2015-2023

RIIO-ED1 **BUSINESS PLAN**

SA-05 Supplementary Annex - Expenditure

June 2013 (updated April 2014)

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

SA-05 Expenditure
Contents

1 Introduction

1.1 This document is a supplementary annex to the Western Power Distribution (WPD) Business Plan for the eight year period from 1st April 2015 to 31st March 2023.

1.2 It sets out the expenditure plans for all the different cost categories.

1.3 It covers expenditure for the four WPD distribution licences of West Midlands, East Midlands, South Wales and South West.

1.4 The eight year period aligns with the next regulatory price control review period, known as RIIO-ED1; the first for electricity distribution to be determined using Ofgem's Revenue = Incentives, Innovation and Outputs framework. The Business Plan, supplementary annexes, detailed cost tables and financial models form the submission under RIIO-ED1 to the regulator Ofgem (Office for Gas and Electricity Markets), who will use the information to determine allowed revenues.

Structure of this document

1.5 We appreciate that the readers of the WPD Business Plan suite of documents will range from regulatory experts and well informed stakeholders through to new customers who may have had little previous knowledge of WPD.

1.6 This document is aimed at readers who require a more detailed understanding. A less detailed description can be found in the main Business Plan Overview document.

1.7 This document is subdivided into the following sections:

Chapter	Title	Content
3-8	**Load related investment**	The expenditure requirements for reinforcing the network and for dealing with diversions.
9-26	**Non-load related investment**	Network investment for replacing and refurbishing assets, improving safety, reducing environmental impact and making improvements to network performance.
27-32	**Network operating costs**	Expenditure on inspection and maintenance, responding to and repairing faults, tree clearance and other network operating costs.
33-43	**Closely associated indirects**	The costs of managing projects, control centres, contact centres, stores and other activities related to delivery of work programmes.
44-47	**Business support costs**	The costs of corporate activities such as human resources and finance.
48-52	**Vehicles, IT, property and small tools**	Expenditure on non-operational items incorporating related areas of expenditure in closely associated indirect costs and business support costs.
53	**Non price control costs**	Expenditure on network related work that is not funded through DUoS. This includes fully funded diversions and service alterations.
54	**Non activity based costs**	Expenditure on items that are in many cases beyond the control of WPD such as transmissions exit charges, business rates and Ofgem licence fees.
55-58	**Special considerations**	A description of other factors that affect the expenditure forecasts such as real price effects and efficiency assumptions.
Appendices		Three appendices covering the Transform model used for forecasting load related reinforcement requirements, a description of cost benefit analysis that supports the business plan and summary cost tables that include pensions.

Costs included in this document

1.8 The expenditure included in this document

- excludes real price effects;
- includes efficiency savings;
- excludes pension costs;
- is in 2012/13 prices.

1.9 For clarity summary tables have been produced using rounding, which in some summary tables leads to minor differences between totals and the sum of the components.

1.10 When comparing the data to the Business Plan Data Template spreadsheets, the gross costs in the spreadsheets will be higher as they include pension costs. Appendix A3 contains summary tables of core costs that include pensions which can be compared to the Business Plan Data Tables.

Costs benefit analysis undertaken

Criteria used for deciding where to include a CBA

1.11 Cost Benefit Analysis (CBA) provides a method for comparing the costs and the benefits of investment proposals.

1.12 Since costs and benefits may occur over time the comparison of each is made as if they are effectively happening 'today' by giving them a Net Present Value (NPV). The NPV is calculated by using a discount rate, in our case the WACC, to reduce the value of future cash flows. By doing so we can effectively treat all cash flows as if they had occurred today.

1.13 Where the NPV is positive the investment is worthwhile in financial terms. Where the NPV is negative there may be other non-financial benefits which are considered before rejecting the investment proposal.

1.14 CBA analyses have been prepared for areas of expenditure that meet the following criteria:

- a material level of expenditure;
- a strategic decision (e.g. decision between leasing or purchasing vehicles);
- where expenditure is optional (i.e. it is possible to not invest but with consequential loss of other benefits e.g. quality of supply improvement);
- where mandated by Ofgem in their CBA guidance.

1.15 In addition Ofgem guidance has also highlighted two other criteria where CBA is required:

- where an approach is adopted that is significantly higher cost than a previous strategy; or
- where a DNO is likely to appear higher cost than others because an alternative approach has been adopted

(we have no areas that fall into either of these categories).

1.16 The CBAs that we have undertaken are a mixture of analysis at asset category/class of expenditure and specific project level.

1.17 All CBAs have been compiled in accordance with the Ofgem guidance

Scope/categories of CBAs

1.18 The above criteria has resulted in CBAs being produced for the following category areas;

- diversions;
- reinforcement;
- asset replacement and refurbishment;
- operational IT and telecoms;
- BT 21 CN;
- quality of supply;
- protection against flooding;
- environment;
- Black Start;
- inspection and maintenance;
- tree cutting;
- smart metering;
- vehicles and transport;
- non-operational IT and telecoms;
- property management.

1.19 The reinforcement category includes CBAs assessing smart solutions in addition to the use of the Transform model to produce forecasts for our best view case, the reference case and the other DECC scenarios.

1.20 Based on benchmarking information and our performance levels, we are satisfied that our business model is efficient. We have therefore used CBA to optimise our asset replacement intervention policies and to confirm that material expenditure decisions have positive NPVs when assessed using the Ofgem methodology.

Uncertainty and sensitivity analysis

1.21 Where costs are uncertain or potential changes in costs may change the outcome of the CBA, sensitivity analysis is undertaken.

1.22 The sensitivity analysis factors in a range of potential variation in costs relevant to the subject area.

Access to CBAs

1.23 To access the detail of each CBA hyperlinks have been established to specific folders contained on the WPD website.

1.24 For ease of use, and to reduce the number of folders reviewers are required to access, we have grouped a number of related CBAs into each folder.

1.25 A description of the CBAs and how these can be accessed for review is contained in Appendix A2 to this document.

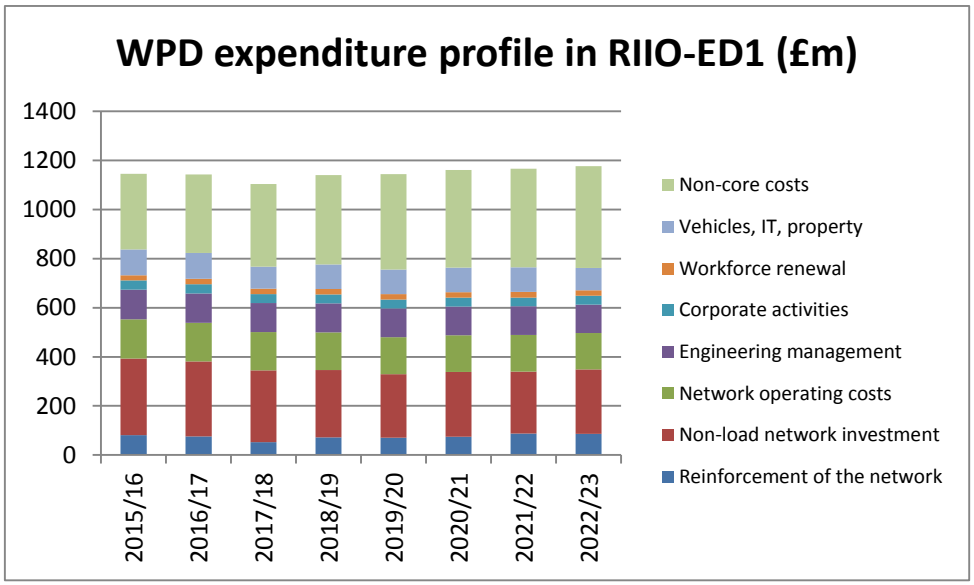
2 High level summary of expenditure

2.1 The following table provides a high level summary of the expenditure that will be funded through DUoS over the RIIO-ED1 period.

Expenditure within the Price Control (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Reinforcement of the network	198.0	267.2	48.6	84.7	**598.5**
Non-load network investment	664.2	587.3	396.9	575.1	**2,223.5**
Network operating costs	355.0	370.9	194.1	304.9	**1,224.9**
Engineering management	288.6	290.8	147.9	214.5	**941.8**
Corporate activities	87.0	83.2	47.3	75.8	**293.3**
Workforce renewal	47.7	47.7	35.6	46.9	**177.9**
Vehicles, IT, property & tools	237.2	233.1	120.3	201.9	**792.5**
Non-core costs and pass through items	801.0	872.0	530.3	728.2	**2,931.4**
Total	**2,678.7**	**2,752.2**	**1,521.0**	**2,232.0**	**9,183.8**

Note that the expenditure represents WPD's best view which includes expenditure for worst served customers and undergrounding in AONBs and National Parks. These two costs categories are not included in the opening 'base' Price Control Financial Model (PCFM) because they are costs that are logged up and funded retrospectively. There is therefore a small difference between WPD's best case and the PCFM base case.

2.2 The following chart illustrates how the expenditure for WPD is profiled over the RIIO-ED1 period.



WPD total core expenditure forecast

WPD Total - Core costs funded through DUoS											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-7.5	6.5	6.0	5.9	6.2	6.6	6.7	6.7	6.8	7.1	52.0
General Network Reinforcement	53.4	43.4	69.9	64.6	36.6	46.8	36.9	31.8	35.4	25.5	347.5
Reinforcement for Low Carbon Technologies	0.0	24.9	4.7	4.7	9.3	18.3	27.3	36.2	45.0	53.6	199.0
TOTAL - Reinforcement of the Network	**45.9**	**74.8**	**80.6**	**75.2**	**52.1**	**71.7**	**70.9**	**74.7**	**87.2**	**86.2**	**598.5**
Asset Replacement	192.4	202.6	203.6	204.4	202.5	203.4	202.7	202.2	201.8	200.2	1620.8
Diversions	25.6	39.2	53.6	52.0	37.2	37.5	28.5	32.9	33.4	38.4	313.5
Quality of Supply (reducing power cuts)	12.6	3.7	5.1	5.1	5.0	4.9	4.9	4.9	0.0	0.0	29.9
Improving service for remote ("worst served") customers	0.3	0.4	0.0	1.6	1.6	0.0	0.0	0.0	0.0	0.0	3.2
Real Time Control Systems and Telecommunications	14.1	12.0	18.9	11.5	24.0	12.5	6.3	8.6	3.6	10.6	96.0
Protecting equipment from flooding risk	4.2	1.9	5.0	4.0	2.3	0.4	0.7	1.3	0.5	0.7	14.9
Enhancing site security, ESQCR and other legal requirements	18.4	11.7	15.7	14.9	14.7	9.9	9.8	9.7	9.6	9.4	93.7
Reducing oil and gas leaks from equipment	4.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	13.6
Undergrounding in National Parks and AONBs	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.0
Other Network Investment	9.9	3.7	8.3	9.4	3.0	3.4	2.4	1.4	1.4	0.6	29.9
TOTAL - Non-Load Network Investment	**283.4**	**277.9**	**312.9**	**305.6**	**293.0**	**274.7**	**258.0**	**263.7**	**253.0**	**262.6**	**2223.5**
Inspection, maintenance and routine tree cutting	75.0	48.4	49.7	49.3	48.8	48.3	47.9	48.1	47.6	47.2	386.9
Tree clearance to improve network resilience to severe weather	4.2	7.6	7.8	7.7	7.7	7.7	7.4	7.4	7.4	7.4	60.5
Responding to and repairing faults	92.0	88.9	93.5	92.2	90.7	89.3	87.9	86.8	85.9	85.0	711.3
Other network operating costs	7.9	8.3	8.5	8.5	8.4	8.3	8.2	8.2	8.1	8.0	66.2
TOTAL - Network Operating Costs	**179.1**	**153.1**	**159.5**	**157.7**	**155.6**	**153.6**	**151.4**	**150.5**	**149.0**	**147.6**	**1224.9**
Engineering management	**132.5**	**117.7**	**119.9**	**119.5**	**118.0**	**117.4**	**116.9**	**117.1**	**116.6**	**116.4**	**941.8**
Corporate activities	**67.1**	**36.7**	**38.0**	**37.8**	**37.1**	**36.7**	**36.4**	**36.1**	**35.8**	**35.4**	**293.3**
Workforce renewal	**20.3**	**22.2**	**21.5**	**22.0**	**22.4**	**22.4**	**22.4**	**22.4**	**22.4**	**22.4**	**177.9**
Vehicles, IT, Property & Engineering Equipment	**115.9**	**99.1**	**105.2**	**105.6**	**89.7**	**100.0**	**100.0**	**100.1**	**100.7**	**91.2**	**792.5**
TOTAL CORE COSTS	**844.2**	**781.5**	**837.6**	**823.4**	**767.9**	**776.5**	**756.0**	**764.6**	**764.7**	**761.8**	**6252.4**

West Midlands - core expenditure forecast

West Midlands - Core costs funded through DUoS											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-2.7	2.3	2.10	2.10	2.20	2.30	2.30	2.30	2.40	2.40	18.1
General Network Reinforcement	26.2	15.6	18.40	19.00	16.40	17.60	16.90	11.50	12.10	12.90	124.8
Reinforcement for Low Carbon Technologies	0.0	6.9	1.30	1.30	2.57	5.07	7.55	10.01	12.46	14.87	55.1
TOTAL - Reinforcement of the Network	**23.5**	**24.8**	**21.80**	**22.4**	**21.2**	**25.0**	**26.8**	**23.8**	**27.0**	**30.2**	**198.0**
Asset Replacement	62.7	62.0	62.7	63.3	62.2	62.4	62.0	61.6	61.4	60.7	496.3
Diversions	9.4	10.8	9.6	8.8	8.5	9.2	9.5	13.9	13.3	13.3	86.1
Quality of Supply (reducing power cuts)	3.7	1.9	2.6	2.6	2.6	2.5	2.5	2.5	0.0	0.0	15.3
Improving service for remote ("worst served") customers	0.0	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	5.0	3.1	5.7	3.9	6.8	1.2	1.6	1.9	0.8	2.5	24.4
Protecting equipment from flooding risk	0.6	0.2	0.0	0.1	0.2	0.1	0.2	0.4	0.1	0.1	1.2
Enhancing site security, ESQCR and other legal requirements	5.0	3.0	3.2	3.1	3.1	3.0	3.0	3.0	2.9	2.9	24.2
Reducing oil and gas leaks from equipment	1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.0
Undergrounding in National Parks and AONBs	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Other Network Investment	1.1	1.2	3.2	3.4	0.7	0.8	0.5	0.3	0.3	0.1	9.3
TOTAL - Non-Load Network Investment	**89.2**	**83.03**	**87.80**	**86.50**	**85.40**	**80.00**	**80.10**	**84.40**	**79.60**	**80.40**	**664.2**
Inspection, maintenance and routine tree cutting	25.9	13.7	14.1	14.0	13.8	13.7	13.6	13.7	13.5	13.4	109.8
Tree clearance to improve network resilience to severe weather	1.3	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	15.6
Responding to and repairing faults	28.6	26.3	27.7	27.3	26.8	26.4	25.9	25.6	25.3	25.0	210.0
Other network operating costs	**2.4**	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	19.6
TOTAL - Network Operating Costs	**58.2**	**44.4**	**46.30**	**45.80**	**45.10**	**44.60**	**43.80**	**43.60**	**43.10**	**42.70**	**355.0**
Engineering management	**44.0**	**36.1**	**36.80**	**36.7**	**36.2**	**35.9**	**35.9**	**35.8**	**35.7**	**35.6**	**288.6**
Corporate activities	**27.2**	**10.9**	**11.30**	**11.2**	**11.0**	**10.9**	**10.8**	**10.7**	**10.6**	**10.5**	**87.0**
Workforce renewal	**4.6**	**6.0**	**5.80**	**5.9**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**47.7**
Vehicles, IT, Property & Engineering Equipment	**36.5**	**29.7**	**31.90**	**31.1**	**25.0**	**28.0**	**31.0**	**32.3**	**31.0**	**26.9**	**237.2**
TOTAL CORE COSTS	**283.20**	**234.72**	**241.70**	**239.60**	**229.87**	**230.37**	**234.35**	**236.61**	**232.96**	**232.27**	**1877.7**

East Midlands - core expenditure forecast

East Midlands - Core costs funded through DUoS											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-3.2	2.1	1.90	1.9	2.0	2.2	2.1	2.3	2.2	2.2	16.8
General Network Reinforcement	19.8	20.3	46.00	39.4	12.9	14.6	8.5	11.7	19.6	10.0	162.7
Reinforcement for Low Carbon Technologies	0.0	11.0	2.06	2.1	4.1	8.1	12.0	15.9	19.8	23.6	87.7
TOTAL - Reinforcement of the Network	**16.6**	**33.4**	**49.96**	**43.4**	**19.0**	**24.9**	**22.6**	**29.9**	**41.6**	**35.8**	**267.2**
Asset Replacement	53.9	52.2	52.60	52.4	52.1	52.0	51.8	52.4	52.3	52.1	417.7
Diversions	9.0	10.5	13.30	12.9	12.6	12.4	8.3	8.2	8.3	8.3	84.3
Quality of Supply (reducing power cuts)	3.7	1.1	1.50	1.5	1.4	1.4	1.4	1.4	0.0	0.0	8.6
Improving service for remote ("worst served") customers	0.0	0.0	0.00	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2
Real Time Control Systems and Telecommunications	5.7	3.2	5.90	4.0	6.9	1.3	1.9	2.0	0.8	2.6	25.4
Protecting equipment from flooding risk	1.5	0.6	1.30	1.7	0.9	0.1	0.2	0.4	0.2	0.2	5.0
Enhancing site security, ESQCR and other legal requirements	3.9	3.2	3.30	3.3	3.2	3.2	3.1	3.1	3.1	3.0	25.3
Reducing oil and gas leaks from equipment	1.7	0.6	0.60	0.6	0.6	0.6	0.6	0.6	0.6	0.6	4.8
Undergrounding in National Parks and AONBs	0.4	0.1	0.10	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8
Other Network Investment	7.7	1.9	4.80	5.3	1.3	1.4	1.0	0.6	0.6	0.2	15.2
TOTAL - Non-Load Network Investment	**87.5**	**73.4**	**83.40**	**81.9**	**79.2**	**72.5**	**68.4**	**68.8**	**66.0**	**67.1**	**587.3**
Inspection, maintenance and routine tree cutting	21.2	11.4	11.70	11.60	11.50	11.40	11.30	11.40	11.30	11.20	91.40
Tree clearance to improve network resilience to severe weather	0.7	1.8	1.80	1.8	1.8	1.8	1.7	1.7	1.7	1.7	14.0
Responding to and repairing faults	30.4	30.3	31.70	31.3	30.8	30.4	30.0	29.6	29.3	29.0	242.1
Other network operating costs	**2.7**	2.9	3.00	3.0	3.0	2.9	2.9	2.9	2.9	2.8	23.4
TOTAL - Network Operating Costs	**55.0**	**46.4**	**48.20**	**47.7**	**47.1**	**46.5**	**45.9**	**45.6**	**45.2**	**44.7**	**370.9**
Engineering management	**44.1**	**36.4**	**37.40**	**37.1**	**36.5**	**36.2**	**36.1**	**35.9**	**35.9**	**35.7**	**290.8**
Corporate activities	**23.4**	**10.4**	**10.90**	**10.80**	**10.5**	**10.4**	**10.3**	**10.2**	**10.1**	**10.0**	**83.2**
Workforce renewal	**4.9**	**6.0**	**5.80**	**5.9**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**47.7**
Vehicles, IT, Property & Engineering Equipment	**36.4**	**29.1**	**29.80**	**29.3**	**26.0**	**28.6**	**30.1**	**30.1**	**31.8**	**27.4**	**233.1**
TOTAL CORE COSTS	**267.9**	**235.0**	**265.5**	**256.1**	**224.3**	**225.1**	**219.4**	**226.5**	**236.6**	**226.7**	**1880.2**

