeburndale Thornbush-Bracksbottom • Middle Lees-Cow Ark • Crimpton-Ing Barn • Wolfen Hall-Fell Foot Chipping • Greenbank Spur Farleton • Priors Farm Hornby • Farleton Crossing 	1.80	2.25	0.16	Visual Amenity
Solway Coast	<ul style="list-style-type: none"> • Priesthill Beaumont • Tile Kiln Cottage Spur Beaumont 	1.61	2.24	0.16	Visual Amenity
North Pennines	<ul style="list-style-type: none"> • Raise Bank Alston • The Loaning Alston • Coatley Hill-Sunnyside Alston 	2.72	3.11	0.31	Visual Amenity
Lake District	<ul style="list-style-type: none"> • High Rough Mill-Scalegate 11kV Spur • NWW Cawdale-Stanegarh 11kV Spur • Rawdale Mardale ABS-Goodcroft PMT • Abbots Reading nr Haverthwaite • Spark Bridge-Broad Haws 11kV spur • Docker Nook-Kilnstone Hydro • Toms Howe-Hill House Longsleddale • Bushby House Caldbeck • LDNPA Surveys Phases 1, 2 & 3 	4.05	3.56	0.16	Visual Amenity
Peak District	<ul style="list-style-type: none"> • The Wash Chapel En Le Frith • Derbyshire Level Glossop 	1.05	1.05	0.16	Visual Amenity
	TOTAL	11.23	12.21	0.95	

In 2017-18 we have the following projects planned:

Table 3: Planned visual amenity activity 2017-18

	Designated Area	Expenditure (£m)	Benefit
Lake District	St Patricks Church Patterdale	0.02	Visual Amenity
	Docker Nook – Kilnstone Hydro	0.13	Visual Amenity
	Toms Howe – Hill House, Longsleddale	0.09	Visual Amenity
	Bushby House, Caldbeck	0.07	Visual Amenity
	Coledale 11kV Spur Braithwaite	0.06	Visual Amenity
	Redsike-Lobbs Troutbeck	0.33	Visual Amenity
Forest of Bowland	Crimpton-Ing barn	0.25	Visual Amenity
Peak District	Pob Green Uppermill	0.17	Visual Amenity
Total		1.12	

Details of our strategy for project assessment and delivery, analysis of costs and benefits, stakeholder engagement and support and our approach to the assessment of projects is included in our document *Undergrounding for Visual Amenity – Scheme Selection and Design Process 05 May 2016* which can be found at the following link:

<http://www.enwl.co.uk/sustainability/reports-and-assurance>

The data relating to our visual amenity activity can be found in worksheet E1 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

2.3 Oil leakage

We have used fluid filled cables since the 1960s as part of our extra high-voltage distribution network at 132,000 volts down to 33,000 volts. The fluid acts as an electrical insulator and will be either mineral naphthenic oil or linear alkyl benzene or a mixture. In all cases the fluids will have a low viscosity and colour, not unlike water.

Leaks from fluid filled cables can occur for varying reasons including cable damage by third party excavations, cable damage due to installation failure, failure of oil equipment, pipe work, monitoring gauges, oil tanks etc. and cable joint failure.

Whilst only a very small percentage of cables ever develop leaks, a leak can present a significant environmental risk if it is adjacent to a water course or an aquifer.

Our strategy to address oil leakage from fluid filled cables is to replace them with alternative modern oil free cabling and to respond quickly to leaks on legacy circuits.

We have committed in our RIIO-ED1 business plan to maintain a leakage rate of less than 30,000 litres per year by 2023. To achieve this we aim to replace 57km of oil filled cable which will reduce our overall oil in service by 131,560 litres and 3,900 litres of oil lost per year.

In 2016-17 we removed a further 10.5km of 33kV and 0.14km of 132kV oil-filled cable taking the total removed in the first two years of the RIIO-ED1 period to 10.6km (19%) of the 57km we plan to remove in the regulatory period.

When leaks are detected we respond in accordance with requirements, including response times, of the joint Environment Agency and Electricity Companies Operating Code on the Management of Fluid Filled Cable Systems Issue 3, 2013.

In 2016-17 a total of 21,096 litres of oil was lost representing 1.6% of the total oil in service.

In 2017-18 we plan to remove a further 35km of oil filled cable.

The data relating to our oil leakage activity can be found in worksheet E2 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.