South Wales - core expenditure forecast

South Wales - Core costs funded through DUoS											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-0.5	1.1	1.0	0.9	1.1	1.0	1.2	1.1	1.1	1.3	8.7
General Network Reinforcement	3.6	3.6	2.3	2.3	2.8	7.4	5.8	5.1	1.7	1.2	28.6
Reinforcement for Low Carbon Technologies	0.0	1.4	0.3	0.3	0.5	1.0	1.5	2.1	2.6	3.0	11.3
TOTAL - Reinforcement of the Network	**3.1**	**6.1**	**3.6**	**3.5**	**4.4**	**9.4**	**8.5**	**8.3**	**5.4**	**5.5**	**48.6**
Asset Replacement	30.9	35.0	34.1	34.9	34.6	35.9	35.5	34.9	35.2	34.9	280.0
Diversions	3.0	8.3	17.4	17.2	8.8	8.7	3.5	3.5	3.6	3.7	66.4
Quality of Supply (reducing power cuts)	2.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	3.0
Improving service for remote ("worst served") customers	0.2	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	1.2	2.9	3.6	2.0	5.5	5.0	1.2	2.1	0.9	2.6	22.9
Protecting equipment from flooding risk	1.3	1.0	3.6	2.1	1.1	0.1	0.2	0.1	0.1	0.3	7.6
Enhancing site security, ESQCR and other legal requirements	3.3	1.3	1.4	1.3	1.3	1.3	1.3	1.2	1.2	1.2	10.2
Reducing oil and gas leaks from equipment	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Undergrounding in National Parks and AONBs	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.6
Other Network Investment	0.9	0.2	0.1	0.2	0.3	0.4	0.3	0.2	0.2	0.1	1.8
TOTAL - Non-Load Network Investment	**43.7**	**49.6**	**61.2**	**59.2**	**53.1**	**52.4**	**43.0**	**43.0**	**41.7**	**43.3**	**396.9**
Inspection, maintenance and routine tree cutting	12.6	9.9	10.2	10.1	10.0	9.9	9.8	9.8	9.7	9.6	79.1
Tree clearance to improve network resilience to severe weather	1.0	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	12.9
Responding to and repairing faults	11.6	11.6	12.3	12.1	11.9	11.7	11.5	11.3	11.2	11.1	93.1
Other network operating costs	**1.1**	1.1	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	9.0
TOTAL - Network Operating Costs	**26.3**	**24.3**	**25.4**	**25.0**	**24.6**	**24.3**	**24.0**	**23.8**	**23.6**	**23.4**	**194.1**
Engineering management	**18.8**	**18.5**	**18.8**	**18.9**	**18.4**	**18.6**	**18.3**	**18.4**	**18.3**	**18.2**	**147.9**
Corporate activities	**6.4**	**5.9**	**6.1**	**6.1**	**6.0**	**5.9**	**5.90**	**5.8**	**5.8**	**5.7**	**47.3**
Workforce renewal	**4.4**	**4.5**	**4.2**	**4.4**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**35.6**
Vehicles, IT, Property & Engineering Equipment	**17.0**	**15.0**	**15.5**	**16.6**	**14.60**	**17.0**	**14.9**	**14.3**	**13.9**	**13.5**	**120.3**
TOTAL CORE COSTS	**119.7**	**123.8**	**134.8**	**133.7**	**125.6**	**132.1**	**119.1**	**118.1**	**113.2**	**114.1**	**990.7**

South West - core expenditure forecast

South West - Core costs funded through DUoS											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-1.1	1.1	1.0	1.0	0.9	1.1	1.1	1.0	1.1	1.2	8.4
General Network Reinforcement	3.8	3.9	3.2	3.9	4.5	7.2	5.7	3.5	2.0	1.4	31.4
Reinforcement for Low Carbon Technologies	0.0	5.6	1.1	1.1	2.1	4.1	6.2	8.2	10.1	12.1	44.9
TOTAL - Reinforcement of the Network	**2.7**	**10.6**	**5.3**	**6.0**	**7.5**	**12.4**	**13.0**	**12.7**	**13.2**	**14.7**	**84.7**
Asset Replacement	44.9	53.4	54.2	53.8	53.6	53.1	53.4	53.3	52.9	52.5	426.8
Diversions	4.2	9.6	13.3	13.1	7.3	7.2	7.2	7.3	8.2	13.1	76.7
Quality of Supply (reducing power cuts)	2.8	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	3.0
Improving service for remote ("worst served") customers	0.1	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	2.2	2.9	3.7	1.6	4.8	5.0	1.6	2.6	1.1	2.9	23.3
Protecting equipment from flooding risk	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	1.1
Enhancing site security, ESQCR and other legal requirements	6.2	4.3	7.8	7.2	7.1	2.4	2.4	2.4	2.4	2.3	34.0
Reducing oil and gas leaks from equipment	1.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Undergrounding in National Parks and AONBs	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	3.2
Other Network Investment	0.2	0.5	0.2	0.5	0.7	0.8	0.6	0.3	0.3	0.2	3.6
TOTAL - Non-Load Network Investment	**63.0**	**71.9**	**80.5**	**78.0**	**75.3**	**69.8**	**66.5**	**67.5**	**65.7**	**71.8**	**575.1**
Inspection, maintenance and routine tree cutting	15.3	13.3	13.7	13.6	13.5	13.3	13.2	13.2	13.1	13.0	106.6
Tree clearance to improve network resilience to severe weather	1.2	2.3	2.3	2.3	2.3	2.3	2.2	2.2	2.2	2.2	18.0
Responding to and repairing faults	21.4	20.8	21.8	21.5	21.2	20.8	20.5	20.3	20.1	19.9	166.1
Other network operating costs	**1.7**	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	14.2
TOTAL - Network Operating Costs	**39.6**	**38.1**	**39.6**	**39.2**	**38.8**	**38.2**	**37.7**	**37.5**	**37.1**	**36.8**	**304.9**
Engineering management	**25.6**	**26.8**	**26.9**	**26.8**	**26.9**	**26.7**	**26.6**	**27.0**	**26.7**	**26.9**	**214.5**
Corporate activities	**10.1**	**9.5**	**9.7**	**9.7**	**9.6**	**9.5**	**9.4**	**9.4**	**9.3**	**9.2**	**75.8**
Workforce renewal	**6.4**	**5.9**	**5.7**	**5.8**	**5.9**	**5.9**	**5.9**	**5.9**	**5.9**	**5.9**	**46.9**
Vehicles, IT, Property & Engineering Equipment	**26.0**	**25.2**	**28.0**	**28.6**	**24.1**	**26.4**	**24.0**	**23.4**	**24.0**	**23.4**	**201.9**
TOTAL CORE COSTS	**173.4**	**188.0**	**195.7**	**194.1**	**188.1**	**188.9**	**183.1**	**183.4**	**181.9**	**188.7**	**1503.8**

Load related investment

3 Background to our 'Best View' forecast

3.1 The UK is committed to reducing its carbon dioxide emissions by at least 80% by 2050, relative to 1990 levels. This commitment will be met through the decarbonisation of heating and transport, improvements in energy efficiency and producing electricity from renewable sources. The Government has set out its approach to energy and climate change in its document "The Carbon Plan: Delivering our Low Carbon Future", published in December 2011. This sets out potential pathways (scenarios) to put the UK on track to halve greenhouse gas emissions, on 1990 levels, by the mid-2020s and a path towards an 80% reduction by 2050. The impact of this on our networks is significant.

3.2 Historically, the main driver of load related investment has been the general economic conditions, as there was a correlation between GDP growth and load growth. In more recent times, this correlation has become weak. The main remaining effect of general economic condition is the effect on the number of new connections to the networks.

3.3 More significant drivers of future load related investment will be:

- the impact of customers installing electric heating (mainly heat pumps), photovoltaic (PV) small scale embedded generation (SSEG) and purchasing electric cars or 'plug in' hybrid cars that will need access to a charging facility;
- continuing growth in larger scale generation (generally solar, wind, waste incineration and the potential for Combined Heat and Power (CHP)).

General economic conditions

3.4 The current economic conditions create uncertainty in relation to future investment. The impact of this uncertainty affects underlying growth in electricity usage, and particularly affects the number of new connections we can expect. It is also likely to impact on the willingness of customers to invest in low carbon technologies as lower economic activity is likely to delay capital investments by customers and also to delay any significant increase in the differential between energy from low carbon sources and carbon derived energy. The current UK fiscal position also makes the introduction of any significant new subsidies to encourage low carbon technologies unlikely in the early part of the RIIO-ED1 forecast.

3.5 In our RIIO-ED1 planning we have reviewed forecast data available from the Ernst & Young ITEM Club (EYIC), The National Institute for Economic and Social Research (NIESR) and also from HM Treasury. From this range of economic indicators we have derived our own set of forecast indicators that we have used within the Business Plan.

3.6 The key economic indicators used to derive our plans are as follows:

Key economic indicators					
		2013	2014	2015	2016 – 2023
GDP growth		0.0%	1.7%	2.5%	2.5%
CPI		1.6%	2.0%	2.0%	2.0%
RPI		2.6%	2.5%	2.5%	2.8%

New connections

3.7 A key driver of electricity demand growth is new connection activity for housing and commercial developments. Data collated by Oxford Economics shows that there will be progressive growth in the volume of connections.

3.8 The new connections activity is within a competitive environment where customers can choose a connections service. WPD has always offered a new connections service, but there are now other providers of this service. Overall we expect that by 2023 we will have lost further new connections activity in the South West and South Wales and we will have regained some market share in the West Midlands and East Midlands.

Impact of low carbon technologies (LCTs)

3.9 Our best view scenario for the impact of LCTs, such as heat pumps, electric vehicles and domestic level PV, on our business is based on the results of work we have undertaken with the Centre for Sustainable Energy (CSE) in Bristol.

3.10 Our best view scenario represents a significant change in the usage of the network by LCTs and our plan incorporates the requirement to allocate resources to deliver as this change occurs.

3.11 The network impact of all scenarios is heavily influenced by the location that low carbon technologies and generation connect to the network. In particular the degree of clustering of heat pumps, electric vehicle charging and small scale embedded generators (SSEG) on the LV network has a significant impact on the investment needed. To date, the only technology that has been installed in significant numbers is SSEGs (almost entirely domestic photovoltaic). The work we have undertaken with the CSE gives a highly detailed view (at individual house level) of where there is likely to be a take up of these different technologies. We have analysed their respective distribution to give a view of clustering for each technology.

3.12 The output from the CSE work has also been used to assess the number of HV/LV substations that are likely to experience loading problems during the RIIO-ED1 period.

3.13 The Department for Energy and Climate Change (DECC) has, via the Smart Grid Forum (SGF) 'workstream 1' created scenarios for heat pumps, electric vehicles and PV that are consistent with the Government's Carbon Plan. A further group of the SGF, 'work stream 3', has produced both national and regional models (the Transform model) to show the impact of these energy scenarios on the GB distribution network.

3.14 The output from these models has been used to understand the range of potential outcomes which has helped to shape the required uncertainty mechanism during RIIO-ED1.

Demand side management and energy efficiency

3.15 Information within the Carbon Plan indicates electrical energy efficiency improvements in buildings of between 7% and 13% by 2020 due to improvement in the electrical efficiency of lighting and appliances. Some further reductions in electricity usage in homes are likely from 2020 following the completion of the smart meter rollout. This will provide better information to homeowners allowing them to better control their own usage of electricity in line with the introduction of more 'Time Of Use' tariffs by suppliers.

3.16 Demand side management (DSM) will be delivered by a combination of the introduction of Time of Use tariffs by suppliers and additional initiatives that will require more direct control of certain types of equipment in customers' premises.

3.17 Our expectation is that uptake of DSM by domestic customers and small and medium enterprises will be slow.

3.18 It is more likely that active DSM on the distribution network will be delivered by larger industrial businesses and generators who are already offering Short Term Operating Reserve (STOR) (needed to help balance demand and generation minute by minute) to National Grid. The Supplementary Annex (SA-03) Innovation highlights the work being undertaken in our FALCON low carbon networks fund project to facilitate DSR at this level.

Distributed generation (DG)

3.19 We continue to see a significant number of enquiries for large scale (5 to 10MW) PV particularly in Devon/Cornwall. Discussions with the main developers indicate a high likelihood of installations totalling 0.5 to 2GW in Devon and Cornwall provided that the current levels of Renewable Obligations Certificate (ROC) subsidies continue. These enquiries are starting to move further north into our South Wales and Midlands areas.

3.20 Plans for new onshore wind farms are expected to continue where significant wind resources are available – this in mainly in mid/south Wales and Lincolnshire.

3.21 Increasingly, urban local authorities are requiring CHP to be an integral part of any significant redevelopment. For example, Birmingham City Council's draft core strategy to 2026 requires large residential developments of more than 50 properties and non-residential developments over 1,000 sq. m. to include CHP or connection to an existing CHP facility. This results in issues associated with the 'fault level' capability of our network and is a key driver for our Low Carbon Network Fund project 'FlexDGrid', which we are undertaking to develop ways to manage such fault level issues. This is described in more detail in the Supplementary Annex (SA-03) Innovation.

3.22 National Grid is currently contracting for significant quantities of STOR each year from generators. We are seeing a significant number of applications for connection of generators in the 10MW to 30MW range to fulfil these contracts. We expect that these will form the majority of fossil fuel generation connected to our networks.

European Network Codes

3.23 The European Union's third legislative package for the internal energy market calls for the European network of transmission system operators for electricity to undertake drafting of network codes. These codes cover the requirements for generators, demand connections, operational security and operational planning and scheduling. As the objective of these codes is focused on cross border trading, the majority of provisions do not directly impact UK DNOs; however there are some provisions which will affect how we deal with the connection of generators, some protection arrangements and a significant increase in the data that will need to be produced and shared with National Grid as the Transmission System Operator. These requirements are likely to increase the resources needed in both network design and control activities.

Description of the CSE work 'On our wires'

Purpose of the work

3.24 The purpose of the work was to develop a better picture of the people and organisations connected to the Western Power Distribution (WPD) network to help forecasting demand (and associated business planning) particularly in terms of the likelihood of the uptake of low carbon technologies.

3.25 The work used statistical modelling and Graphical Information System (GIS) analysis techniques combining a range of existing high resolution, geo-spatially disaggregated socio-economic and property-related data-sets together with WPD network location data.

3.26 Modelling work has been undertaken by CSE using their Housing Assessment Model which is a sophisticated model of the housing stock at individual property level. This uses data about housing type, tenure and socio-demographic group to model which households are more likely to take up technologies and what the capacity would be. The technologies included are PV, ground source heat pumps, air source heat pumps, and direct electric heating.

Modelled new heat related demand

3.27 The heat demand for a property is calculated in the CSE Housing Assessment Model using data on:

- the size of the property in terms of number of bedrooms;
- built form (e.g. detached house, flat);
- wall type (solid or cavity - derived from the property age).

3.28 It also uses data from the English House Condition Survey and calculations based on the Building Research Establishment's Standard Assessment Procedure (or SAP, a way of measuring the energy cost of heating a dwelling). It calculates a heat transfer coefficient for each property and this is used with an internal target temperature of 21°C, an external sub-zero temperature of -5°C and the total net gains in the dwelling (taking into account solar and internal gains for that time of year) to calculate a peak heat demand for these circumstances.

3.29 To receive a heat pump in the modelling, properties had to be capable of improvement to a SAP D (SAP ratings go from A, which is the most efficient level met by only a handful of properties, to G being the most inefficient). Where properties would meet this level with improvement measures (wall and loft insulation), the peak demand figure used is the demand after the improvements.

3.30 A significant level of detail has been included in the analysis to show what the impact will be at distribution substation level.

3.31 More details of this work can be seen in the Centre for Sustainable Energy report. This may be found http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Supporting-Expenditure-information/CSE-On-Our-Wires-Methodology-Report.aspx

4 Provision of connections

Introduction

4.1 Customers who require a new or increased (augmented) electricity supply need to obtain a new or larger connection to the network. This may require new assets that will be exclusively used by the customer (sole use assets) and may also require the capacity of the existing network to be increased (reinforcement).

4.2 When a customer requests a connection, WPD carries out the network design, calculates the associated costs and provides a connection quotation. Once the customer accepts the quotation, the work is organised and dates are agreed with the customer. All aspects of the process are subject to Ofgem Guaranteed Standards of Performance and WPD strives to achieve zero failures against these guarantees.

Connection categories

4.3 There are three main types of connections:

- demand;
- distributed generation (DG);
- unmetered.

4.4 Demand connections are provided for customers who consume electricity.

4.5 Distributed generation connections are provided where the predominant use of the connection is the export of electricity or where an existing connection has to be augmented to enable the export of electricity. This category does not include new demand connections that also have an element of generation export, e.g. a new property fitted with a PV installation is a demand connection not a DG connection.

4.6 Unmetered connections are provided to local authorities and developers for low power consumption equipment such as street lights and traffic lights.

Competition in connections

4.7 Historically, DNOs were the only organisations that could provide a connection but the opening up of the connections market to third party providers has led to increased competition in the provision of connections.

4.8 Over the last ten years there has been growth in the number of third party providers carrying out connections work, with customers now being able to choose from:

- Independent Connection Providers (ICPs) who construct the network and pass on ownership of that network to DNOs or IDNOs via Connection and Adoption Agreements;
- Independent Distribution Network Operators (IDNOs) who retain ownership and operation of the networks;
- DNOs.

4.9 Third party providers have the freedom to elect whether or not to accept connections work, but under the Electricity Act 1989, DNOs are obliged to provide a connection if asked to do so. This has resulted in competition for larger developments but negligible competitive activity for smaller schemes or one-off small value connections.

4.10 Third parties can only carry out work that is deemed to be contestable (open to competition).

4.11 Initially contestable work was limited to the construction of new assets within the boundaries of new developments, but the scope of work that is contestable has grown progressively, with third party providers now being able to make the final live connections to the existing WPD overhead and underground network at LV. WPD will endeavour to continue to extend the scope of the contestable work, co-operating with third parties and developing processes. This will include allowing third parties to carry out reinforcement of the network which to date has predominantly been an activity carried out by DNOs.

4.12 More detail of the expansion of the scope of contestable work and the movement in market share between WPD and third parties is detailed below.

Expenditure overview

4.13 The following provides a summary of the costs for each type of connection:

Connections expenditure (by connection type) - Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD total**
Demand connections	140.0	135.2	72.7	136.2	484.2
DG connections	38.8	29.6	33.6	45.5	147.4
Unmetered connections	13.3	6.8	2.8	5.9	28.8
Total connections expenditure	**192.1**	**171.6**	**109.1**	**187.5**	**660.4**

4.14 The cost for each category can be subdivided into sole use costs and costs for network reinforcement.

4.15 Sole use costs are treated as being outside the price control since they are fully funded by the customer requesting the connection.

4.16 Reinforcement costs are considered as part as the price control because a proportion of the costs are funded through DUoS. The part of reinforcement funded by connection customers is determined by comparing the capacity required specifically for the customer against the overall capacity provided by the reinforcement. This proportion is called the Cost Apportionment Factor (CAF) and the methods for calculating it are defined within Connections Charging Statements published by each DNO. The remainder of the costs for reinforcement are funded through DUoS.

4.17 This treatment of costs create three main cost categories:

- sole use costs;
- customer funded reinforcement;
- DUoS funded reinforcement.

4.18 The following tables show how the costs for demand connections and DG connections are split across these cost categories:

Demand connections expenditure - Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD total**
Sole use	114.7	110.3	61.5	124.5	411.0
Customer funded reinforcement	9.4	10.2	5.1	5.9	30.7
DUoS funded reinforcement	15.9	14.7	6.1	5.8	42.5
Total demand connections expenditure	**140.0**	**135.2**	**72.7**	**136.2**	**484.2**

DG connections expenditure - Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD total**
Sole use	35.7	25.5	29.0	40.9	131.1
Customer funded reinforcement	1.0	1.9	2.1	1.9	6.8
DUoS funded reinforcement	2.2	2.2	2.5	2.6	9.5
Total DG connections expenditure	**38.8**	**29.6**	**33.6**	**45.5**	**147.4**

4.19 The following table summarises the DUoS funded expenditure and illustrates that this equates to approximately 8% of total connection costs across WPD.

DUoS expenditure - Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD total**
Total DUoS funded expenditure	18.1	16.9	8.6	8.4	52.0
%age of total connections expenditure	9.4%	9.9%	7.9%	4.5%	7.9%

Future forecasts

4.20 The forecast of future expenditure has been carried out by assessing requirements within different market segments. For each market segment we have considered:

- the volumes of connections;
- the growth in work that is contestable;
- the proportion of projects delivered by third party providers;
- the proportion of projects that require reinforcement;
- the impact of third party providers carrying out reinforcement work;
- the impact of LCTs on connection costs.