2.4 Carbon impact and climate change

2.4.1 Business carbon footprint

Within our Environment and Energy Management Policy we have committed to minimise the carbon footprint of our business and actively contribute to the low carbon economy. The carbon footprint is a measure of the impact of our business on the environment through our emissions of greenhouse gases.

The target set in our RIIO-ED1 business plan is to reduce our 2014-15 business carbon footprint (excluding losses) by 10% by the end of 2019-20. The benefits of this reduction will be the equivalent of 2,440 tonnes of CO₂ emissions saved including a reduction of 1,237,379 kWh of energy used in powering our buildings and substations and a reduction of 804,727 litres of diesel used to power the operational fleet, plant and equipment.

In 2016-17 we continued to realise the benefits from our investment in fuel efficiency including reduced vehicle weights, installation of engine rev limiters and educating our drivers on the most efficient manner in which to use our fleet. Further investment in the refurbishment of our buildings also took place including the installation of more energy efficient equipment.

This investment, alongside continued promotion of energy reduction behaviour with our employees, is driving down the electricity used to power our buildings.

The amount of emissions from unplanned events decreased significantly in 2016/17. The Desmond/Eva storms in December 2015 meant higher generator usage, and consequentially higher emissions from diesel consumption, in 2015/16. Our carbon emissions are sensitive to these events and such fluctuations are to be expected going forwards.

Our business carbon footprint (excluding losses) for 2016-17 was 21,012 tCO₂e, a reduction of 2,121 tCO₂e (9.2%) on the previous year.

Table 4: Business carbon footprint 2016-17

Emissions	2016/17 tonne CO ₂ e	2015/16 tonne CO ₂ e
Scope 1		
Operational transport (direct labour)	3,541	3,376
Operational transport (contractors)	3,610	4,043
Business transport - road	1,231	1,192
Fugitive emissions - SF ₆	1,259	334
Fugitive emissions - other	17	18
Fuel combustion	2,657	4,113
TOTAL	12,315	13,076
Scope 2		
Buildings energy usage	8,595	9,840
TOTAL	8,595	9,840
Scope 3		
Business transport - rail	19	29
Business transport - air	83	188
TOTAL	102	217
Business Carbon Footprint (exc. losses)	21,012	23,133
Losses	580,352	667,982
Business Carbon Footprint (inc. losses)	601,364	691,115

The data relating to our business carbon footprint can be found in worksheet E3 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.



2.4.2 Sulphur hexafluoride emissions (SF₆ Emitted)

SF₆ is a gas with excellent electrical insulation and other properties, which have led to its widespread use in electrical switchgear and in a number of other industrial applications. However, there is concern over any SF₆ that escapes into the atmosphere since it is a potent greenhouse gas.

In terms of our strategy to address the level of SF₆ emitted, we contribute to the overall UK electricity transmission and distribution industry in supporting the Government initiatives to ensure the implementation of sound policies for the control and use of SF₆. The European electricity industries have also agreed a set of actions with the manufacturers of electrical equipment using SF₆, to reduce emissions of the gas to the atmosphere. Leakage rates are being reduced in cooperation with power equipment manufacturers under a programme of continuous improvement.

On a company level our current policy is to continue to install modern SF₆ equipment with lower leakage rates and over the RIIO-ED1 period we plan to reduce our leakage rate by over 20% from a rate of 0.38% (as a proportion of the mass in service) in 2013 to 0.30% by 2023.

In 2016-17 a total of 55.23 kg of SF₆ was lost from our system, with a carbon equivalent of 1,259 tCO₂e. This loss equates to 0.39% of the total mass in service.

The data relating to our SF₆ holding, leakage and associated carbon footprint can be found in worksheet Regulatory Instruction Guidance worksheets E2 and E3 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

2.4.3 Distribution losses

When electricity is generated not all of the electrical energy which flows through the power network reaches the customer. This is because power networks use-up some of the energy in the process of transporting the electricity to customers. In the broadest sense, distribution network losses are the difference between the electrical energy entering the distribution network, and the electrical energy that leaves it. Some losses are associated with the technical characteristics of the electricity network ('technical' losses), whilst other losses are more to do with measurement and billing ('non-technical' losses).

Losses cost customers money and contribute to carbon emissions. They can be reduced in various ways but these measures also cost money. At Electricity North West we act on behalf of our customers to determine the appropriate balance between spending money on reducing losses, and saving money for customers by lowering the energy lost during transportation.