Market segments used in the forecast

4.21 Connections have been categorised into segments that are dependent on the voltage of the connection, the highest voltage being worked on, the size of the development and whether it is for demand, generation or an unmetered supply. The segments used are based upon regulatory reporting segments, which are more disaggregated than the market segments used for the regulatory Competition Test.

4.22 The segments used for demand connections align with regulatory reporting categories and are:

- LVSSA – Single domestic connections with no mains work at low voltage (LV);
- LVSSB – 2 to 4 domestic connections or one-off commercial connections at LV;
- LVAL - All other LV (with only LV work);
- LVHV - LV end connections involving high voltage (HV) work;
- HVHV - HV end connections involving only HV work;
- LVEHV - LV end connections involving extra high voltage (EHV) work;
- HVEHV - HV end connections involving EHV work;
- EHV - EHV end connections involving only EHV work;
- HV132 - HV or EHV connections involving 132kV work;
- 132 - 132kV end connections involving only 132kV work.

4.23 The total project costs for each demand segments are shown below, illustrating that the majority of expenditure is on LVSSA, LVAL, LVHV and HVHV connections.

Demand connections expenditure in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
LVSSA	16.1	16.3	12.7	23.5	68.6
LVSSB	4.5	5.2	1.6	2.0	13.3
LVAL	28.4	31.1	11.9	19.0	90.4
LVHV	42.3	47.6	28.5	57.5	175.9
HVHV	37.8	26.7	9.7	26.0	100.2
LVEHV	-	-	-	-	-
HVEHV	5.4	5.4	5.4	5.4	21.7
EHV	1.9	1.9	1.9	1.9	7.5
HV132	2.5	-	-	-	2.5
132kV	1.0	1.0	1.0	1.0	4.1
TOTAL	**140.0**	**135.2**	**72.7**	**136.2**	**484.2**

4.24 The segments used for DG connections are based on regulatory reporting requirements, but the category for HV work has been subdivided further to assess LV DG connections with HV work separately to HV DG connections with HV work. The full list of categories used for DG connections is:

- DGLV – DG connections involving LV work only;
- DGLVHV – DG connections at LV requiring work at HV;
- DGHV – DG connections at HV requiring HV work only;
- DGEHV – DG connections requiring EHV work;
- DG132 – DG connections requiring 132kV work.

4.25 The total project costs for each DG segment are shown below, illustrating that the majority of expenditure is on HV and EHV connections.

DG connections expenditure in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DG LV	1.7	1.2	0.8	0.5	4.2
DG LVHV	2.2	2.1	0.3	5.3	9.9
DG HV	21.6	12.3	16.6	19.3	69.9
DG EHV	12.3	11.7	11.7	13.7	49.4
DG 132	1.1	2.2	4.1	6.7	14.0
TOTAL	**38.8**	**29.6**	**33.6**	**45.5**	**147.4**

4.26 The segments used for unmetered connections are

- UMLA – ummetered local authority;
- PFI – unmetered connections for private finance initiatives;
- OUMC – other unmetered connections.

4.27 The total project costs for each unmetered segments are shown below, illustrating that the majority of expenditure is on unmetered local authority connections.

Unmetered connections expenditure in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
UMLA	10.0	4.4	2.3	3.2	20.0
PFI	-	-	-	-	-
OUMC	3.3	2.4	0.5	2.6	8.8
TOTAL	**13.3**	**6.8**	**2.8**	**5.9**	**28.8**

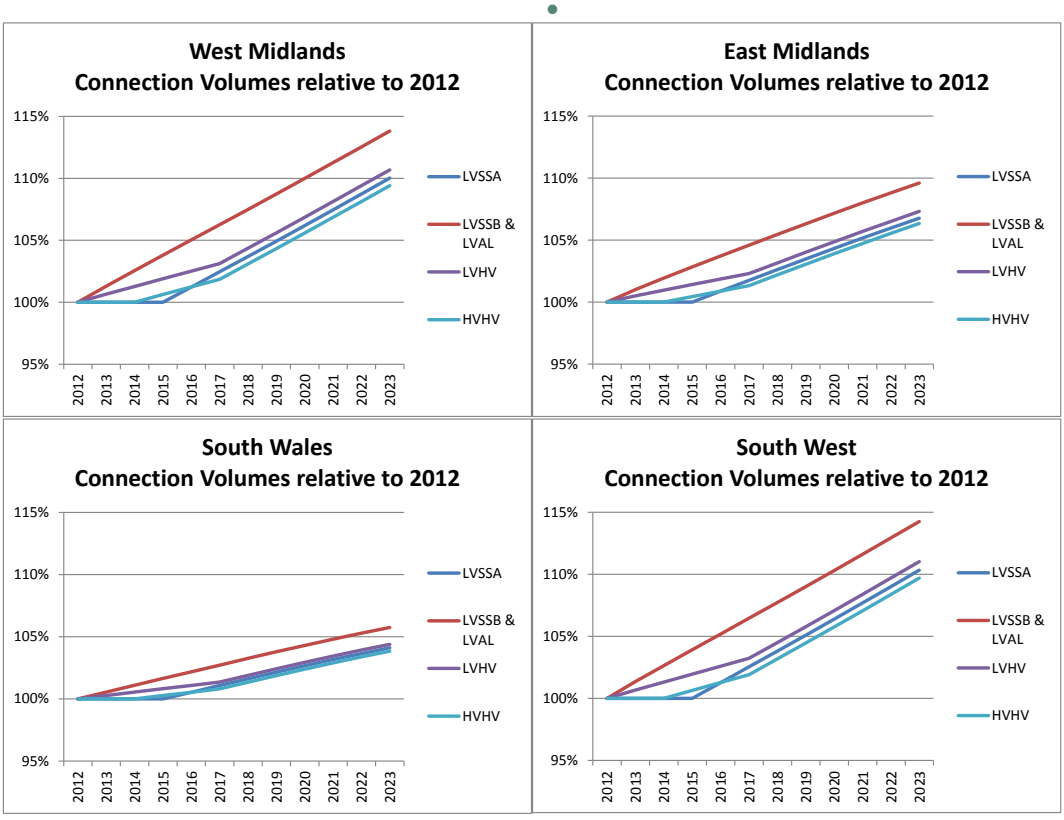
Future connections activity

Demand connections

4.28 The volume of connections varies each year and is dependent upon various factors including economic strength, attitude of developers and government incentives. Data collected by Oxford Economics on housing stock projections by local authorities has been used to determine the annual percentage change in housing stock. This change has then been applied in varying degrees to different segments.

4.29 The following charts show the market volumes relative to 2012 for segments involving LV and HV work. These growths are based upon the following assumptions:

- The most buoyant market is for small to medium sized housing developments which do not required any HV work. The housing stock projections have been applied in full to the LVAL and LVSSB segments;
- One-off plot volumes (LVSSA) will remain constant until 2015 at which point small developers will feel more confident about market conditions and volumes will grow in line with housing stock projections;
- Large domestic developments where work is required at HV (LVHV) will grow, but at half the rate of housing stock projections until 2017, with growth after this point being in line with projections;
- Commercial and industrial connections at HV requiring HV work (HVHV) will be constant until 2014, then grow at half the rate of housing stock projections until 2017, after which the full rate applies.



4.30 Connection volume growth across the four licence areas will differ, with growth being highest in the West Midlands and the South West (approximately 15% increase in LVAL volumes in 2023 compared to 2012) and lowest in South Wales at 6%.

4.31 Demand connection volumes will be very low on EHV and 132kV networks and the following assumptions have been used for the entire RIIO-ED1 period:

- LVEHV - no volumes are forecast in this segment.
- HVEHV - four projects in each licence area; two requiring reinforcement.
- EHV – two projects every six years; one without reinforcement and one with reinforcement.
- HV132 - a project every six years without reinforcement in West Midlands only.
- 132 - one project in each licence area across the period that will not require reinforcement.

4.32 The table below shows the total forecast volume of demand connection projects across RIIO-ED1:

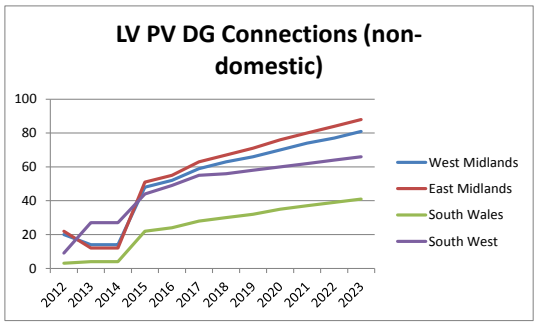
Forecast number of demand connections projects in RIIO-ED1					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
LVSSA	19,434	18,662	13,394	30,191	81,681
LVSSB	2,522	2,566	849	1,339	7,276
LVAL	4,507	4,773	2,074	4,010	15,364
LVHV	1,858	1,573	1,931	3,357	8,719
HVHV	648	613	188	421	1,870
LVEHV	-	-	-	-	-
HVEHV	4	4	4	4	16
EHV	3	3	3	3	12
HV132	1	-	-	-	1
132kV	1	1	1	1	4
TOTAL	**28,978**	**28,195**	**18,444**	**39,326**	**114,943**

Distributed generation connections

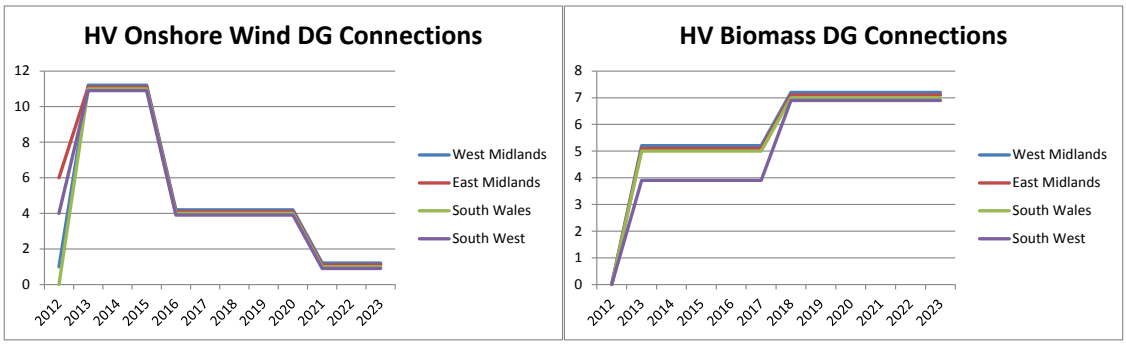
4.33 DECC scenario projections show a high take up of domestic PV installations. These will be installed on a 'fit and report' basis and it is assumed that none will require a new DG connection.

4.34 The collective effect of connecting them could give rise to the need for network reinforcement or installation of voltage regulation equipment and the costs for this are captured within general network reinforcement expenditure.

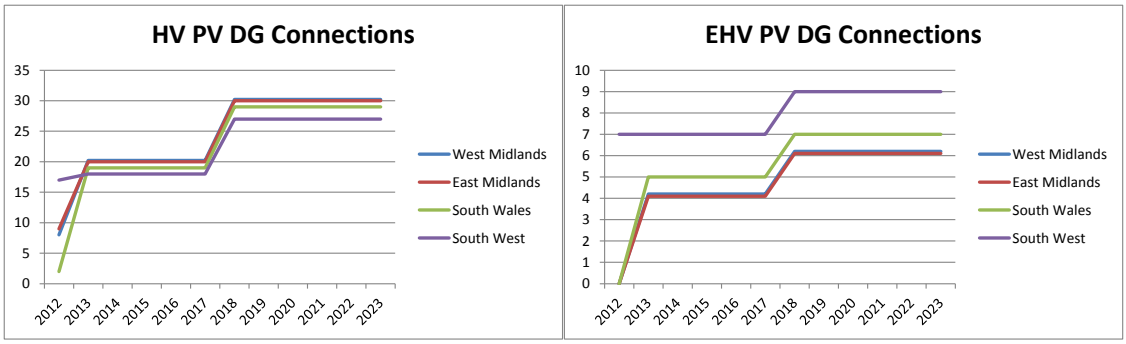
4.35 LV DG connection volumes are derived from forecasts of non-domestic PV installations assuming that 10% require a new or augmented connection.



4.36 HV DG connection volumes are derived from forecasts for onshore wind, biomass and large scale PV generation. The opportunities for onshore wind are becoming limited and we predict that volumes will fall. We expect that there will be a steady stream of connection projects for biomass fuelled generators. The following charts illustrate the forecast volume of HV DG connection projects for onshore wind and biomass generation.



4.37 Across the South West and increasingly across the rest of the areas, developers are installing large scale PV arrays on fields. Support mechanisms are making these installations very profitable for farmers who would otherwise use the land for alternative purposes. Many of the PV arrays require a connection to the HV network, whilst some of the largest installations are connected directly onto the 33kV network (particularly in South West and South Wales).



4.38 There are a very small volume of DG connection projects at 132kV. The highest forecast is for 6 connections to be made to the South West network across the RIIO-ED1 period.

4.39 The table below shows the forecast volume of DG connection projects in RIIO-ED1:

Forecast number of DG connections projects in RIIO-ED1					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DG LV	346	410	240	103	1,099
DG LVHV	196	175	26	369	766
DG HV	295	295	287	271	1,148
DG EHV	44	52	52	68	216
DG 132	1	2	4	6	13
TOTAL	**882**	**934**	**609**	**817**	**3,242**

Expansion of scope of contestable work

4.40 Work that can be carried out by a third party is described as being contestable.

4.41 The forecasts assume that at LV the majority of work on overhead lines and cables is contestable. The only exception is work in existing substations such as the provision of an additional feeder way. Substation work is infrequent and therefore it has been assumed that LV work is 100% contestable.

4.42 Processes have been developed to allow trials to extend contestable work on HV networks. The current trials allow jointing and associated operational activity by suitable accredited third parties with interaction with WPD's operational control and operational technicians. It is anticipated that these works will become contestable before 2014. It has been assumed that the scope of contestable work will grow to include overhead line connections and construction work within existing substations by 2018.

4.43 The operation of the EHV and 132kV networks is subject to more complex arrangements and access to the network depends on outage availability. It has been assumed that third parties will be able to build new assets 'off line' but final connections to the network will be carried out by WPD.

Market share lost to third parties

4.44 Third parties are most active in the LVAL, LVHV and HVHV segments providing connections for medium to large domestic estates and commercial/industrial developments. Many third party providers are based in the Midlands area and consequently this is where there is the most competitive activity. It is anticipated that third parties will expand into the Newport and Cardiff areas in South Wales and Bristol, Bath and Somerset in South West.

4.45 It has been assumed that third party providers will continue to increase or retain their market share in the segments where they are active. The exceptions to this are for LVHV and HVHV demand projects in the West Midlands and East Midlands where it is forecast that WPD will recover market share as a consequence of more competitive, lower connection costs arising from efficiencies introduced following WPD's takeover.

4.46 Market share changes for demand connection projects carried out by third party providers at 2012 and projected to 2023 are shown below. For all other market segments we have assumed no change to market share.

Proportion of demand connection projects carried out by third parties (RIIO-ED1)				
Segment	**West Midlands**	**East Midlands**	**South Wales**	**South West**
LVAL	Increase from 11% to 13%	Increase from 13% to 15%	Increase from 1% to 2%	Increase from 1.5% to 6%
LVHV	Held at 15%	Reduction from 25% to 20%	Increase from 1% to 10%	Increase from 1% to 12%
HVHV	Reduction from 55% to 40%	Reduction from 47% to 40%	Increase From 5% to 18%	Held at 30%

4.47 Third parties providers have been very active in the DG connections market for connections involving HV or EHV work and our forecasts suggest that their market share will continue to increase. The proportions carried out by third parties at 2012 and projected to 2023 are shown below:

Proportion of DG connection market share carried out by third parties (RIIO-ED1)				
Segment	**West Midlands**	**East Midlands**	**South Wales**	**South West**
DGLV	No change Remains at 0%	No change Remains at 0%	No change Remains at 0%	No change Remains at 0%
DGLVHV	Increase from 0% to 5%	Increase from 2% to 7%	Increase from 0% to 5%	Increase from 0% to 5%
DGHV	Increase from 20% to 30%	Increase from 25% to 30%	Increase from 21% to 30%	Increase from 18% to 30%
DGEHV	Increase from 20% to 75%	Increase from 42% to 75%	Increase from 33% to 75%	Increase from 46% to 75%
DG132	Assumed flat at 25%	Assumed flat at 25%	Assumed flat at 25%	Assumed flat at 25%

4.48 The impact of these changes means that third parties providers will carry out more sole use work. The RIIO-ED1 expenditure forecasts exclude those costs that are expected to migrate to third party providers because they will become direct transactions between customers and third party providers.

4.49 The value of expenditure that is assumed to migrate to third party providers in the future is summarised in the table below. This is equivalent to 4.4% of the demand and DG connection sole use expenditure that will remain within WPD.

Sole use costs that will migrate to third party providers Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Demand connections	3.9	2.2	1.7	8.3	16.1
DG connections	4.2	0.8	1.2	1.5	7.7
Total sole use costs migrating to third parties	8.1	3.0	2.9	9.8	23.8

Connections requiring reinforcement

4.50 The majority of connection projects can be carried out as pure network extension work where all the new assets are specifically for the new connections (sole use). In some instances the existing network requires to be reinforced to provide the necessary upstream capacity.

4.51 The anticipated growth in demand based LCTs for vehicle charging and heat pumps will lead to less spare capacity on the LV network as more of these LCTs are connected, leading to a greater proportion of connections requiring reinforcement to enable connection. For demand connections this will mainly impact the LVAL and LVHV connection segments, with limited change in other segments. The table below illustrates the change for WPD provided demand connections.

Percentage of demand connection projects delivered by WPD requiring reinforcement (RIIO-ED1)				
Segment	**West Midlands**	**East Midlands**	**South Wales**	**South West**
LVAL	Increase from 7.0% to 9.5%	Increase from 7% to 9.5%	Increase from 1.9% to 4.4%	Increase from 4.3% to 6.8%
LVHV	Increase from 37% to 42%	Increase from 43% to 48%	Increase from 44% to 49%	Increase from 28% to 33%

Reinforcement work becomes contestable

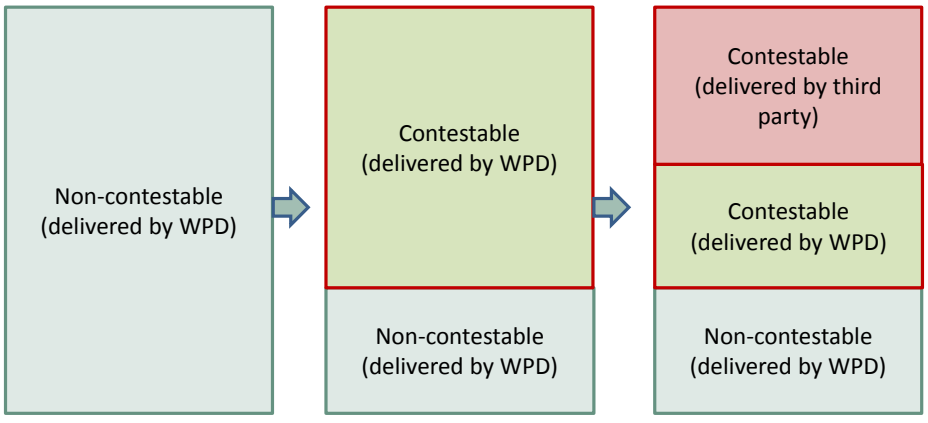
4.52 Network reinforcement accounts for approximately 14% of all connections expenditure.

Connection reinforcement expenditure - Total RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD total**
Customer funded reinforcement	10.4	12.0	7.2	7.9	37.5
DUoS funded reinforcement	18.1	16.9	8.6	8.4	52.0
Total connections reinforcement expenditure	28.5	29.0	15.8	16.2	89.5
%age of total connections expenditure	14.8%	16.9%	14.5%	8.7%	13.6%

4.53 Whilst third parties have been permitted to carry out sole use work to extend the network for new connections, DNOs have generally carried out network reinforcement activity. This situation will change as elements of reinforcement work become contestable and third parties start to carry out reinforcement work.