The overall level of losses will be influenced to a greater extent by electricity usage i.e. the more electricity consumed, the more power transmitted and distributed, the more losses and vice versa. This movement in losses is reflected in the total losses associated with our network. In 2016-17 losses¹ were 1,408,449,596 kWh or the equivalent of 580,352 tCO₂e.

This was a reduction of 36,804,414 kWh (2.5%) from 2015-16 which together with a change on the conversion factor equated to a reduction of 87,630 tCO₂e.

We can however proactively target losses reduction and our strategy for losses is to continually review the options for reducing the losses on our network. We have examined the potential to reduce network losses through the application of various alternative investment strategies during the RIIO-ED1 period and are adopting, as policy, only those strategies that deliver clear positive benefits for our customers.

We also plan to maintain and expand our activities to investigate and minimise non-technical losses, such as theft, while continuing to establish a more reliable losses reporting baseline within RIIO-ED1.

As part of this strategy we have identified a number of priorities for reducing both technical and non-technical losses.



¹ It should be noted that the reported losses figure is a snapshot of received data as of the date of this report and will change as further settlement reconciliation runs are carried out (up to 28 months after each relevant settlement date).

Table 5: Losses strategy summary

Investment	Actions	
Technical losses		
Distribution transformers (ground-mounted)	Replace old (pre-1990) large, ground-mounted, secondary network transformers with capacities of 800kVA and 1000kVA with lower loss EU Eco design	Proactive
Primary transformers	When installation or replacement required, replace with lower loss EU Eco design	Opportunistic
Grid transformers	When installation or replacement required, determine best type to reduce losses with all new transformers lower loss EU Eco design	Opportunistic
Distribution transformers (pole-mounted)	When installation or replacement of larger pole-mounted secondary network transformers required, replace with lower loss EU Eco design	Opportunistic
Cables (high voltage and low voltage)	Install large-cross section cables (300mm ²) at both HV and LV as standard	Opportunistic
Non-technical losses		
Transactional theft	Continue to work alongside suppliers to help reduce transactional theft	Proactive
	Monitor / share best practice with other DNO's	Proactive
Theft in conveyance	Develop our theft in conveyance services	Proactive
	Contribute to the development of the National Revenue Protection Code of Practice	Proactive
	Increase number of investigations undertaken	Proactive
	Monitor / share best practice with other DNO's	Proactive
Unmetered supplies	Undertake regular audits of unmetered supply inventory	Proactive
Low Carbon Networks (LCN) Fund Strategy		
LCN Fund	Review and analyse the details of the LCN Fund innovation projects	Proactive

Our losses strategy can be found at the following link:

<http://www.enwl.co.uk/docs/default-source/default-document-library/electricity-north-west---losses-strategy---april-2015>

A summary of our activity in this area is contained in the tables below.

Table 6: summary of losses costs and benefits from activities in RIIO-ED1²

Programme / project title	Distribution Losses – Justified Costs £m		Reduced Losses GWh		Reduced Emissions Associated with Losses tCO2e		Cumulative reduced losses to date GWh
	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	
Standardise use of 300mm ² HV cable	1.23	1.07	0.00	2.41	0.00	992.56	2.41
Standardise use of 300mm ² LV cable	0.71	0.74	0.00	0.94	0.00	387.97	0.94
Proactive replacement of pre-1990 1000kVA transformers	0.62	0.93	0.00	0.97	0.00	397.83	0.97
Proactive replacement of pre-1990 800kVA transformers	0.14	0.26	0.00	0.19	0.00	76.55	0.12
Opportunistic primary transformer replacement	0.09	0.51	0.00	0.10	0.00	40.56	0.10
Opportunistic pole-mounted transformer replacement	0.02	0.02	0.00	0.04	0.00	18.45	0.04
Relevant theft of electricity action	(0.01)	(0.01)	1.81	2.23	834.24	920.45	4.04
TOTAL	2.80	3.52	1.81	6.88	834.24	2834.37	8.62

² For all technical losses initiatives it is assumed that there were no losses saving in the first year (2015-16) and the full losses saving will commence in the following years.

Table 7: summary of amount of losses activity in regulatory year and estimate for 2017-18

Programme / project title	Description of unit	Volumes in regulatory reporting year	Forecast volumes for following regulatory year
Standardise use of 300mm ² HV cable	1 km of cable	138	260
Standardise use of 300mm ² LV cable	1 km of cable	43	40
Proactive replacement of pre-1990 1000kVA transformers	Transformers	71	45
Proactive replacement of pre-1990 800kVA transformers	Transformers	22	10
Opportunistic primary transformer replacement	Transformers	11	2
Opportunistic pole-mounted transformer replacement	Transformers	45	50
Relevant theft of electricity action	Theft case identified	577	600

The data relating to our loss reduction activities can be found in worksheet E4 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

The cost and benefit analyses for our innovative solutions are included in the appendices.



2.5 Other environment related activities

2.5.1 Energy management system

To underpin our target of reducing our business carbon footprint by 10% by 2020 we have implemented an energy management system across the company. This system has driven us to carry out a full review of our energy use and consumption, identify opportunities for improving energy performance, set energy reduction targets and put procedures in place for managing energy use. The system was certificated to the ISO 50001 standard in 2016-17.

2.5.2 Hazardous waste

Our oil recycling facility at Blackburn continues to play a significant part in managing our environmental impacts by allowing us to minimise the use of raw materials and disposal of waste oil.

2.5.3 Noise complaints

We received 30 noise related complaints in 2016-17 compared to 38 in the previous year. All complaints in the year related to substation noise and were dealt with through our customer service processes.

The data relating to noise complaints can be found in worksheet E2 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

3. Smart grids, innovation and our role in the low carbon transition

3.1 Introduction

As the electricity distribution network operator for the north west of England we have a key role to play in enabling the transition of our region to low carbon energy and through this in supporting the UK as a whole in meeting its climate change targets.

This section describes our activity in 2016-17 in regard to smart grids, innovation and generally how we are fulfilling our commitment in this area.

3.1.1 Key challenges

The long term challenges our business and industry face in regard to energy use remain the same.

- Government initiatives on energy efficiency, carbon costs, renewable energy generation and electric vehicles combined with increasing customer awareness of energy issues will drive changes in customer behaviours that will impact significantly on electricity consumption in terms of patterns and levels of demand.
- Increased use of electricity for heating and transport will increase customer demand for electricity, improved reliability of supply and information when supply is interrupted.
- Our assets are ageing with many of our assets now approaching their previously assumed end of life and at a time when we are asking them to perform new functions.

Equally the opportunities these challenges and the new technologies that are emerging to tackle them present have not changed.

- New technology itself has the overall ability to add value to our business by enabling improvements in customer service and reducing costs.
- Energy storage can help us manage demand uncertainty and help customers and communities improve energy efficiency.
- Smart meters will allow us to monitor how much power our customers are using or producing in near real time, and allow us to positively influence usage and operate the network more responsively.
- New markets are emerging through which customers can earn value while helping solve network constraints.
- Regulatory models can be developed that support changes needed.

Our innovation strategy is built to resolve these new challenges and to realise the opportunities. It is made up of five objectives with the aim of delivering value to our customers.

- Maximise the use of existing assets
- Apply innovative solutions to real problems
- Deploy proven technology today
- Generate value for customers now
- Offer new services and choice for the future

In line with this strategy we have developed a range of projects, some of which have been completed and a number of which are currently in flight. All projects are designed to support one or more key innovation themes:

- **Safety and environment** – strive to continuously improve safety and reduce impact on the environment
- **Network resilience** – improve network performance and reduce risk
- **Capacity** – maximise the use of existing assets to increase demand and generation capacity
- **Efficiency** – provide our existing services at lower cost
- **Customer service** – improve customer experience and offer new services with more choice
- **Commercial evolution** – change our role from network operator to system operator

Full details of our innovation work can be found on our dedicated 'Future' web pages through the following link:

<http://www.enwl.co.uk/about-us/the-future>

Our innovation strategy can be found at the following link:

<http://www.enwl.co.uk/docs/default-source/innovation-strategy/innovation-strategy-2017.pdf>

The data relating to the benefits of using innovative solutions for connections can be found in worksheet E6 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

The cost and benefit analyses for our innovative solutions are included in the appendices.

3.1.2 Low carbon technologies connected

In 2016-17 we connected 5,004 low carbon technologies with a total capacity of 174 megawatts (MW). 4,996 of these were connected onto our secondary³ network, the majority of which were photovoltaic systems. On our primary⁴ network we connected 8 low carbon technologies all of which were non-G83 distributed generation units.