4.54 The following diagram illustrates this evolution where:

- currently all reinforcement work is non-contestable;
- at some point in the future (which we have assumed ranges from 2014 to 2016 for different market segments) a proportion of the work will become defined as contestable but WPD will still carry out this work whilst third party providers go through an authorisation process;
- at 'future 2' third parties will progressively start to deliver some of the contestable reinforcement, once they have received approval to carry out the work and financial mechanisms have been developed. We have assumed that this occurs the following year after reinforcement is declared as being contestable.

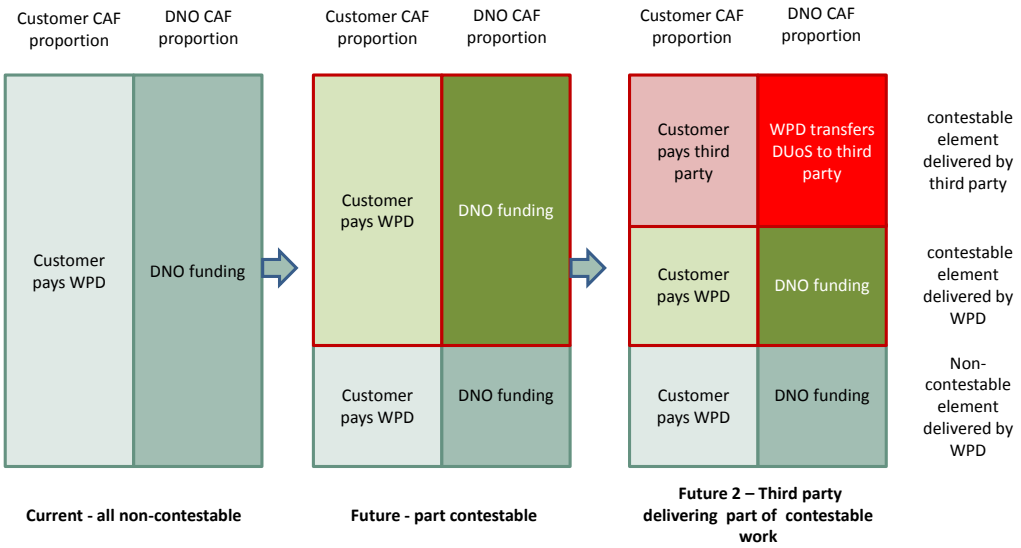


4.55 Where customers only utilise part of the capacity provided by reinforcement, they fund a proportion of the costs determined by the Cost Apportionment Factors (CAF) defined within Connection Charging Statements. For example if a customer uses half the capacity they will contribute 50% to the cost of the reinforcement. The remainder of the reinforcement will be funded by WPD from DUoS allowances. The move to allowing third parties to carry out reinforcement work will lead to changes in how the reinforcement is funded.

4.56 Currently reinforcement of the network is carried out by WPD and the customer pays WPD for their CAF proportion of the costs. Once this changes so that part of reinforcement work is defined as contestable (but remains delivered by WPD), the customer will still pay WPD for their CAF proportion of the costs but there will be two classifications of cost (contestable and non-contestable).

4.57 When third parties start to carry out some of the contestable reinforcement (at future 2), the payments will become more complex as illustrated in the following bullet points and diagram.

- the customer will pay WPD their CAF proportion of any non-contestable work;
- WPD will fund the remainder of non-contestable work;
- the customer will pay WPD their CAF proportion of contestable work delivered by WPD;
- WPD will fund the remainder of contestable work delivered by WPD;
- the customer will pay the third party their CAF proportion of contestable work delivered by the third party;
- WPD will pay the third party (transferring DUoS) for the remainder of the costs of contestable work delivered by the third party.



4.58 The detailed calculations used for the connection forecasts assume a proportion of costs become contestable and that third parties deliver some of the reinforcement work. Relative to the current situation where all costs are non-contestable, this means that the contributions from customers for reinforcement will reduce (because some of the payments will go directly to the third parties who are executing the works), but the DUoS requirement will be the same (albeit that some of it will be transferred to the third party).

4.59 The expenditure forecasts in the Business Plan include these costs, as it is uncertain when the industry will reach agreement on how to implement the changes to allow third parties to carry out reinforcement.

4.60 The potential impact, should the change arise has been forecast and is shown in the table below:

Potential impact of third parties carrying out reinforcement for connections in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Customers make payments to third parties instead of DNOs	0.7	0.4	0.2	0.1	1.5
Transfer of DUoS from WPD to third parties	1.5	0.7	0.6	0.1	2.9
Total potential impact	**2.2**	**1.1**	**0.8**	**0.3**	**4.4**
%age of total reinforcement costs	8%	4%	5%	2%	5%

Impact of low carbon technology on connection costs

4.61 As customers adopt more LCTs and this becomes an integral part of new connections (e.g. vehicle charging points in new properties) the assets used for new connections will need to be of a larger capacity, with associated higher costs. This will impact all demand segments where the end connection is at LV.

Overlap with forecasts for general reinforcement

4.62 There is no overlap with the forecasts for general reinforcement. The forecast for general reinforcement use the output from a model that assumes that future networks will be built with sufficient capacity to cater for connection of low carbon technology. The model does not include any allowance for increased costs of new connections in its results.

Unmetered connections

4.63 Volumes of unmetered connections in the West Midlands and East Midlands are forecast to remain steady over the RIIO-ED1 period since third party activity is established and not forecast to change.

4.64 Volumes in South Wales are forecast to increase as a result of some local authorities currently using third parties reverting back to WPD, attracted by lower connection prices. It is assumed that volumes will grow by 5% per annum between 2012/13 and 2015/16 and then remain at the higher levels during RIIO-ED1.

4.65 Volumes in the South West are forecast to fall as business is lost to third parties. It is assumed that volumes will reduce by 5% per annum from 2012/13 until the middle of RIIO-ED1.

4.66 The volumes of connections forecast to be delivered by WPD in each market segment are shown in the table below:

Volumes of unmetered connections (RIIO-ED1)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
UMLA	11,044	4,864	2,537	3,570	22,015
PFI	-	-	-	-	-
OUMC	3,601	2,641	567	2,871	9,680
TOTAL	**14,645**	**7,505**	**3,104**	**6,441**	**31,695**

5 General reinforcement

5.1 General reinforcement is an area of activity that enables WPD to provide adequate capacity in the network to meet load demands and ensure that the voltage of the network remains within statutory limits.

Objective

5.2 The provision of network capacity is defined in two main documents:

- Electricity Networks Association Engineering Recommendation for Security of Supply P2/6 specifies the expected capability of the network to meet demands under defined outage conditions.
- The Electricity Supply Quality and Continuity Regulations (ESQCR) define voltage limits.

5.3 The fundamental planning principles used by WPD for the development of the network seek to comply with these expectations and meet the future needs of customers. Load forecasting techniques are used to predict future demands and voltage regulation is examined by considering the impact of loads and connected generation.

5.4 Where forecasts suggest that networks will become overloaded, actions will be taken to ensure that the networks remain compliant with P2/6 and meet the voltage limits of the ESQCR.

Changing operating context

5.5 For many years the function of electricity networks has remained unchanged, acting as a one-way conduit to transport electrical energy from central generation to homes and businesses. Load growth has been reasonably predictable; steadily increasing as more electrical goods have been used and easing back during times of recession. The provision of additional capacity has been achieved through installing larger or additional transformers, lines and cables.

5.6 Concerns about global climate change have led to unprecedented levels of interest in energy. To address this issue the Government has agreed to a reduction in greenhouse gas emissions and introduced incentives and obligations to create a lower carbon future. Decarbonisation of travel, heating and energy production is anticipated to have a significant impact on distribution networks, resulting in a recognition that distribution networks will need to change over time to accommodate electric vehicle charging, growth in electricity based heating and an upsurge in distributed generation.

5.7 Scenario modelling suggests that there could be significant load growth and/or voltage regulation issues requiring extensive network reinforcement on a scale that would lead to large increases in costs to customers. The obligation to provide an economic solution for customers means that ‘smarter’, lower cost alternatives to traditional reinforcement need to be developed and adopted.

5.8 During RIIO-ED1 the changes to energy usage will be progressive and therefore ‘smart’ solutions will be used in an incremental way, being considered when local circumstances indicate they are appropriate. These smart alternatives may include commercial arrangements for demand side management (DSM) (where customers will be incentivised financially to change their electricity usage), demand side response (DSR) (where customers are incentivised to reduce demand at short notice in response to issues on the network) or technical solutions such as active network management, electrical energy storage or one of the many other smart technical solutions being developed. Details of the activities and plans for these are included in the Supplementary Annex (SA-03) Innovation.

5.9 Specific solutions will continue to be managed in response to the local driver by accommodating it in the most appropriate manner, balancing economic, technical and operational considerations.

Traditional reinforcement

5.10 The capacity of a network is limited by the rating of equipment and the number of circuits available to carry load current. Where load growth leads to capacity being used up the traditional approach to providing more headroom has been to replace those assets with higher rated equivalents or to provide additional circuits or transformers. Whilst these solutions will continue to be used, the use of smart interventions will grow as the techniques and systems for their use are established.

Smarter interventions

5.11 Funding obtained through Ofgem's Low Carbon Network Fund has accelerated innovation on distribution networks. The development of advanced network techniques such as dynamic rating of equipment, automatic network meshing and active voltage control means that there are alternative ways of providing additional capacity headroom. The introduction of commercial arrangements for demand side management provides a mechanism to influence users to change their loads at time of high demands. These are all considered as smart interventions.

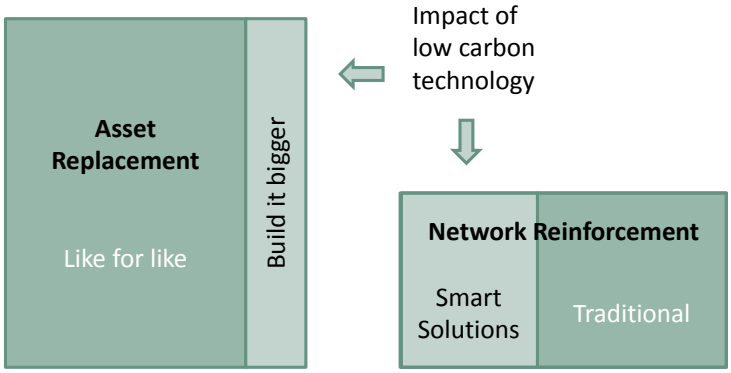
5.12 There will be an increase in demand caused by the volumes of LCT required to meet greenhouse gas reduction targets. Modelling techniques employed by WPD allow predictions to be made about the potential impact but the speed, location and scale of adoption remains uncertain.

5.13 Since there is uncertainty about the volume and location of LCT, it is prudent to develop smarter networks incrementally, progressively improving them as more is learnt about their operation, their benefits and any practical difficulties. WPD will use network monitoring to identify where deployment of smarter solutions is appropriate.

5.14 This approach is supported by stakeholders who believe that the networks should be developed to make better use of the system capacity using smart technology and telecommunication with new solutions being applied incrementally to benefit from this progressive learning.

5.15 Stakeholders also suggest that when replacing assets we should consider future proofing and therefore there will be a proportion of the existing asset replacement programme (particularly where there is confidence about load growth) where 'bigger' assets are installed to take the opportunity to increase capacity whilst this work is being carried out anyway. This will predominantly apply to secondary networks.

5.16 The overall impact of increased loads from LCTs will result in some asset replacement being carried out with larger assets and applying smart solutions to provide capacity headroom without the need for network reinforcement as shown in the diagram:



Legacy network management

5.17 Historic planning approaches in the West Midlands and East Midlands allowed circuits and substations to exceed their firm capacity on more occasions and for longer periods of time. This placed the network at greater risk and meant that the amount of spare capacity to deal with outages was limited as the network was generally more heavily loaded.

5.18 WPD's approach to planning has a lower tolerance of loading that exceeds firm capacity. This is wholly consistent with business objectives to provide a reliable supply of electricity to customers.

5.19 When WPD acquired the licences of West Midlands and East Midlands it inherited a network that had a significant number of substations where demand exceeded firm capacity. These sites are being addressed progressively during DPCR5 and into RIIO-ED1. This means that at the end of DPCR5 there will still be sites that are heavily loaded. This will lead to higher levels of reinforcement in West Midlands and East Midlands (compared to South Wales and South West) whilst the legacy of pre-existing network deficiencies is addressed.

Load forecasts

5.20 WPD uses a range of load forecasting approaches to determine which parts of the network require reinforcement. These include:

- generic assessments considering economic conditions; housing forecasts, energy efficiency predictions and assumptions on the uptake of low carbon technology;
- site specific assessments considering local circumstances;
- the use of the representative network Transform model developed by EA technology for work stream 3 of the Smart Grids Forum.

5.21 These forecasts identify shortfalls in the network capacity and to remain compliant with the objectives above, the shortfalls are subsequently addressed through reinforcement or a smart intervention.

LCT related reinforcement

5.22 The Transform model uses generic load/generation profiles to build up a total system demand. This is able to forecast future system demand growth as a result of a number of factors. These include:

- new build connections;
- the uptake of LCTs (in both new build properties and retrofit to existing properties);
- the clustering of LCTs in a geographic location due to property suitability, socio-economic drivers or availability of natural resources;
- the changes in heating systems, and insulation levels;
- the energy savings associated with efficiency improvements in lighting/domestic appliances;
- the impacts of demand side management.

5.23 Further information about the model can be found in EA Technology's report 'Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks', published at http://www.ofgem.gov.uk/Networks/SGF/Publications/Pages/index.aspx.

5.24 The clustering of LCTs has been informed by the CSEs work, which shows that there will be high clustering which will have an impact on the network demand and reinforcement requirements.

5.25 The Transform model has been used to forecast system demand growth for each of WPD's regions for our Business Plan model, and for the four DECC scenarios through the RIIO-ED1 period. The assumptions we have used in the Transform model can be found in appendix A1. The table below shows the resultant WPD Best View scenario forecast for annual percentage growth in peak demand.

Best View Scenario	Annual Load Growth %									
	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
West Midlands	0.13%	0.14%	0.13%	0.13%	0.14%	0.31%	0.47%	0.98%	1.14%	1.28%
East Midlands	0.37%	0.37%	0.34%	0.39%	0.36%	0.57%	0.76%	1.38%	1.58%	1.73%
South Wales	0.04%	0.09%	0.07%	0.05%	0.05%	0.50%	0.75%	1.09%	1.20%	1.20%
South West	0.45%	0.46%	0.46%	0.46%	0.46%	0.77%	1.05%	1.65%	1.94%	2.14%

5.26 All areas show limited growth in the early years, followed by an accelerated growth starting around 2018/19. Energy efficiency initially offsets the growth due to new connections; however the forecast growth due to increasing LCTs becomes more dominant from 2018/19.

Real price effects

5.27 Different types of solutions in the Transform model have different real price effects or 'cost curves' setting how their price changes over time. Ofgem's guidance on the Transform model states that the model should be run with real price effects (RPEs) included, but that the RPEs associated with the conventional solutions cost curve (Type 1 – high aluminium, steel, or copper content) should then be stripped out of the model results. This allows the model to take price movements into account in the cost-benefit assessment of solutions, but present costs on a consistent price base.

Re-profiling of Transform results

5.28 The Transform model uses a small number of generic circuits to represent the thousands of unique circuits in a licence area. Therefore when a particular generic circuit reaches a headroom limit, it purchases the appropriate solution as many times as there are real circuits represented by that generic circuit. This results in unrealistically sporadic investment.

5.29 LCT related reinforcement will require more gradual investment as real circuits reach their headroom. To reflect this in WPD's 'best view' the output of the model has been re-profiled to mirror the forecast ramped uptake of LCTs.

Scaling of Transform results

5.30 It is WPD's view that it is appropriate to scale the resulting expenditure from the Transform model for the following reasons:

- there is significant uncertainty around the future uptake of LCTs, their clustering and hence the impact of LCTs upon distribution networks;
- clustering has a significant impact on the investment needed and whilst our forecasts are based on a detailed analysis of property types and demographic information, other factors such as subsidy or support mechanism designs may result in differing clustering patterns emerging;
- there will be some overlap with asset replacement of HV and LV assets which is difficult to forecast accurately;
- a scaling down of the forecast investment provides a strong incentive on WPD to further innovate and seek the lowest cost solution;
- it is appropriate to share the risk of these uncertainties between WPD and customers.

5.31 As a result, the output from the Transform model for LCT reinforcement in RIIO-ED1 has been scaled down by 30% to determine the expenditure requirement in our Business Plan.

LV and HV non-LCT general reinforcement

5.32 The existing DPCR5 levels of expenditure have been used as the trend for the underlying LV and HV general reinforcement expenditure in RIIO-ED1 and represent the ongoing levels of expenditure driven by local requirements. However, the savings from the use of smart solutions have been recognised within the Business Plan by applying a percentage reduction to these costs. These percentage savings are shown in the table below.

Generic Smart Solution Savings								
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
LV	0.0%	0.0%	2.0%	4.0%	5.0%	5.0%	5.0%	5.0%
HV	0.0%	0.0%	4.0%	8.0%	10.0%	10.0%	10.0%	10.0%

5.33 It is our view that a higher level of saving through the application of smart solutions will be gained at HV compared to LV. This is due in part to the aggregation of any LV demand management impacting the upstream HV networks and the development of the HV/LV substation real time rating solution.

5.34 The total expenditure across all four licence areas through the RIIO-ED1 period is approximately £3m per year for LV and approximately £8m per year for HV.

EHV/132kV general reinforcement

5.35 Existing peak electricity demands on our EHV network substations are surveyed each year to establish existing network demands. These are calculated by analysing demand data which is collected on a half hourly basis via our network data & control systems infrastructure. This data provides the 'actual' demand flows but it is then corrected to take account of a number of factors including:

- the impact of larger embedded generation (which offsets 'real' demand);
- abnormal network configurations (where we re-arrange the network for faults or planned outages);
- weather conditions (design standards are based on average weather conditions whereas the peak demand may occur in particularly hot or cold conditions dependent on the make-up of customer load).

5.36 The process above results in a tabulated data set for the normal demand level on each EHV and 132kV substations. Load growth is at each site is forecast by applying the regional demand growth consistent with the results from the Transform model (i.e. including energy efficiency, new connections, LCT uptakes) and is adjusted by known localised developments. These forecasts also form the data for Load Index forecasts.

5.37 The EHV and 132kV substation demand forecast data set is then analysed to identify specific EHV networks where available capacity is forecast to be exceeded. Specific reinforcement schemes are then developed to address these issues.

5.38 These EHV and 132kV schemes are phased through the RIIO- ED1 period to address the forecast system deficiency. This is generally on a 'just in time' basis although due to the significant nature of these schemes the expenditure may take place over a number of years, particularly where new consents for new circuits may be required.

5.39 These schemes have been developed utilising conventional reinforcement approaches. It is recognised that smart solutions will be developed through the RIIO-ED1 period and will become established and available for deployment at the EHV system level. This will lead to lower reinforcement costs towards the end of the period or the deferment of investment. It is not possible at this point in time to identify which individual schemes will benefit from and be appropriate for the deployment of a smart solution. However, this saving has been recognised

within the Business Plan by applying the reductions shown in the table below to EHV scheme costs:

Generic Smart Solution Savings								
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
EHV/132kV	0.0%	0.0%	5.0%	7.5%	10.0%	10.0%	10.0%	10.0%

Impact of demand side management (DSM)

5.40 We have used an assumption that there will be low uptake of DSM where the majority of DSM is supplier led. The model does however consider the purchase of DSM agreements as a smart solution option as an alternative to reinforcement and these have contributed to the generic smart solution savings applied to EHV reinforcement.

Scheme development

Scheme categorisation

5.41 Whilst demand growth is generally the main driver of load reinforcement schemes, there are a number of different possible drivers:

- Maximum demand and compliance with N-1 and N-2 outage requirements;
- Voltage levels exceeding statutory limits (high at minimum demand condition and low at maximum demand conditions);
- Step changes in voltage;
- Circuit thermal loadings (where cables and lines limit the demand that can be supplied);
- Fault levels exceeding equipment current carrying capability.

5.42 Where more than one driver applies, schemes are classified by the main driver. This avoids double counting of investment in more than one category.

5.43 Where RIIO-ED1 load reinforcement projects coincide with a condition based replacement projects, the driver has been assigned as being asset replacement.

Scheme design timing

5.44 Load forecasts provide an estimate of when substations will require intervention.

5.45 For the preparation of the RIIO-ED1 business plan this required forecasts for up to 10 years into the future.

5.46 As with any forecast, the actual speed and scale of growth may differ. This means that it is important to focus planning resource effort on those projects where there is greater certainty of need.

5.47 A full scheme design is not undertaken until ‘need’ for investment approaches the timeframe for construction. This is timed so that construction occurs before the risk increases significantly so that the network remains compliant with statutory and industry obligations.

5.48 The start of detailed design is therefore dependent upon the specific requirements of each site. A simple transformer replacement with no off-site or consent issues could be started 18 months before ‘need’. The time-scales are predominantly driven by the lead times for equipment delivery and the availability of outages on the network. A more complex construction of a new 132/33kV site with associated 132kV circuit works requiring external consents/consultation could be started up to four years before the need.

5.49 For projects in the longer-term, outline scopes are produced and annual reforecasting revises time-scales.

5.50 Since growth in demand is dependent upon external factors, there will be some churn of projects in the programme during RIIO-ED1. Some projects will be advanced, some will be delayed and new requirements will be identified. The expenditure forecasts in the plan represent the current best view and since churn includes both advancement and deferment the proposed programme is representative of the need even if the specific projects change.

Scheme design 'optioneering'

5.51 Reinforcement of the network has traditionally involved installing additional assets or larger assets. Whilst these solutions will continue to be used, the extensive innovation programme being carried out by WPD and learning from other DNOs is expected to yield a range of new cheaper smart alternatives. WPD will use the most appropriate and cost effective interventions to provide additional network capacity.

5.52 The initial project design analysis will consider a range of different options, some of which will be dismissed quickly due to the expense involved.

5.53 Typical options that would be considered are:

- permanent load transfers;
- reinforcement by installing additional assets;
- reinforcement by changing assets for higher capacity assets;
- reconfiguration of the network;
- installation of new substations (especially if the load centre has moved and existing network infrastructure is conveniently located);
- the amount of capacity headroom to be created (larger headroom may be considered if there is confidence that other interconnected sites may require reinforcement in the near future);
- use of dynamic line ratings with installation of associated monitoring equipment (where the limiting factor is the circuit);
- potential for demand side management (especially where there are large industrial customers who could manage load demands);
- joint schemes with other distribution network operators (e.g. where demand on one network can be offset by generation on another)
- joint schemes with National Grid (where work on DNO networks can help to reinforce grid supply points);
- multiple cost driver schemes to address other network constraints (such as poor condition assets).

5.54 Investment appraisal is used to determine the most cost efficient option, but this is then considered alongside practical constraints such as obtaining consents for new lines and sites and civil construction requirements.

5.55 When the site approaches need for construction, the selected options undergo a detailed build design that considers the construction requirements on site. Practical issues identified during this phase of design could lead to modifications to the high level option.

Expenditure forecast

5.56 Modelling suggests that the most cost effective means of dealing with future load growth is to have a combination of traditional reinforcement and smart solutions and our proposals for reinforcement expenditure in RIIO-ED1 consider both approaches. The table below shows expenditure by voltage.

General reinforcement expenditure in RIIO-ED1 by voltage (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
LV	49.1	78.3	11.5	36.4	175.4
HV	33.3	42.4	10.7	20.6	107.0
EHV	44.2	60.5	2.4	8.7	115.7
132kV	39.7	48.7	14.7	5.6	108.7
Total	**166.3**	**229.8**	**39.4**	**71.3**	**506.9**

5.57 The table below compares RIIO-ED1 expenditure against DPCR5 expenditure. The difference between the breakdown by voltage and overall expenditure is due to a small proportion of transmission exit charges that will be funded through an ex-ante allowance being included in the overall 8 year total for RIIO-ED1

General reinforcement expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	23.7	19.3	3.4	3.6	50.1
RIIO-ED1 Annual Average	21.0	28.8	4.9	8.9	63.7
RIIO-ED1 Total (8 years)	**168.2**	**230.6**	**39.4**	**71.3**	**509.5**

5.58 Annual EHV expenditure is shown in the table below. The WPD regions of West Midlands, East Midlands and South West show a reduction in average expenditure levels through the RIIO-ED1 period, while South Wales shows a small increase.

5.59 The requirement to establish a new 132/11kV substation site in the rapidly developing area of Milton Keynes is a significant scheme that dominates East Midlands EHV reinforcement in the first two years of the period.

EHV and 132kV General Reinforcement (£m)											
	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	**RIIO-ED1 Total**	RIIO-ED1 Ave	DPCR5 Ave
West Midlands	12.6	13.1	10.3	12.0	12.6	6.4	7.9	9.0	**83.9**	10.5	20.0
East Midlands	41.0	33.5	3.6	3.3	3.9	7.2	12.4	4.1	**109.2**	13.6	14.7
South Wales	0.8	0.9	1.4	5.9	4.4	3.6	0.0	0.0	**17.1**	2.1	1.9
South West	1.5	1.9	1.1	4.2	3.4	1.5	0.6	0.0	**14.3**	1.8	2.0
Total	**56.0**	**49.4**	**16.4**	**25.5**	**24.3**	**18.7**	**20.9**	**13.1**	**224.5**	**28.1**	**38.6**

Asset requirements

5.60 During RIIO-ED1 the following number of assets will be installed/reinforced as part of reinforcing the network:

	General reinforcement additional/reinforced assets			
	West Midlands	**East Midlands**	**South Wales**	**South West**
LV Cable/Line (km)	467	755	140	437
HV Cable/Line (km)	389	559	150	221
EHV Cable/Line (km)	309	241	31	2
132kV Cable/Line (km)	42	59	13	4
Pole Mounted Dist Tx	1,344	1,311	659	1,654
Ground Mounted Dist Tx	288	469	71	125
EHV Transformers	48	30	2	12
132kV Transformers	28	9	3	3

Network capacity and Load Indices

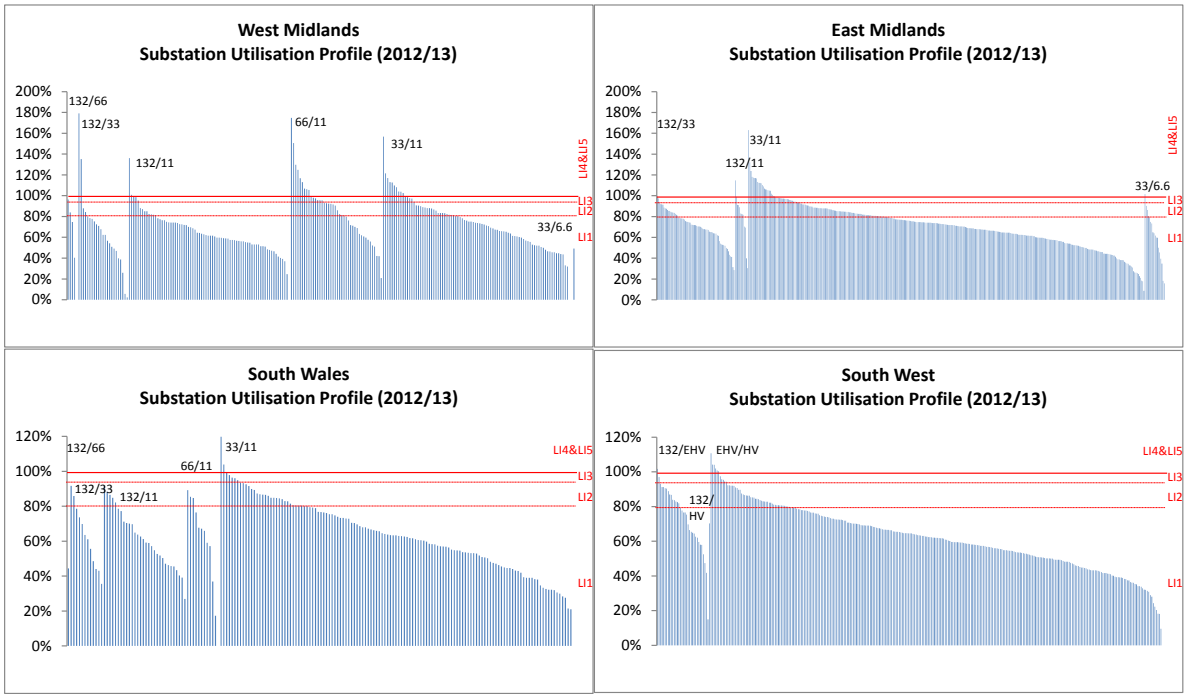
5.61 The capacity of the network is limited by the size (rating) and configuration of existing assets.

5.62 The utilisation of those assets is calculated by comparing the maximum demand to the firm capacity (load rating of the system assets remaining under the outage requirements of P2/6).

5.63 In DPCR5, Ofgem introduced utilisation measures called load indices (LIs) that categorise substations into defined bands of loading. The utilisation at each WPD substation has been used to derive a load index for each site using the common RIIO-ED1 load index bandings proposed by Ofgem (these are shown in the table below).

LI rank	Definition	Loading
LI1	Significant spare capacity	0-80%
LI2	Adequate spare capacity	80%-95%
LI3	Highly utilised	95%-99%
LI4	Fully utilised, mitigation requires consideration	100% for <9 hours per year
LI5	Fully utilised, mitigation required	100% for >9 hours per year

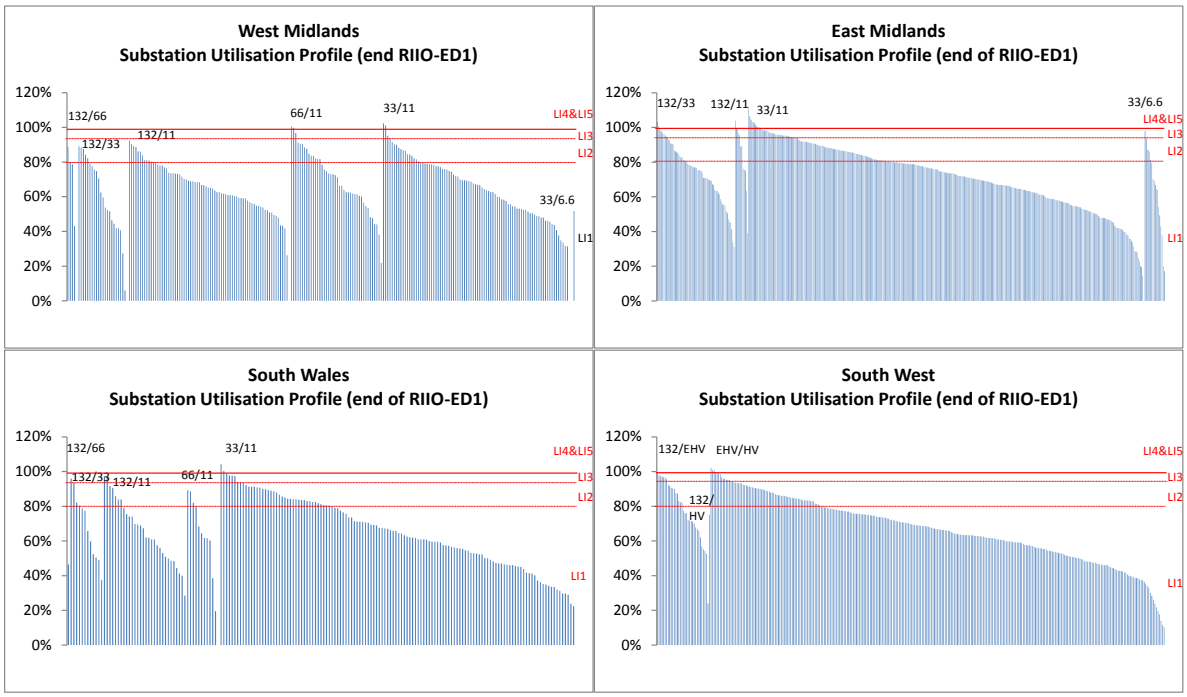
5.64 The following charts show the utilisation in 2012/13 for each substation (each column represents a substation). Note that there are a number of substations with very high utilisation in the West Midlands and East Midlands when compared to South West and South Wales and therefore the charts are presented on different scales.



The charts are based upon the common criteria used in defining LI bands for RIIO-ED1.

5.65 The charts show that in the West Midlands and East Midlands there are higher volumes of substations that exceed 99% of firm capacity (i.e. have peaks above the bold red line). The majority of these LI4 and LI5 substations (that are predominantly 66/11kV or 33/11kV sites) will be addressed during the remainder of DPCR5 and in RIIO-ED1.

5.66 The following charts show the forecast utilisation profiles (all on the same scale) for the end of RIIO-ED1 taking into account the proposed investment.



The charts are based upon the common criteria used in defining LI bands for RIIO-ED1.

5.67 The charts illustrate that the utilisation profiles at the end of ED1 will be broadly similar across all four WPD licence areas.

5.68 They also show that there will remain a small number of substations that will be in the LI4 and LI5 load index categories at the start of RIIO-ED2. These sites represent the future requirement for network reinforcement beyond RIIO-ED1.

5.69 Once the legacy issues have been addressed, future investment requirements should be at lower levels of expenditure because fewer substations will require reinforcement.

Load index movement during RIIO-ED1

5.70 It is WPD's aim to bring the Load Index risk to similar levels across all four licence areas. The same design principles and investment strategies will be employed to meet security standards. The target is to reduce the number of sites classified as LI5 down to zero.

5.71 The following tables summarise volumes of sites in each LI band

- at the start of RIIO-ED1;
- at the end of the period without investment (the change is driven by load growth); and,
- at the end of period with investment (showing the impact of the proposed work programme).

West Midlands – Load Index positions			
Load Index ranking	**Start of RIIO-ED1**	**End of RIIO-ED1 without intervention**	**End of RIIO-ED1 with intervention**
LI1	166	153	180
LI2	42	43	42
LI3	7	4	2
LI4	7	13	4
LI5	6	15	0

East Midlands – Load Index positions			
Load Index ranking	**Start of RIIO-ED1**	**End of RIIO-ED1 without intervention**	**End of RIIO-ED1 with intervention**
LI1	309	258	281
LI2	108	112	119
LI3	11	31	33
LI4	13	19	14
LI5	8	29	2

South Wales – Load Index positions			
Load Index ranking	**Start of RIIO-ED1**	**End of RIIO-ED1 without intervention**	**End of RIIO-ED1 with intervention**
LI1	150	129	129
LI2	32	45	45
LI3	0	7	7
LI4	1	2	2
LI5	0	0	0

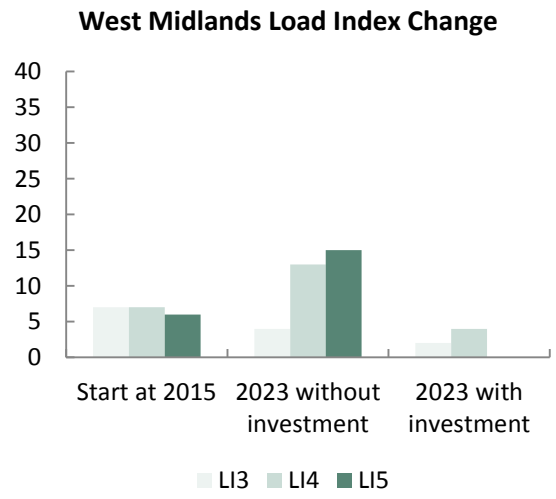
South West – Load Index positions			
Load Index ranking	**Start of RIIO-ED1**	**End of RIIO-ED1 without intervention**	**End of RIIO-ED1 with intervention**
LI1	267	233	243
LI2	54	67	69
LI3	9	12	13
LI4	2	9	7
LI5	0	11	0

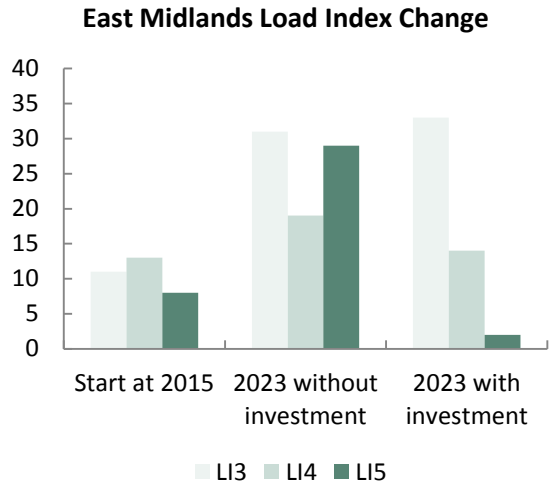
5.72 It can be seen from the tables above, that both East Midlands and West Midlands have a starting point at the beginning of RIIO-ED1 that does not meet WPD's target for no LI5 categorised sites.

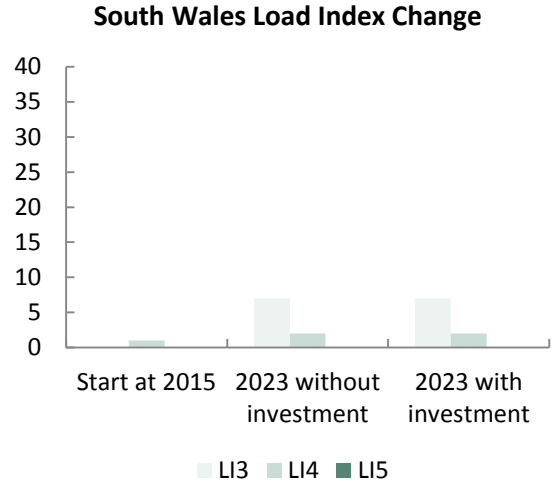
5.73 Data for the end of RIIO-ED1 without investment shows that load growth will lead to an increased number of substations being categorised as LI4 and LI5. The investment programme for RIIO-ED1 will address a number of these LI4 and LI5 sites.

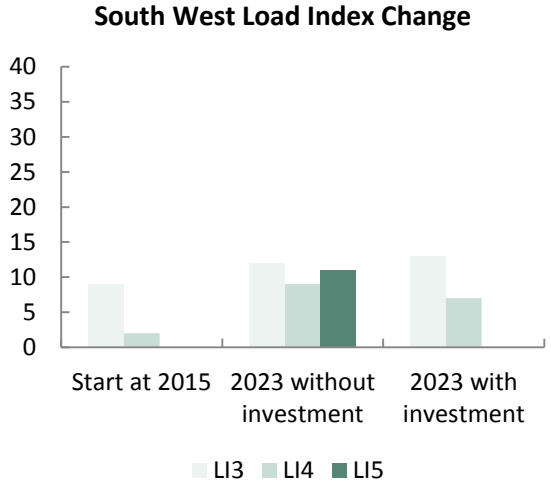
5.74 Overall, this will result in fewer LI4 and LI5 sites in West Midlands and East Midlands at the end of RIIO-ED1 when compared to the start of the period.

5.75 The impact on LI3, LI4 and LI5 categories is also illustrated in the following charts (LI1 and LI2 have not been shown as they would dominate the scale of the charts).









5.76 The largest volume of change between the position without and with investment will be in the East Midlands and whilst the majority of highly loaded sites will be addressed, some will remain. These residual sites will be addressed in RIIO-ED2.

Loading risk

5.77 Load index data can be converted to a risk score by multiplying the number of customers supplied from a substation by a weighting that is dependent upon the load index. Ofgem has proposed the following weighting within Business Plan Data Templates:

Weighting of LIs for conversion to loading risk					
	LI1	LI2	LI3	LI4	LI5
Ofgem weighting	1	1	1	20	100

5.78 Applying these weightings to the LIs and multiplying by the number of customers at each substation gives the following risk positions.

Loading risk – using Ofgem weightings			
Licence Area	**Start of RIIO-ED1**	**End of RIIO-ED1 without intervention**	**End of RIIO-ED1 with intervention**
West Midlands	8,338,896	25,115,535	3,452,548
East Midlands	11,503,853	37,680,797	11,150,822
South Wales	1,589,608	1,676,286	1,676,286
South West	3,061,322	22,514,386	4,302,630

5.79 It should be recognised that the total loading risk score for a licence area is dependent on the total number of customers within that area and by the overall design of the primary networks in terms of multiple transformation levels. For example, South Wales has the lowest number of customers (approximately 1.1m) and East Midlands the highest (approximately 2.6m) which means that the cumulative customer risk score will be correspondingly higher in East Midlands. Also, in networks that utilise both 132/EHV and EHV/11kV transformation levels each customer will tend to be counted twice in this cumulative risk score.