We anticipate similar deployment in 2017-18.

The volume of low carbon technologies connected was below the forecast volumes for the year although overall there was an increase of 35% in units from 2015-16. The capacity of photovoltaic systems connected however was above the anticipated level. There is still a challenge with data visibility for items connected beyond the meter. As an example, we only had notifications in the year of nine heat pump installations although it can be assumed that more installations took place.

The data relating to low carbon technologies deployed can be found in worksheet E7 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack in the appendices.

3.2 Progress of the innovation strategy

For the second year of the RIIO-ED1 period, we have continued to both prepare for and actually deploy a number of Innovative Solutions. Many of these solutions will come into active use in future years and our activities have been limited to transitioning them into BAU via a number of new and amended policy updates, completion of associated procurement exercises to allow us to purchase key products and services as well as internal training on how to carry out the range of activities associated with the deployment of the innovative solutions.

Innovative Solutions

There are six Innovative Solutions which formed part of our business as usual activities during 2016-17. These are listed below together with the project on which the Innovative Solution depends. These projects are shown in brackets alongside the innovative solutions.

- Capacity to Customers
- Demand Side Response – Catterall
- Power Saver Challenge
- Transformer Regeneration (Combined Online Transformer Monitoring)
- Fault Support Centre (Bidoyng Smart Fuse)
- Connect and Manage PV Clusters (LV Smart Joint)

³ 11kV and below

⁴ 33kV to 132kV

3.2.1 Summary of innovative solutions deployed

CAPACITY TO CUSTOMERS (now known as managed connections)

What the solution is

Managed connections provide customers wishing to connect to the network with a lower cost connection and reduced waiting times versus traditional network reinforcement-based connection arrangements. It utilises advances in network automation and communications alongside innovative commercial terms. It is a form of Active Network Management (ANM) solution which may seek to disconnect managed customers from the network for agreed periods only in the event of a relevant network fault.

How the solution is being used

Managed connections are now the standard connection offer provided to all generation customers connecting to the HV and EHV network. Managed connections afford customers a lower cost connection and as such have become the default connection offer provided to all DG customers.

To support decision making by customers, information on the potential 'curtailment factor' (i.e. the typical period of time that a customer could expect to be at risk of disconnection) is provided alongside the connection offer.

Customers may choose to reject the managed connection offer and instead opt for a more traditional connection arrangement without the managed elements.

How the solution is delivering benefits

Managed connections are providing a number of benefits. Economic benefits flow to connection customers from lower reinforcement costs and reduced time to connect. Environmental benefits accrue as a result of the connection of low carbon generation such as solar/wind farms.



DEMAND SIDE RESPONSE - CATTERALL

What the solution is

Catterall Primary Substation has a single 7.5MVA transformer and a firm capacity of 5 MVA, limited by High Voltage transfer capability. The peak demand at Catterall Primary is 7.41 MVA, which exceeds the firm capacity by 2.41 MVA.

Catterall primary is compliant with ENA Engineering Recommendation (ER) P2/6. The non-compliance issue only exists when the system is operating abnormally (i.e. under a fault situation), as the demand exceeds the transfer firm capacity. Deferring the reinforcement and entering into a commercial contract with United Utilities to purchase the demand at Catterall allows us to monitor Catterall's primary demand patterns and enables us to be compliant with ER P2/6. Purchasing Demand Response (DR) ensures that the demand does not exceed the capacity when the system is abnormal.

How the solution is being used

Under system abnormal conditions, we will switch out the United Utilities circuit at Catterall GSP to reduce the demand at the United Utilities Franklaw site, to enable the restoration of supplies connected to Catterall GSP so the transfer capacity of 5 MVA is not exceeded. United Utilities have agreed to have their demand reduced by 3 MVA for up to eight hours to allow time for us to identify and resolve the issue. This is an agreed three year contract, with a payment of £13,500 per MVA, for six events over the three year period.

How the solution is delivering benefits

DR provides a lower value of excess capacity and with continuous monitoring provides the opportunity to analyse the demand to defer or carry out reinforcement in the future if demand increases.