5.80 These loading risk scores can be normalised by using the total number of 'load customers' (the sum of all the customers supplied by primary substations, including double counting where multiple voltage levels are used). This leads to the following results:

Load risk points per load customer	West Midlands	East Midlands	South Wales	South West
Start of RIIO-ED1	2.72	2.29	1.23	1.08
End of RIIO-ED1 with no intervention	8.19	7.50	1.30	7.97
End of RIIO-ED1 with intervention	1.13	2.22	1.30	1.52

5.81 The table shows that the risk per load customer in West Midlands and East Midlands at the start of RIIO-ED1 is around double the value in South Wales and South West. Load growth causes this to increases significantly (in West Midlands, East Midlands and South West) and the proposed investment programmes reduce the risk per load customer. It also shows that the risk per load customer will be allowed to increase slightly in South Wales and South West over the period.

5.82 A load risk point per load customer value of 1.5 equates to around 2.5% of customers being supplied by substations that are LI4 (loaded above 99% of firm capacity), with the rest being LI3 or lower.

5.83 It is proposed that the long term target for load risk points per load customer should be 1.5 or lower. This compliments the target to have no LI5 substations and limits the number of customers who are supplied by LI4 substations to 2.5% of the customer base.

5.84 This means that further reduction of load risk will be required in the East Midlands beyond the end of RIIO-ED1 in order to bring it in line with risk levels in West Midlands, South Wales and South West.

6 Fault level capability

6.1 Certain faults that occur on the network can allow very high current to flow until the network is switched off automatically by circuit breakers. Whilst the network is designed to withstand these levels, the number of generators and large induction motors connected to the network can cause the fault current to exceed the rating of the circuit breakers. This can introduce a risk of catastrophic failure when the switchgear operates.

6.2 WPD has a duty of care to its employees and members of the public to ensure that they are not at risk of injury due to the failure of the company's assets.

6.3 When new high fault level situations are identified, operational limitations are used to reduce the risk. Since these introduce sub-optimal running arrangements, they are only used as interim solutions until the equipment can be changed. The implementation of sub-optimal network running arrangements can affect network performance and constrain the capacity of the network restricting the connection of additional load or generation.

6.4 The main approach to resolving the issue is the replacement of the switchgear for higher rated equipment. In some instances changing transformers for higher impedance models can also provide some fault level headroom.

6.5 An annual fault level survey identifies the locations and situations where the fault level potentially exceeds 95% of the switchgear rating. Solutions are generated to eliminate the risks and restore optimal running arrangements.

6.6 One of the factors that can influence fault level is the connection of distributed generation. The anticipated growth in distributed generation is likely to lead to a number of new fault level issues arising over the RIIO-ED1 period, particularly where generators are located close to primary substations. Traditionally this has been resolved by replacement of equipment with a higher rating, but smarter solutions (being investigated under innovation projects) such as more accurate measurement devices for fault level or using fault current limiters may be lower cost options in some situations.

6.7 Fault level survey results are incorporated into the Long Term Development Statement (LTDS). This provides an indication to potential distributed generation developers where there may be limitations or constraints and therefore financial implications for the connection of distributed generation onto the network. The data in the LTDS is updated annually to reflect changes due to network reinforcement, asset replacement and the connection of DG.

6.8 Fault levels are generally higher in the two WPD Midlands areas due to the number of large power stations connected to National Grid's network. The higher density of load has also lead to the use of 132/11kV substations which tends to create higher fault levels.

6.9 The cost forecast has been derived from specific schemes that will be carried out to address known fault level issues identified in the fault level analysis.

Expenditure forecast

Fault level reinforcement expenditure in RIIO-ED1 by voltage (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
HV switchboards	2.8	8.0	0.8	-	11.6
EHV switchboards	1.7	1.3	-	1.2	4.2
132kV switchboards	7.3	10.6	-	3.6	21.5
Total	**11.7**	**19.9**	**0.8**	**4.8**	**37.1**

Fault level reinforcement expenditure (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DPCR5 Annual Average	2.5	0.4	0.2	0.2	3.3
RIIO-ED1 Annual Average	1.5	2.5	0.1	0.6	4.6
RIIO-ED1 Total (8 years)	**11.7**	**19.9**	**0.8**	**4.8**	**37.1**

7 Transmission exit points

7.1 The WPD network is connected to the National Grid at Transmission Connection Points (TCPs). National Grid provides infrastructure at these exit points to allow power to flow from the transmission system to the distribution network. National Grid recovers the cost of providing these connection points through annual charges.

7.2 The National Grid charges include the costs for new assets when additional capacity is requested by WPD and the costs of replacing existing assets determined by National Grid's replacement programme and are charged over a forty year period.

7.3 Where additional capacity is required WPD's preference is to reinforce the distribution network as the costs are usually lower. Inevitably there will still be circumstances where it is necessary to request additional capacity from National Grid. WPD works closely with National Grid at 'Joint Technical Planning Meetings' (JTPM) to determine which approach to reinforcement is the most economical.

7.4 Even though National Grid provides a quotation for any proposed work, the eventual charges are determined by the actual costs of the work. This means that if additional costs are incurred they are passed through to the charges levied on WPD. Hence there is little opportunity to influence the costs once projects are under way.

7.5 Through the JTPMs held with National Grid, WPD have determined the sites and assets that are due to be replaced by National Grid within the RIIO-ED1 period. Depending on the arrangements of the sites, only some of these assets are chargeable through to WPD. Where they are deemed chargeable WPD have used National Grid's charging methodology statement for the indicative charges that will result.

7.6 Based on load growth projections and network developments we have forecast the future capability of the TCPs to remain compliant with the security design standard. This has identified two sites where WPD will require National Grid to reinforce the network in RIIO-ED1. An additional supergrid transformer will be required at Shrewsbury (West Midlands) in 2018 and Staythorpe (East Midlands) in 2021.

7.7 The installation of an additional supergrid transformer is forecast to increase TCP charges by £0.4m per annum from the year of installation. The total new TCP charges during RIIO-ED1 due to WPD requirements are shown below:

Transmission exit point charges due to WPD requirements in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
RIIO-ED1 Total (8 years)	**1.9**	**0.7**	**-**	**-**	**2.6**

7.8 The majority of the increases in Transmission exit points expenditure is as a result of National Grid's replacement programme. The following are therefore treated as pass through costs.

Transmission exit point charges treated as pass through costs (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
DPCR5 Annual Average	9.8	7.1	5.1	6.5	28.5
RIIO-ED1 Annual Average	13.5	11.6	8.6	9.0	42.7
RIIO-ED1 Total (8 years)	**107.9**	**92.7**	**68.7**	**71.6**	**340.9**

8 Diversions, conversion of wayleaves to easements and highways work

Background

8.1 WPD operates a vast distribution network via 185,000 substations, 92,000km of overhead lines and 129,000 km of underground cables. Whilst statutory rights allow installation of the distribution network in public land (such as adopted highways), where the network passes over or under private land WPD requires agreements with the property owners.

8.2 Wayleave agreements are used in most cases due to the lower costs involved. A wayleave is a form of licence, granted by a landowner, that gives WPD the right to place and maintain its equipment on private land. It is generally a quick and simple agreement to obtain, usually requiring no legal input, and becomes active the moment it is signed. The majority of wayleaves involve paying the landowner an annual rental for the equipment on their land and compensating the land user for any impact on their activities on the land.

8.3 There are however two main disadvantages:

- a wayleave is a personal contract with the landowner and does not automatically bind their successor in title;
- wayleaves can, in many cases, be terminated.

8.4 Easements are permanent rights of way that remain in place even if the land is sold. Legal rights of way are drawn up by a solicitor and due to their cost tend to be reserved for underground cables, 132kV, 66kV and 33kV overhead lines and other situations where strategically important items of plant must be given an absolute right to exist on private land or where it is cost effective for WPD compared to other solutions.

8.5 The presence or construction of the distribution network can lead to customers or landowners claiming for injurious affection (the cost incurred due to a detrimental effect on the value of land or property).

8.6 Landowners may also trigger requests to remove or divert parts of the existing distribution network to facilitate development of land or where a landowner no longer wants to host WPD equipment on their land.

8.7 The 1989 Electricity Act provides rights for DNOs to acquire land or rights over land either by a compulsory purchase order (CPO) or a necessary wayleave. Both require applications to be made to the Secretary of State and hearings to be conducted. The purchase of land using a CPO is very expensive and takes significant time to complete. The acquisition of a necessary wayleave is more accessible and therefore is used on a more frequent basis. Both approaches can lead to further expense and involve time consuming hearings at the Lands Chamber (an independent specialist judicial body) if terms cannot be agreed for compensation once the necessary wayleave or CPO has been granted.

8.8 The Act allows WPD up to a maximum of 3 months, from the date of a wayleave termination removal notice issued by a landowner or their agent, to make an application to the Secretary of State for a necessary wayleave or CPO. Following this three month period WPD is deemed to be trespassing on the land and has to remove any equipment if such an application has not been made.

8.9 Requests for network diversions, termination of wayleaves or claims for injurious affections can prove costly to WPD. Since the use of statutory powers is expensive and often takes a long time, they are used as a last resort, with WPD using a range of approaches to minimise the potential costs of keeping assets on land or diverting equipment.

Conversion of wayleaves to easements, easements and injurious affections

8.10 Whilst WPD prefers to use lower cost wayleave agreements, in some cases permanent agreements or deeds of easements are required where routes need to be maintained. A lump sum payment (rather than an annual rental) is paid for a permanent or long term agreement to cross the land. Most easements do not involve any injurious affection consideration. The capital cost of the easement is therefore equivalent to a multiple number of the annual wayleave payments had a wayleave agreement been in place. The costs are grouped under the capital expenditure category 'conversion of wayleaves to easements'.

8.11 Where the distribution network (either new or existing) affects the value of property or land, landowners can in some cases claim compensation for this loss. This is particularly true of existing overhead lines or underground cables on wayleave agreements or on easements with compensation clauses. This is governed by compensation law and is known as injurious affection.

8.12 Landowners who believe they have an injurious affection claim will approach WPD to negotiate a compensation settlement. Where a wayleave exists, WPD would seek to acquire a permanent easement in exchange for payment of compensation. WPD's preference is to negotiate with the landowner. But in some cases the negotiation takes place against the background of a formal termination of the wayleave by the landowner.

8.13 If a settlement cannot be reached for a formal termination, the legal process would result in a DECC hearing for a necessary wayleave at considerable cost (which WPD cannot recover even if it wins the case). In some cases, a CPO may be used instead. Following the granting of a necessary wayleave or CPO, where agreement can still not be reached, either party can refer the matter to the Lands Chamber for determination of the compensation sum to be paid but this is usually avoided due to the costs, timescales and risks involved. WPD is only likely to take the formal legal approach in 'ransom' situations or where the proposed settlement would be out of line with established comparable situations and valuation principles.

8.14 Over the last 10 years, a number of compensation agents have established themselves (many in the Midlands area), specialising in injurious affection compensation due to overhead electricity lines affecting property. The landowner or their agent may submit a wayleave termination together with an offer to negotiate a permanent easement to retain the line.

8.15 Each claim is rigorously challenged, but the careful negotiation of many claims over the last 10 years (and the settlement of similar cases by other network operators) has inevitably established principles for calculating the injurious affection, as well as many comparable settlements.

8.16 WPD will normally seek to avoid legal hearings, unless absolutely necessary, as these would increase the costs significantly with the very strong likelihood that the resulting compensation settlement would be in line with the valuation levels already established.

8.17 The typical cost of a necessary wayleave hearing is £15k to £50k (costs will be much higher if a Lands Chamber hearing also results) compared with the average injurious affection settlement for single urban properties of £10k. The resultant timescale and friction with the agent and/or landowner would also have a detrimental effect on WPD's longer term business interests.

8.18 Well established, pragmatic and co-operative relationships with landowners and their representatives is essential to allow WPD to operate, maintain and expand the distribution network in the future. Souring these relationships unnecessarily will only lead to access problems and increased costs in future (e.g. through lack of co-operation to access land). Historically, some other DNOs have gone down a more intransigent route of hearings and delay for what are valid wayleave terminations. This has had little positive effect.

8.19 Where required and appropriate, WPD will legally challenge a claim or termination, should this impact adversely on expenditure.

8.20 It is worth noting that the use of statutory powers is not a panacea for dealing with wayleave terminations and this is generally why hearings are only held for larger and more significant matters. The points to consider are:

- the costs are high per wayleave hearing case and a large resource is also needed to manage the process and prepare evidence;
- each party bears its own costs in relation to a wayleave hearing regardless of outcome;
- to date, all the obligations fall on the network operator to prepare for a hearing (there are no requirements for the landowner to do so);
- assuming a necessary wayleave is granted, further costs (often in the region of £200k) could be incurred if the level of compensation is referred to the Lands Chamber for determination;
- at development sites, planning conditions from the local authority can require the removal of overhead lines. The challenge to this through use of statutory powers cannot be guaranteed and is a complex area of law.

8.21 Where WPD has assets on development sites and these are to be retained (rather than being diverted) there is often an injurious affection compensation liability and unless the demands are outside comparable values there is nothing to be gained from taking the legal route.

8.22 WPD uses a variety of processes, specialists, methods and strategies to control the expenditure associated with injurious affection claims. These include:

- centrally controlled and well established processes for dealing with all injurious affection claims that ensures a consistent approach and appropriate treatment for every case so that compensation costs are in line with comparable settlements (in WPD and other DNOs);
- centralised authorisation of injurious affection settlements and higher value standard easements to ensure control and scrutiny against policy and comparable settlements;
- use of chartered surveyors, acting for WPD, to evaluate and negotiate injurious affection claims for individual properties and for large and complex development sites;
- use of architects or planning consultants to evaluate development plans to ensure optimum layouts have been adopted to minimise compensation due to an overhead line;
- monitoring of local authority development plans and core strategy policies to identify where proposals could affect the distribution network and lead to a cost burden for WPD's customers.

8.23 WPD has worked hard with DECC and other DNOs to review the framework and rules governing the necessary wayleave process to see what changes can be implemented to make it harder for agents or landowners to use the threat of a wayleave hearing as a disproportionate negotiating lever. This resulted in DECC consulting on options at the end of 2012 and with changes to be introduced later in 2013 if approved.

8.24 The main changes propose to introduce a Code of Conduct for both agents and DNOs to follow and to re-address the balance of effort required for wayleave hearings so that the landowner also has certain obligations to meet, with the potential for award of certain costs against the landowner, should they fail to meet their obligations in the process.

8.25 The incentive for landowners to push for unnecessary hearings should be reduced and although other measures are possible to further shift the balance, DECC are highly unlikely to implement statutory powers which adversely affects a landowners rights against network operators. These changes will however assist in removing unnecessary wayleave hearings for ransom type claims (and the costs/resources involved in running these). The changes are unlikely to reduce the expenditure on injurious affection overall, as the duty in law to compensate exists and the majority of claims will be settled against the established values of historic settlements.

8.26 WPD's injurious affection settlements compare favorably to cases we are aware of from other DNOs. Information on individual cases is commercially confidential and can't therefore be set out in this document but the edited examples below demonstrate this well:

- WPD paid 5.5% compensation for a tower at 80m distance, and DNO1 paid 8.2% for one at 75m distance;
- WPD paid 3% for a 132kV overhead line at 57m distance and DNO2 paid 5% for one at 46m distance;
- WPD paid 1.5% for a 132kV overhead line at 125m distance and DNO1 paid 2% for one at the same distance.

Expenditure forecast

8.27 The expenditure forecast and activity volumes for the RIIO-ED1 period for this activity reflect historic costs in DPCR5 and additional costs required to deal with the higher number of claims on development sites that are being progressed following being delayed or mothballed as a result of the economic downturn since 2008.

Development claims

8.28 Development claims are mainly on residential sites but also include commercial sites and mineral extraction/quarry sites. The value of development claims can be significant and the liability for each site typically ranges from £0.5m to £3m (influenced by land values).

8.29 Activity in DPCR5 has been suppressed due to the recession and economic conditions. For this reason, the historic expenditure since 2010 has not included any major development site settlements, but some payments have been made on smaller sites across all of WPD's four licence areas. The value of these payments has been between £100k and £300k in each case.

8.30 We are now seeing increased activity and negotiating again on previously mothballed sites. We expect this to continue as the economic outlook improves.

8.31 During 2012 and 2013 we have had very active discussions on several mothballed sites where the compensation settlement is likely to be significant (£millions in some cases) and which will conclude in the next few years.

8.32 We have also been given outline details of approximately ten new large development sites in WPD's area which are likely to be built in the RIIO-ED1 period, most in the earlier years, and which will require WPD to either pay compensation due to loss of development or divert major 132kV and 33kV overhead lines.

8.33 The following table shows a list of known or potential larger development sites where higher value injurious affection easements are likely to be settled or agreed over approximately the next 5 years. We expect many of these to conclude in the first half of the RIIO-ED1 period and therefore there will be further sites not yet known to us coming forward in the second half of the period.

Development Sites Requiring Higher Value Injurious Affection Easements		
Licence Area	**Site Location**	**Development Type**
West Midlands	Norton Caines (Brownhills Road) Banbury (Wroxton Fields) North Yate, Gloucestershire North West Cheltenham Bevere (Worcester)	Residential Quarry/Mineral Residential Residential & Commercial Residential
East Midlands	Corby (Stanion Way) Kingsbury Quarry (Tamworth) Castle Ashby Boscatt (Boston) Leicester (Faricharm Estate) Milton Keynes (west of town)	Commercial Quarry/Mineral Quarry/Mineral Commercial Residential Residential
South Wales	Llantarnam (Cottage Farm) Church Village Hirwaun	Residential Residential Residential & Commercial
South West	Exeter (Topsham phase 2) Bristol (Emersons Green – part of site) Bristol (Harry Stoke – first phase) East Devon (first phase)	Residential Residential Residential & Commercial Residential

8.34 In our forecasts, we have assumed that these settlements will represent typical levels of activity that will also be seen in the remainder of the RIIO-ED1 period. This means that on average each of WPD's four licence areas will have one to two injurious affection claims on new major development sites per year.

8.35 The complexity of development claim negotiations, as well as unpredictable timescales from developers (influenced by the time taken to obtain planning permissions) affects the timing of capital expenditure. This can significantly affect year on year expenditure. Whilst in reality there will be volatility, the RIIO-ED1 forecast uses a flat profile assuming average costs are incurred each year.

8.36 The expenditure forecast includes the following annual values for large development sites:

- West Midlands: £0.6m/year;
- East Midlands: £1.1m/year;
- South Wales: £0.5m/year;
- South West: £0.8m/year.

General claims/settlements (non-development):

8.37 We have seen the number of 132kV network injurious affection claims start to stabilise in DPCR5. We anticipate that the overall number will start to fall in the next price control period. We expect the volumes to continue to be higher in the Midlands compared to other areas due to size of the network area as well as the developed nature of the land and the presence of many of the specialist compensation agents.

8.38 We expect that the agents specialising in advising landowners on claims for injurious affection, will move their attention on to the next lower voltage level (i.e. 66kV and 33kV). We estimate the numbers will increase by 10%/year initially and then by 20%/year. We expect the volumes of EHV claims will overtake the number of 132kV claims during RIIO-ED1 but the average settlement per claim will be lower due to the lesser impact of EHV overhead lines generally.

8.39 We have also estimated that in a similar manner HV claims will start to increase in the latter part of the RIIO-ED1 period.

8.40 The net effect will mean that the level of expenditure on higher voltage non-development claims will remain broadly in line with historic trends but the activity will shift from 132kV to EHV and HV.

8.41 The approach to be taken in the Midlands will reflect the application of WPD policy to offer long term wayleaves (for lump sum payments) in addition to standard wayleave agreements (with annual rental). These are mainly used on LV and HV lines and cables and enable WPD to secure consent (in low risk situations where an easement is not required or too costly). These have been successful in adding flexibility to negotiations. The increase in volume of transactions due to this policy change does not affect the overall expenditure on LV and HV particularly as the value of each one is quite low.

Conversion of wayleaves to easements, easements and injurious affection expenditure (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DPCR5 Annual Average	3.4	3.5	1.4	1.8	10.1
RIIO-ED1 Annual Average	3.3	3.5	1.9	2.6	11.3
RIIO-ED1 Total (8 years)	**26.4**	**28.2**	**15.4**	**20.4**	**90.4**

Diversions due to wayleave terminations

8.42 Diversions arise when landowners request that assets are moved, often through a wayleave termination or under the threat of one. This may be for reasons such as to facilitate a house extension or for the development of land. They can also arise when large infrastructure upgrades take place such as the electrification of railway lines.

8.43 It is preferred that the person making the request funds the diversion, but it is sometimes necessary for WPD to divert the equipment at its own cost. Wayleaves and easements can also be subject to a "lift and shift" clause, which can provide a mechanism for a landowner to instigate a diversion at the expense of WPD.

8.44 For standard lower value LV and HV diversions, our forecasts for RIIO-ED1 are generally in line with historical values incorporating the slight increasing trend that has been noticeable for a number of years.

8.45 Diversions may also be required where the cost of purchasing an easement or using statutory powers and competition law to retain assets in situ exceeds the cost of moving the equipment.

8.46 We are now seeing increased activity on previously mothballed sites and as the economic outlook improves, we anticipate the number of higher voltage (132kV and EHV) diversions needed on development sites to increase in the RIIO-ED1 period. In some cases the value of injurious affection claims can be high enough for a WPD funded (or part funded) diversion to be the cheaper alternative. The factors affecting this are complex but can be due to the value of land or local authority planning policies, as well as political and public pressure against retaining overhead lines on developments.

8.47 WPD aims to minimise expenditure on diversions due to wayleave terminations by using a variety of different approaches including:

- developing landowner relationships locally through a staff structure that gives Wayleave Officers a geographical area to cover. (Face to face negotiations is normally a very effective way of resolving a termination and can avoid a diversion altogether or lead to an outcome where both sides contribute to the costs.);
- negotiating an agreement to retain the equipment instead of carrying out a more expensive diversion. The option to use statutory powers will also mean negotiations are carried out against this formal alternative;
- central support and co-ordination of complex or higher value cases, ensuring consistent approach to minimise costs;
- making representations to local authorities regarding planning policies which can lead to a requirement for diversion of overhead lines, especially those involving towers (pylons) where a cost burden is placed on WPD and its customers rather than on the developer who benefits financially from the development.

8.48 The following represents a list of known sites where higher cost diversions are likely in the next 5 years (during DPCR5 and first half of the next price control). There will inevitably be future schemes occurring later in the period and this list is taken as representative snapshot of the volume of activity over a typical 5 year period:

Developments sites requiring diversions			
Licence Area	**Site Location**	**Voltage**	**Development Type**
West Midlands	Cheltenham (Midwinter) Bishops Cleeve Redditch (Silcott Farm) Redditch (East Brockhill) Rugeley	66kV 66kV 66kV 66kV 132kV	Residential Residential Residential Residential Bridge Diversion
East Midlands	Newark on Trent Sywell Mansfield Nottingham (Toton) Overstone Leys (Northampton) Brackley (Radstone Fields) Milton Keynes (West)	132kV and 33kV 33kV 66kV 132kV and 33kV 33kV 33kV 33kV	Residential/Commercial Commercial Residential Residential Residential Residential Residential/Commercial
South Wales	South Sebastapool Bridgend (Cefn Cribbwr) Bridgend (Brackla) Hirwaun (Tower Colliery) Merthyr	66kV 66kV 132kV 33kV 33kV	Residential Residential Residential Mine Mine
South West	Emersons Green (Bristol) – part of site Plymouth (Sherford) Truro (Threemilestone) Exeter (Topsham) – phase 1 Taunton (Staplegrove) Bristol (Harry Stoke) – part of site Bridgwater (Bath Road) Taunton (Monkton Heathfield) East Devon Developments	132kV 132kV 132kV 132kV 132kV 132kV 33kV 33kV 132kV	Residential Residential/Commercial Residential Residential Residential Residential Residential Residential Residential/Commercial

Network Rail electrification

8.49 The electrification of railway lines means the replacement of older diesel trains with electric trains. Network Rail has long term proposals for many existing rail lines to be electrified

8.50 WPD has a number of overhead lines and cables that are placed on Network Rail land that will need to be diverted to facilitate the electrification.

8.51 WPD and Network Rail have a Master Wayleave Agreement (MWA) covering rights for WPD overhead lines and cables to be situated on railway property. This agreement dates from 1961 and is in effect a terminable licence (like any other wayleave). There will be similar MWAs in place between Network Rail and the other DNOs.

8.52 Network Rail has informed WPD that it requires that these diversions be at WPD's cost.

8.53 Should a dispute arise as to the nature of diversions required or where the costs fall, the MWA contains arbitration provisions which we expect Network Rail would seek to use as one way of determining the issue of compensation/costs.

8.54 The alternative route in the event of a dispute may be the use by WPD of its statutory powers under the Electricity Act 1989. This would secure WPD's existing rights, although Network Rail may seek compensation for any interference they felt the presence of WPD lines would cause.

8.55 Should this occur and in the absence of an agreement, Network Rail is likely to refer matters to the Lands Chamber for determination. The outcome of arbitration or any referral (for compensation) to the Lands Chamber is at present unknown but WPD must work on the basis that it could be required to meet all the costs or be required to pay an unknown level of compensation. The most likely outcome would be the diversion of WPD equipment to enable electrification of the railway lines.

8.56 Amongst the schemes having received approval from the Department for Transport, the following will impact WPD during the RIIO-ED1 period:

- electrification of the railway line from London Paddington to Swansea (including the Welsh Valley Lines);
- electrification of the Midlands Mainline from Bedford to Sheffield through the East Midlands.

8.57 The current RIIO-ED1 forecast includes costs for diverting WPD assets for these two known schemes and an assumption that work will start on the Birmingham-Plymouth route in the second half of the period.

High Speed 2

8.58 Since High Speed 2 (HS2) is a new line without existing wayleave agreements in place, the costs of diversions will be predominantly fully funded and treated as an excluded service outside of the price control. The Act for HS2 is still in draft but Network Rail have informed us that they expect the relevant provisions covering cost of diversions will be similar to the Crossrail Act 2008.

8.59 A small nominal amount (<£1m) has been included within the diversion forecasts for potential HS2 diversions associated with existing railway routes on Network Rail land.

Diversions due to wayleave termination expenditure

Diversions due to wayleaves terminations (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	5.7	5.5	1.6	2.6	15.4
RIIO-ED1 Annual Average	6.6	6.5	6.4	7.0	25.6
RIIO-ED1 Total (8 years)	53.1	51.6	51.3	56.4	212.4

Network diversions for highways work

8.60 Highways work, such as large scale development of new motorways and road widening may require the diversion of WPD equipment. Whilst the majority of the costs of the diversions are rechargeable to the local authorities or Highways, Regulation 4 of The New Roads and Street Works Act (NRSWA) requires WPD to contribute 18% to the costs. These projects are managed in a co-ordinated manner to minimise the cost impact.

8.61 The forecasts reflect that the majority of the roadworks will continue to be focused in the Midlands with improvements to junctions, road widening and further expansion of managed motorways (variable speed motorways utilising hard shoulders during times of peak traffic). The forecast costs represent the proportion that is not funded by the authorities. Forecasts for RIIO-ED1 are in line with previous levels of expenditure.

Diversions for highways work (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.7	0.3	0.0	0.0	1.0
RIIO-ED1 Annual Average	0.9	0.7	0.1	0.1	1.8
RIIO-ED1 Total (8 years)	7.3	5.2	0.5	0.7	13.7

Summary expenditure

Diversions, conversion of wayleaves to easements and highways work expenditure RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Easements & injurious affection	26.4	28.2	15.4	20.4	90.4
Diversions due to wayleave terminations	53.1	51.6	51.3	56.4	212.4
Diversions for highways work	7.3	5.2	0.5	0.7	13.7
RIIO-ED1 Total Gross	**86.9**	**85.1**	**67.2**	**77.5**	**316.7**
Customer contributions	(0.8)	(0.8)	(0.8)	(0.8)	(3.2)
RIIO-ED1 Total Net	**86.1**	**84.3**	**66.4**	**76.7**	**313.5**

Non-load network investment

9 Risk based asset replacement

Introduction

9.1 The objective of WPD's asset replacement programme is to replace or refurbish assets in a timely manner in order to ensure that the condition based risk is managed to the optimum level for each asset type and the distribution network asset base overall.

9.2 WPD uses both longer term outlooks and shorter term forecasts to derive asset replacement volumes.

9.3 Longer term outlooks (i.e. greater than 10 years) use age based survivor modelling techniques to provide an understanding of long term resource requirements and changing patterns of asset replacement.

9.4 Shorter term forecasts (i.e. 2 to 10 years) use risk based modelling techniques to establish asset replacement volumes that optimise condition based risk.

Distribution network asset management strategy

9.5 WPD's overall Distribution Network Asset Management strategy is outlined in WPD policy document POL:AM1, which states:

> *"It is WPD strategy to install, inspect and maintain its substations, plant, underground cables and overhead lines such that:*
>
> - *An optimum balance is achieved between asset life, cost and reliability;*
> - *The safety of employees, the public and the environment is not unreasonably compromised;*
> - *They comply with statutory and regulatory requirements;*
> - *They are refurbished or replaced when their condition is no longer consistent with an acceptable level of reliability or safety."*

Optimum condition based asset replacement

9.6 As stated in the introduction, the objective of WPD's asset replacement programme is to replace or refurbish assets in a timely manner in order to ensure that the condition based risk is managed to the optimum level for each asset type and the distribution network asset base overall.

9.7 This objective does not presuppose that the prevailing level of condition based risk is correct or cost effective.

9.8 WPD's asset replacement strategy to achieve this objective is to:

- establish condition based "trigger points", based on both probability and consequences of failure, for each asset category, that identify the economic optimum point during an asset's life when the asset should be replaced or refurbished;
- routinely collect and record actual asset condition data; and

- undertake the replacement, or refurbishment, of an asset no earlier than when the actual condition is equal to the relevant optimum condition based trigger point.

9.9 The determination of the optimum condition based trigger point takes into account:

- network performance risk (i.e. impact of Customers Interrupted and Customer Minutes Lost);
- safety risk (e.g. injury to a person coincidental with condition based failure);
- environmental risk (e.g. leakage of oil);
- financial risk (i.e. cost of repair following condition based failure); and
- cost of undertaking asset replacement or refurbishment.

Overview of asset replacement forecasting

9.10 For RIIO-ED1, WPD has used two different techniques, in tandem, to formulate the asset replacement forecast. Longer term forecasts have been produced using age based survivor modelling, which have been refined with shorter term forecasts that use risk based modelling.

9.11 By considering the longer term forecast, WPD aims to ensure that the asset replacement activity levels, in the RIIO-ED1 period, will not lead to a requirement for a step change in overall activity levels in subsequent price control periods. This enables efficient resourcing and stability in expenditure and funding requirements.

9.12 For the shorter term, WPD has used risk based modelling and cost benefit analysis to identify the optimum economic point for asset replacement. This approach compares the cost of asset replacement against the benefits of removing future risk and identifies the point at which the maximum net benefit is delivered. The volume of asset replacement is derived by considering those assets whose health shall reach the optimum economic point for replacement.

9.13 This approach is new for RIIO-ED1.

9.14 WPD has not used risk based modelling to derive asset replacement forecasts for previous price control periods (the DPCR5 forecast considered asset health, but did not incorporate consideration of consequences of failure for individual assets).

9.15 Consequently, the risk based approach used by WPD does not aim to maintain the future network risk at existing levels. Such an approach would presuppose that the existing level of network risk is at the correct level or the most cost effective.

9.16 By adopting a strategy of replacing assets when they reach the optimum economic point for replacement, the overall network risk will naturally migrate to the optimum level.

Longer term forecasting (greater than 10 years)

9.17 Since DPCR3 the industry has used survivor modelling to forecast future asset replacement volumes. Survivor models are age based models that use age as a proxy for condition. The presumption is that as an asset ages, the greater the likelihood that it is in poorer condition and hence the higher the probability that the asset will need to be replaced.

9.18 Survivor models are applied to each asset category and rely upon the following types of information:

- age profile of the asset population;
- mean asset life expectancy;
- an assumed distribution of replacement.

9.19 A distribution of replacement is used because it is unrealistic to assume that all assets are replaced when they reach the mean life expectancy. The statistical distribution determines the probability of replacement for assets in each year of their lives. The models are based on a normal distribution using the mean asset life expectancy and a standard deviation.

9.20 The survivor models produce a forecast of the probable volume of assets that will require replacement in each future year.

9.21 Due to the statistical nature of the model, and the limited data requirements, survivor models are capable of easily producing credible indicative long term forecasts. Forecast volumes, from survivor models, for each year up to 2039/40 have been examined, when considering the long term impact of WPD's RIIO-ED1 asset replacement forecasts.

Shorter term forecasting (2-10 years)

Condition Based Risk Management

9.22 Condition Based Risk Management (CBRM) is an asset management decision support tool that has been developed by EA Technology Limited. It is used to:

- determine both current asset health and current probability of condition based failure;
- forecast deterioration of asset health and the associated change in probability of failure; and
- assess consequences of failure.

9.23 By combining probability of failure and consequence of failure, CBRM can determine both the current and forecast risk of condition based failure.

9.24 CBRM is used by a number, but not all, DNOs in the UK industry. WPD has been working with EA Technology Limited since 2007 on the application of CBRM to WPD asset data.

Condition assessment

9.25 The condition assessment of assets is embedded in WPD's routine inspection and maintenance procedures. For major items of equipment, this is supplemented by additional condition assessment as assets approach the expected average life for the asset type.

9.26 Condition data collected during routine inspection, routine maintenance and non-routine condition assessment, defect repair, etc., is recorded in WPD's asset management system called CROWN.

9.27 This information is used, within the CBRM models, for the evaluation of asset health and condition based risk.

Determining asset health within CBRM models

9.28 CBRM assigns health scores to assets using a continuous scale from 0.5 to 10. These scores are numerical representations of the condition of each asset, with 10 representing assets in poorest condition. The use of a continuous scale facilitates the modelling of degradation of asset health with time.

9.29 An initial health score is derived from an asset's age, locational factors (e.g. whether the asset is located indoors or outdoors, proximity to the coast) and duty factors (e.g. in power transformers, the degree of loading affects the rate of ageing of the winding insulation).

9.30 The initial health score is modified to create the adjusted asset health score by incorporating the condition assessment data, defect history and test results. This modification can result in the initial health score increasing or decreasing.

9.31 In order to forecast degradation of asset health, the CBRM model assumes that future asset health deteriorates with age. A typical degradation curve is shown in figure 1 below. The rate of degradation of health of an individual asset is dependent upon the original construction of the asset along with its locational and duty factors.

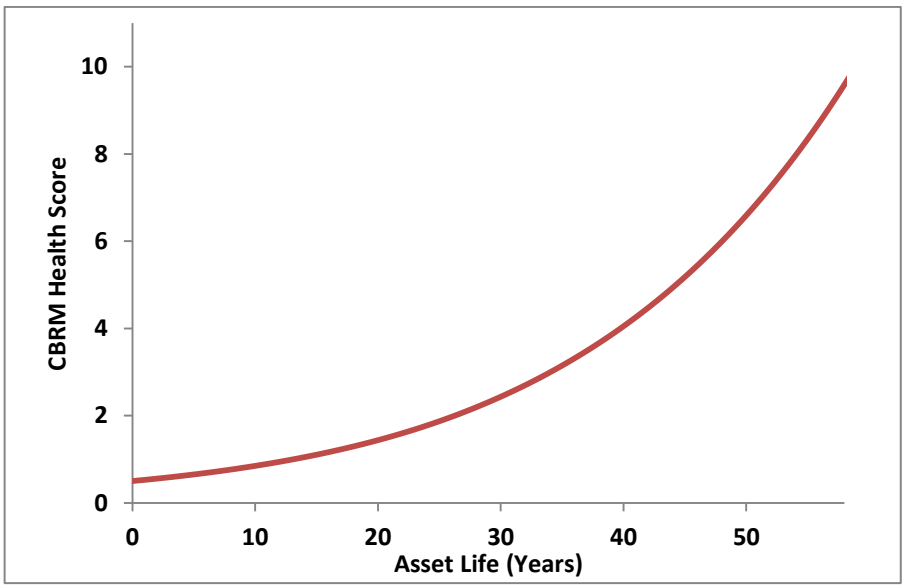


Figure 1: Typical asset health degradation curve.

Probability of condition based failure

9.32 Within the CBRM models, the probability of condition based failure is determined from the asset health score. This probability of failure (POF) is calculated using the following formulae:

for HS > 4:-

$$\text{POF} = \left(1 + (1.35 \times \text{HS}) + \frac{(1.35 \times HS)^2}{2!} + \frac{(1.35 \times HS)^3}{3!}\right) \times k$$

for HS < 4:-

$$\text{POF} = \left(1 + (5.4) + \frac{(5.4)^2}{2!} + \frac{(5.4)^3}{3!}\right) \times k$$

where:-

POF = probability of failure per annum;
HS = CBRM asset health score; and
k is a constant

9.33 For asset types, where condition based failures are managed reactively (e.g. cables, where repairs/ replacement is mainly undertaken in direct response to a failure), the constant 'k' is determined such that the calculated total probability of condition based failure for the asset type approximates to observed failure rates.

9.34 For asset types, where the risk of condition based failure is managed by proactive asset replacement, constant 'k' has been evaluated, using best engineering judgement, to reflect the underlying probability of failure that would be expected if the assets were not managed proactively.

9.35 When standard assumptions for degradation of asset health with age are applied (as shown in figure 1), the resulting probability of failure curve is shown in figure 2. This approximates to the standard 'bath tub distribution' used in the statistical modelling of reliability.

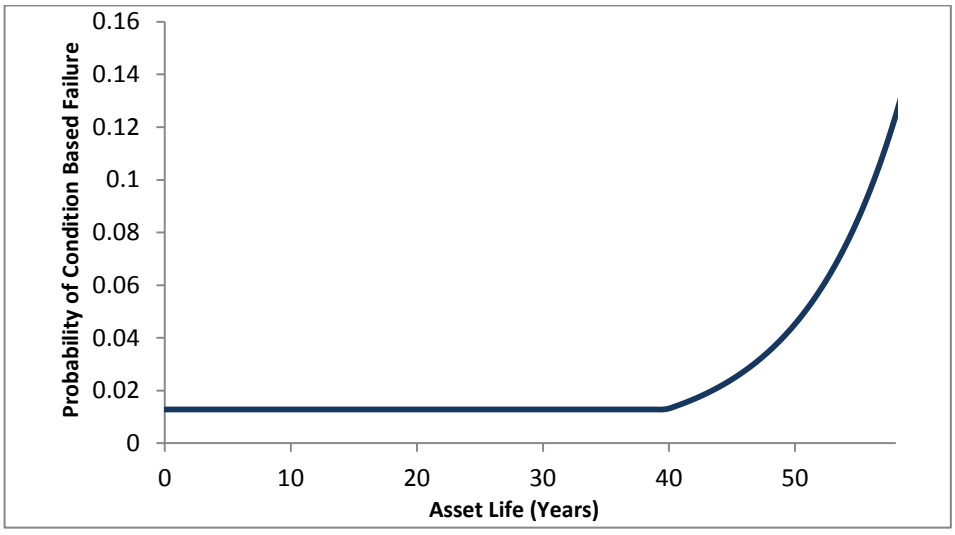


Figure 2: Typical probability of failure curve

Consequence of condition based failure

9.36 Consequence of failure refers to the impact of a condition based asset failure.

9.37 During 2012, WPD worked with the other DNOs to develop a common framework for assessing asset criticality ('criticality' being a relative measure of consequence of failure). This work was undertaken as part of the Criticality and Health subgroup of Ofgem's Reliability & Safety Working Group. The subgroup developed the Criticality Index framework that is used for the reporting of consequence of failure within the RIIO-ED1 BPDT tables, including defining principles for the determination of consequences of failure.

9.38 WPD's risk modelling evaluates consequences of failure consistently with the recommendations developed by the Criticality and Health subgroup.