POWER SAVER CHALLENGE

What the solution is

The project covered 1,055 domestic consumers within the Stockport area of Greater Manchester. Half of these consumers are located in the Heaton Mersey area which is generally affluent, the other half are located in the Heaton Norris area that has a high proportion of fuel poverty residents. Electricity demand monitoring was installed on the feeder at the local substation supplemented by in-home monitoring devices to measure the impact of the demand reduction measures and any changes in consumer behaviour. A target of up to 1MW of peak load reduction was set. This project forms part of our Corporate and Social Responsibility plan.

How the solution is being used

The recommended interventions of reduced energy usage from washing machines, cooking appliances and power showers were supplemented with the improved lighting efficiency options. These technically enabled options were packaged together as a suite of efficiency measures and provided free of charge to participating consumers. Participating consumers agreed to the fitting of low energy light bulbs, washing machine controllers and shower timers funded by the project. The installations were accompanied by an education programme for the households.

How the solution is delivering benefits

Project costs were reported as General Reinforcement. A target of up to 1MW of peak load reduction was set. However, in this particular example it was decided to reinforce the network in the area and as such, this project acts as a proof of concept rather than a specific alternative to network reinforcement.

TRANSFORMER REGENERATION

Another significant innovation which we have now transitioned across to BAU is the regeneration of transformers to avoid the need to replace with new. During the FY16 period our activities were limited to the preparation and mobilisation of the various teams that will be used to deliver this programme. Several Refurbishment works were carried out in FY17. However for some further sites there are additional works which are at an advanced stage of completion and these will be reflected in the volumes for 2017-18.

What the solution is

The condition of the oil in the transformer main tank is a good proxy for the general condition of the transformer as a whole. It has been shown from recent research that deployment of a unique application of transformer oil regeneration (a process whereby transformer oil is cleaned through an on-site process) can result in an improvement in overall condition of the transformer which when used in combination with enhanced condition monitoring, can extend the expected life of the transformer.

How the solution is being used

Transformer regeneration is being used as an alternative to traditional transformer replacement during RII0-ED1 thus reducing the cost of asset replacement.

How the solution is delivering benefits

The financial benefits from this project are derived from the potential transformer life extension and deferral of asset replacement costs. Other benefits include quality of supply benefits which are limited to improved understanding of the risk of failure of older transformers and a better insight into the oil ageing process. The Environmental benefits result from extending the life of transformer and its oil therefore reducing the requirement for disposal and recycling of used oil and scrap transformers.

COMBINED ONLINE TRANSFORMER MONITORING (FACILITATES TRANSFORMER REGENERATION)

What the solution is

As transformer life is extended through the use of techniques such as transformer oil regeneration, network operators must be certain that the life extended units will continue to operate both safely and reliably. To support this, a real-time condition monitoring system has been developed which provides us with enhanced information on each refurbished transformer via an on-line information dashboard.

How the solution is being used

Transformer monitoring will be fitted to all transformers which are to have their oil regenerated in RIIO-ED1 for a period of time to confirm via observable data that both the initial condition of the transformer is improved and that this improved condition is maintained thereafter. The solution is being used as part of our intervention plan to extend the life of a large number of Grid & Primary transformers. The technology is fitted to targeted transformers for a short period prior to the commencement of the regeneration process and continues for a defined period thereafter.

How the solution is delivering benefits

The condition monitoring provides us with confirmation that the transformer regeneration process has been successful in improving the condition of the transformer oil and thus the main tank. The combined online transformer monitoring is a key enabling technology for the refurbishment of large volumes of Grid & Primary transformers via the Transformer Regeneration Innovative Solution.

BIDOYNG (SMART FUSE) (FACILITATES FAULT SUPPORT CENTRE)

What the solution is

The Bidoyng is an innovative replacement for the standard low voltage fuse. It provides for a multi-shot re-close feature as opposed to the single shot available from the standard fuse. This means that customer supplies can be automatically restored in the event of a transient fault. This reduces the number of customer interruptions and customer minutes lost reduces the cost associated with managing our response to a loss of supply and LV fault and improves customer satisfaction outcomes.

In addition, the Bidoyng provides increased network visibility via its ability to measure and transmit via SCADA key network parameters and make this available in near real-time.

How the solution is being used

The Bidoyng is used to reduce the customer impacts of faults, support increased understanding of the impact of the connection of low carbon technologies and improve the management of network faults.

The Bidoyng smart fuse is acting as an enabler for a number of innovation solutions and applications. In particular, the Bidoyng is a key tool in the management of Low Voltage transient faults. These faults are intermittent in nature and are often difficult to find and repair. The Bidoyng is used to both minimise the customer disruption associated with a fault (i.e. by automatic restoration of supplies) and to help engineers to locate the fault thus allowing proactive repair of the fault.

How the solution is delivering benefits

The Bidoyng smart fuse is a key enabling technology. It is being used as the main technology deployed on faulty parts of the LV network as part of the Fault Support Centre. In addition, it is providing information on the performance of the network to support the application of the Connect & Manage approach to domestic PV clusters connected to the LV network.

FAULT SUPPORT CENTRE (FSC)

What the solution is

The Fault Support Centre is an enhanced Low Voltage network fault management solution which makes use of the increased penetration of intelligent devices such as the Bidoyng coupled with innovative commercial partnership with a third party provider. The FSC provides a real-time operational management of low voltage networks to allow for the proactive management of faults. The data obtained can be further used to target areas of the network which would benefit from asset replacement.

How the solution is being used

The solution is being used as the business-as-usual way in which all transient faults are managed. In the event that a transient fault is detected, a Bidoyng smart fuse (or suitable alternative such as the Weezap) is fitted to the suspect LV network. Our third party service provider (Kelvatek) is informed of the event and crucial information is passed across that allows real-time monitoring of the associated network.

Kelvatek will continue to monitor the affected networks until they have determined the location of the fault and issued an instruction to our field teams to investigate or it can be reasonably shown that the transient fault is no longer active. In such cases, the equipment will be recovered and redeployed elsewhere.

How the solution is delivering benefits

The Fault Support Centre allows for the proactive management of LV transient faults. It is clear from our own customer engagement that these types of fault are amongst the biggest cause of customer dissatisfaction. The ability to repair these faults before they have chance to progress into a permanent fault will significantly reduce the number of associated faults and reduce customer disruption accordingly.

Further benefits flow from the reduced CI and CML and associated fault costs that the proactive management of faults delivers.

CONNECT & MANAGE PV CLUSTERS ON LV NETWORKS

What the solution is

As a result of the learning outcomes of the LCNF Tier 1 Project – Low Voltage Network Solutions (LVNS), we have been able to successfully implement a streamlined approach to the connection of domestic scale PV systems to the LV network. These systems are often connected in clusters and can give rise to associated network voltage and thermal issues.

Traditionally, a network operator would require detailed and time consuming network assessments to be performed in advance of allowing the connection to proceed. These assessments are aimed at understanding if the connection could give rise to any of the aforementioned problems. However, as a result of the research that was undertaken as part of the LVNS project and the sophisticated network modelling that underpinned this allowed us to adopt an alternative approach.

We have successfully shown that up to a certain threshold (i.e. percentage of customers with PV systems) it is acceptable to allow the connections to proceed. Once the threshold is met however we will install network monitors to assess using actual recorded data if the network requires and further assessments.

How the solution is being used

The solution is being actively used across our network. We use this to avoid the often costly and time consuming network assessments that can accompany generation connections. We have established a business process supported by internal policy that provides for a continued monitoring of the PV volumes. Specific actions are triggered when these volumes are exceeded and follow up actions are performed as appropriate.

How the solution is delivering benefits

The solution delivers benefits to customers in the form of avoided waiting times associated with the connection of PV systems to the LV network. We have also been able to avoid expensive and resource intensive network connection studies, thus reducing internal costs and freeing up resources to concentrate of other parts of our connection services.

3.3 Roll out of smart grids and innovation into business as usual

All our innovative solutions are designed, implemented and monitored through a set process

Figure 1: innovative solutions roll-out process



The cost and benefit analyses for our innovative solutions are included in the appendices.

3.4 Transfer to business as usual (BAU)

Managing the transition of an innovative solution, device, technology or new operating arrangement into BAU is perhaps the most important stage in delivering benefits to customers. This phase generally represents the final stage of a project's time line and is the culmination of its successful outcome.

The ability to transition the innovation to BAU is an important consideration when innovation investment opportunities are assessed. We recognise that some projects are aimed at informing our understanding and learning and in such instances BAU transition

normally involves updates to business processes, procedures and specifications. The BAU assessment also considers the technology risk, the development time line and our ability to support the developers in a meaningful manner before embarking on a project.

To ensure the successful transition to BAU, we select innovation investments that are assessed as having a good chance of delivering value for customers. We focus on challenges that have been identified in our business plan and use innovation to address these issues. We use a cost benefit analysis approach to ensure that best value projects are taken forward.

We have developed a five stage initiative-tracking process which enables us to take innovation and other business initiatives into BAU.

Figure 2: innovative solutions transfer to business as usual



3.4.1 Benefits and impacts

With the roll-out of the above innovative solutions in 2016-17, the following benefits have been realised:

Innovative Solution	Additions	Benefits		
		Estimated Gross Avoided Costs (£m)	CI Impact (Interruptions)	CML Impact (Minutes)
Capacity to Customers	4	7.60	N/A	N/A
Demand Side Response	1	2.20	N/A	N/A
Power Saver Challenge	1	N/A	N/A	N/A
Transformer Regeneration	3	2.37	N/A	N/A
Fault Support Centre and LV Reclosing Devices	807	1.34	17,114	1,540,260
Connect and Manage PV Clusters on LV Networks	947	0.14	29.59	2,604

3.4.2 Smart metering

Although the energy supply companies are responsible for their rollout, we are preparing to maximise the benefits from the data they will provide in the future.

Our strategy is to help customers and suppliers with the transition to the new meters, for example by upgrading our service positions where necessary to accommodate a smart meter.

At the same time we will train our employees and upgrade our IT systems so we can use smart meter data for the benefit of our customers. We are also working with suppliers to ensure customers are properly informed about smart meters.

In 2016-17 a total of 192,071 smart electricity meters were installed in our distribution service area.

In 2016-17 we incurred £2.94m in IT costs covering the procurement, implementation and commissioning of the gateway infrastructure connecting our IT systems to the Data and Communications Company's (DCC) central systems as part of the Smart Meter Implementation Programme and required by the Smart Energy Code. Connection to DCC's central systems facilitates access to smart meter data, generated from alerts and service requests, which in the longer term will enable a system operator to manage its network more effectively and cost efficiently for its customers.

We also paid £1.45m in communication licensee costs to the DCC, as required by the Smart Energy Code and defined by DCC's published charging methodology statement.

Throughout the year, we have continued to play an active role at industry level through the Energy Networks Association Smart Metering Operations Group and its sub-group looking specifically at the safety aspects of the roll-out.

The smart meter programme has not yet rolled out to the extent that benefits are identifiable. However, in 2017-18 we are hopeful that the roll-out will have progressed to the point where we will be to quantify realised benefits.

The data relating to smart meter readiness expenditure can be found in worksheets E5 of the RIIO-ED1 Environment Report – Environment and Innovation Reporting Pack and in section E5 of the RIIO-ED1 RIGs Environment and Innovation Commentary in the appendices.



4. Appendices

Regulatory Reporting Pack and Commentary:

- Environment and Innovation Reporting Pack_Final
- Environment and Innovation Commentary_Final

Cost Benefit Analyses (Losses):

- 2017 Install 300sqmm HV Cable versus 185sqmm HV CV1 CV2
- 2017 Install 300sqmm HV Cable versus 185sqmm HV CV3
- 2017 Install 300sqmm HV Cable versus 185sqmm HV CV7
- 2017 Install 300sqmm HV Cable versus 185sqmm HV Other
- 2017 Install 300sqmm LV Cable Versus 185sqmm LV CV1 CV2
- 2017 Install 300sqmm LV Cable Versus 185sqmm LV CV3
- 2017 Install 300sqmm LV Cable Versus 185sqmm LV CV7
- 2017 Install 300sqmm LV Cable Versus 185sqmm LV Other
- 2017 Opportunistic 200kVA PMT Replacement CV7
- 2017 Opportunistic 200kVA PMT Replacement Other
- 2017 Proactive 800kVA GMT Replacement CV21
- 2017 Proactive 1000kVA GMT Replacement CV21
- 2017 Programme 23MVA Replacement CV7
- 2017 Programme 23MVA Replacement Other
- 2017 CBA for E4 Theft of Electricity v2

Cost Benefit Analyses (Innovation):

- C2C CBA RII0 ED1_v1.0
- Catterall DSR CBA RII0 ED1_v1.0
- LV fault management CBA RII0 ED1_v1.0
- PV CBA RII0 ED1 FY18 v1.0
- TX Regen CBA RII0 ED1_v0.1





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