9.39 Within the CBRM model, the overall consequences of failure are evaluated for each asset, taking into account:

- network performance consequences (i.e. the number of customers interrupted as a result of a failure and the likely duration of the outage);
- safety consequences;
- environmental consequences; and
- financial consequences (i.e. cost of repair).

9.40 All consequences are evaluated as costs (in pounds sterling). This means that:

- the consequences of failure, in each of the above consequence categories, are additive; and
- the cost effectiveness of reductions in the risk of condition based failure can be evaluated against the cost of undertaking asset replacement works.

Consistency with parameters used in Ofgem's stylised cost benefit analysis templates

9.41 WPD has used consistent parameters in the evaluation of consequences of failure to those used in Ofgem's stylised cost benefit analysis templates that DNOs were required to complete and submit as part of the RIIO-ED1 Business Plan (refer to Appendix A2 of Supplementary Annex SA-05 Expenditure).

9.42 For example, in Ofgem's cost benefit analysis template, a value of £36 was specified for the environmental impact of loss of a litre of oil. The same value is used in WPD's CBRM modelling.

9.43 Also, the Ofgem cost benefit analysis template uses a value of £15.44 for a Customer Interrupted and £0.38 for a Customer Minute Lost. These values have been used in the derivation of network performance consequences in WPD's CBRM risk modelling.

9.44 The WPD CBRM based approach inherently embodies cost benefit analysis, but it is separate and distinct from the Ofgem stylised cost benefit analysis template.

Incorporating business improvements

9.45 The number of customers interrupted per asset failure, and likely duration of the outage, are used to determine network performance consequences. Where appropriate, these parameters are evaluated from historic incident data for the relevant asset types.

9.46 Following the acquisition of the West Midlands and East Midlands licence areas, and the introduction of WPD working practises into these areas, WPD has significantly improved the restoration times, during unplanned incidents. As a result, the CBRM models for West

Midlands and East Midlands use a forward looking view of the likely duration of outages when evaluating network performance consequences, rather than historic data.

9.47 Using the forward looking view is important because it determines the asset replacement volumes based upon future consequences of failure. If historic slower restoration times were used this would lead to higher consequences of failure, which in turn would lead to higher volumes of replacement.

Reporting criticality index data within the BPDT

9.48 Work with other DNOs and Ofgem, within the Criticality and Health subgroup of Ofgem's Reliability and Safety Working Group, has developed a process for the categorisation of consequence of failure into a Criticality Index framework.

9.49 The framework uses the average overall consequence of failure, for assets in a given Health Index category, as a reference point and allocates assets to a criticality band using the rules shown in Table 1.

Category	Description	Criticality values included
C1	Low criticality	Less than 75% of the average overall consequence of failure
C2	Average criticality	Greater than, or equal to, 75% and less than 125% of the average overall consequence of failure
C3	High criticality	Greater than, or equal to, 125% and less than 200% of the average overall consequence of failure
C4	Very High criticality	Greater than, or equal to, 200% of the average overall consequence of failure

Table 1: Banding definitions for the Criticality Index reporting framework

Managing condition based asset failure risk

9.50 Condition based asset failure risk is the product of probability of failure and the consequences of failure. Therefore changes to either the probability of failure, or the consequences of failure, will affect risk.

9.51 For any particular asset, the consequences of failure will only change significantly as a result of a discrete event. This may be:

- a specific intervention by the DNO (e.g. the introduction of control measures such as bunding to mitigate oil pollution risk); or
- changes in circumstance external to the DNO's control (e.g. change in adjacent land usage).

9.52 Such events are infrequent and not time specific. The CBRM models assume that the consequences of failure do not change progressively with time.

9.53 Since the future health of an asset deteriorates with age, the future probability of failure for a particular asset will increase as the asset ages.

9.54 The increase in the probability of failure leads to an increase in future condition based risk.

9.55 Figure 3 shows a typical curve that represents how asset failure risk changes as an asset ages. Due to the 'bath tub' shape of the probability of failure curve, the risk during the earlier part of an asset's life remains constant. Asset replacement during this period does not reduce risk, because the replacement asset (assuming 'like for like' replacement) has the same probability of failure as the asset being removed.

9.56 The shaded area under the curve shows the risk that can be managed by asset replacement activity (i.e. the risk that is removed when an asset is replaced with a new asset). It should be noted that this is only the risk that is above the level associated with a new asset.

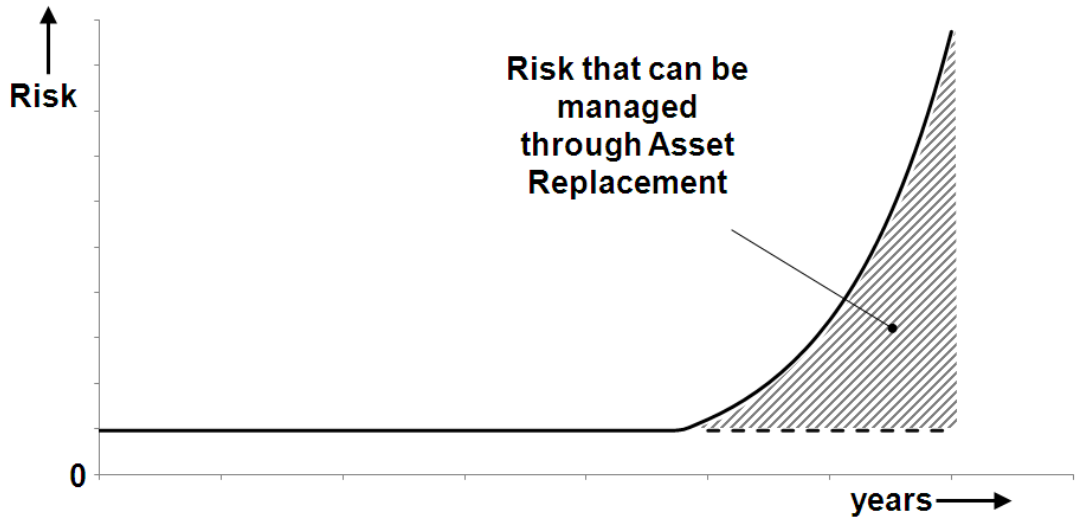


Figure 3: The condition based risk that can be managed through asset replacement

Determining the optimum economic point for asset replacement

9.57 For each asset type at each voltage level, WPD has examined the balance between the present value of the:

- cost of asset replacement; and
- benefits of reduced future risk.

9.58 The analysis determines the costs/ benefits associated with undertaking asset replacement at different points in time during an asset's life. This generates a profile of net benefit and enables the optimum economic point for asset replacement to be determined.

9.59 Due to network differences, the analysis is carried out separately for each asset type at each voltage level in each WPD licence area. This ensures that the optimum economic point for replacement reflects:

- differences in the cost of asset replacement between licence areas; and
- differences in typical consequences of failure between licence areas (e.g. different levels of network performance consequence due to load density, network topology etc.).

9.60 Future asset health is forecast by applying the degradation curve to the current asset health in CBRM. This provides a relationship between probability of failure and asset age, which when combined with the consequences of failure provides a relationship between condition based risk and age.

9.61 The benefit of risk removed in the year of asset replacement is calculated as the difference between the cumulative risk avoided and the risk associated with the new asset.

9.62 For example, assume that an asset is replaced in year 60 of its life. If the original asset has a condition based risk of £1,094.7 in year 60, and the new replacement asset has a condition based risk of £310, then the improvement in risk, in year 60, is £784.70. However, by replacing the asset in year 60, there is also a benefit in reduced risk in the following year, and subsequent years thereafter. This is illustrated in the example shown in Table 2 below.

Year	Condition Based Risk In Year (£) - if original asset retained in service (£)	New asset risk – asset installed in year 60 (£)	Benefit In Year (£): Change In Condition Based Risk (In Year) Delivered By Asset Replacement	Present Value of Benefit In Year (£)
	(a)	*(b)*	*(c) = (a)-(b)*	*discount factor *(c)*
60	1,094.7	310	784.7	99.6
61	1,215.7	310	905.7	111.1
62	1,350.4	310	1,040.4	123.3
63	1,500.2	310	1,190.2	136.3
64	1,666.9	310	1,356.9	184.4
.	.	.	.	.
.	.	.	.	.
100	3,385.4	1,095	2,290.4	73.4
etc.	etc.	etc.	etc.	etc.
	Total Benefit Of Future Risk Removed if asset replacement undertaken in Year 60:			**8,390.9**

Table 2: Example calculation of the benefits of risk removed (where asset replacement is undertaken at year 60)

9.63 In subsequent years the condition based risk increases due to the higher consequences of failure. The risk associated with a new asset initially remains constant, but over time the condition of the new asset will degrade and its associated risk will increase (e.g. new asset risk value is £1,095 in year 100 - when it is 40 year old, which is higher than the initial value of £310 in year 60 – when it is installed).

9.64 Taking the present value of the benefit in each future year (using a discount factor of 3.5%), an overall cumulative benefit in reduction of future years' risk can be calculated in present value terms at £8,390.90. This benefit can be compared to the present value of the cost of replacement in year 60, to determine the cost effectiveness of replacement undertaken at that point in the asset's life.

9.65 In this way, the costs and benefits have been evaluated, in present value terms, for undertaking asset replacement at each year of an asset's life. Figure 4 shows an example of the curve for the present value cost of asset replacement (shown in red) considering each year that the replacement could be undertaken. The cumulative present value benefit of future risk avoided is also shown (by the green curve) for each year that asset replacement could be undertaken. By summating the cost and benefit curves for undertaking asset replacement at each year of an asset's life (shown by the black curve), it is possible to determine the optimum economic point for replacement of the asset. In the example shown in Figure 4, the optimum economic point is where the net benefit/cost curve reaches its maximum value, i.e. around year 60.

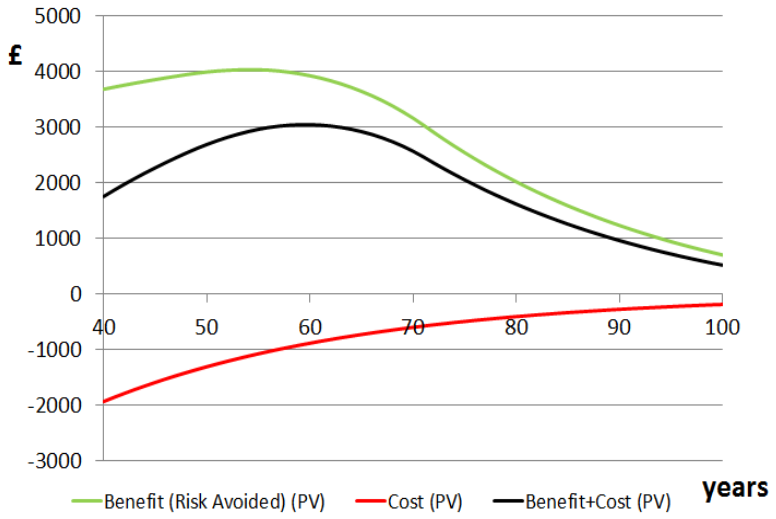


Figure 4: Comparison of cost of replacement and benefit of risk avoided, considering asset replacement across a range of years

9.66 From Figure 4 it can also be seen that the replacement of the asset at any time across the age range shown in the chart would return a positive net present value. Whilst the replacement at such alternative times may be demonstrated as NPV positive, the assets will not be replaced at the optimum economic point in their lifecycles. Therefore these alternatives would not be the most cost effective replacement strategy.

9.67 The determination of an optimum economic point for replacement does not mean that all assets that reach that age are replaced. Instead, this point in time is used to identify the equivalent asset health score by reference to the typical asset health degradation curve. This creates a trigger value of asset health for asset replacement. When an asset's health reaches, or exceeds, the trigger value then the asset should be replaced.

Using criticality to adjust the optimum economic point

9.68 The analysis considers the effect that different levels of consequence of failure have upon the optimum economic point for replacement.

9.69 For each asset type, at each voltage level, in each licence area, the average consequences of failure are determined for the population of the asset type. Individual assets are categorised into four bands, relative to the average consequences of failure for the asset type. These bandings used the same definitions as the Criticality Index bandings, shown in Table 1. The

average consequences of failure for each consequence band are then calculated. This process is illustrated in Figure 5, below.

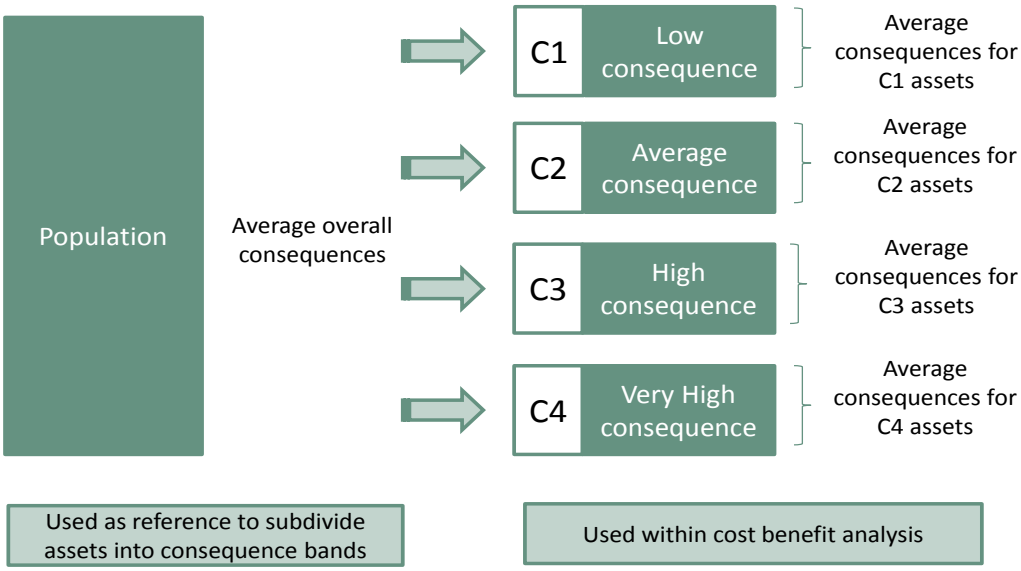


Figure 5: Classification of asset types into consequence bands

9.70 Cost benefit analysis, to determine the optimum economic point of replacement, is then undertaken considering the average consequences of failure for each of the four consequence bands.

9.71 In this way a different optimum point of replacement is determined for each consequence band. This corresponds to a different asset health trigger value for replacement for each consequence band.

9.72 The optimum economic point for assets with lower consequences of failure is later than for assets, of the same type, with higher consequences of failure. This is shown in Figure 6, which shows an example of the net cost benefit curve for four different consequence bands for the same asset type. The optimum point of replacement for assets in the 'Low consequence' band (C1) is shown to be later than for assets in the 'Very High consequence' band (C4).

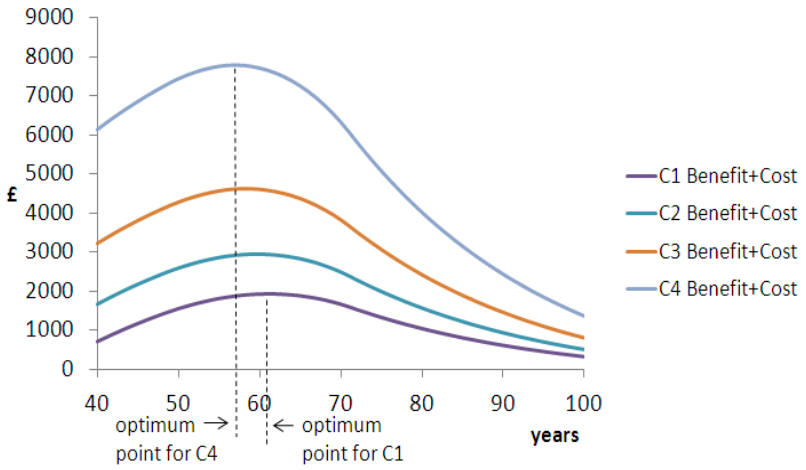


Figure 6: Considering the optimum economic point for replacement for different levels of consequence of failure

9.73 It follows that the asset health trigger value for asset replacement will be greater for assets with lower consequences.

Forecasting asset replacement volumes using the optimum economic point for replacement

9.74 Asset replacement forecasts for RIIO-ED1 are derived from the CBRM models by:

- determining the appropriate consequence band for each individual asset;
- identifying the appropriate trigger value for asset replacement for the appropriate asset type and consequence band;
- determining the asset health score, on the WPD CBRM scale, for each individual asset; and
- comparing the health score for each individual asset against the trigger value to identify those assets where the health score at the end of RIIO-ED1 reaches, or exceeds, the trigger value for replacement.

9.75 This approach determines the optimum volume of assets to cost effectively manage condition based risk. By only replacing those assets that reach the trigger value for asset replacement, the network risk shall migrate to the optimum level. This will lead to the overall optimisation of condition based risk across each of WPD's distribution networks.

9.76 Overall, by refining the asset replacement forecast using risk based modelling, determining the optimum economic point for replacement and optimising condition based risk, WPD's RIIO-ED1 asset replacement expenditure forecast for RIIO-ED1 is reduced to 88% of the expenditure that would be forecast using age based modelling only.

9.77 For some individual asset types, however, risk based modelling has identified higher asset replacement volumes than forecast using age based modelling. These tend to be assets where the ratio of consequences of failure to cost of replacement is relatively high.

Linkage between the asset replacement forecast and the BPDT health index and criticality index tables

Health Index categories

9.78 In DPCR5, Ofgem introduced a system of health index classification that allows categorisation of assets into five bands of health from 'as-new' condition to 'requiring intervention'. The WPD CBRM asset health scale is mapped to the Ofgem categories as follows:

Ofgem Health Index category	Ofgem Description	WPD CBRM health score
HI1	New or as new	0 to 1.5
HI2	Good or serviceable condition	1.5 to 3
HI3	Deterioration requires assessment and monitoring	3 to 6
HI4	Material deterioration, intervention requires consideration	6 to 7
HI5	End of serviceable life, intervention required	Greater than 7

Table 5: Translation of CBRM health scores into Ofgem Health Index categories

DPCR5 output methodology

9.79 In addition to specifying health index categories, Ofgem also introduced an outputs methodology that used the health indices to ensure that DNOs focused on delivering replacement programmes in line with their forecasts. As illustrated in figure 7, DNOs had to determine the health index profile of assets at three points:

- the starting position at the beginning of DPCR5;
- how the health indices will change as a consequence of degradation without any intervention at the end of DPCR5; and
- the impact of proposed replacement programmes on the position at the end of DPCR5.

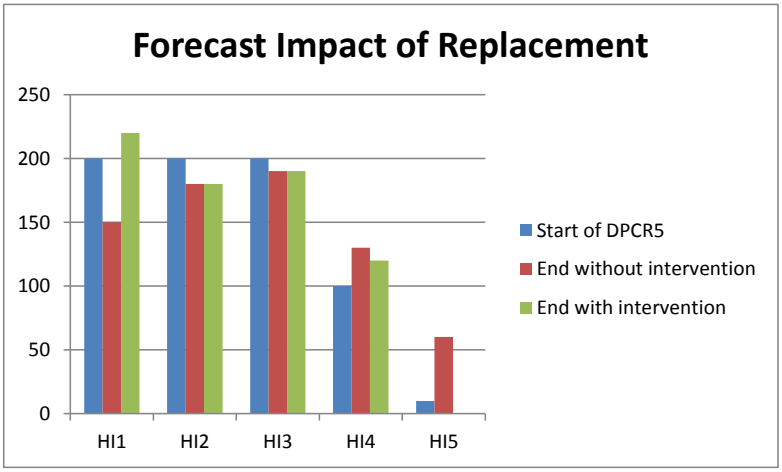


Figure 7: Example of DPCR5 output forecast

9.80 During DPCR5, Ofgem enhanced the assessment by introducing the concept of health index points to assist in calculating whether DNOs had delivered replacement programmes. Health index points are essentially a weighting factor that assigns more points to poor condition assets i.e. HI5 asset generate more points than HI4 assets.

9.81 The health index output forecasts have been converted into a health index points target by assessing the difference between the positions at the end of DPCR5 with and without intervention.

9.82 At the end of DPCR5, Ofgem will compare the number of health index points delivered through asset replacement and refurbishment against the health index points implied by the original forecasts to determine whether DNOs have delivered their work programmes. Where this is not the case Ofgem can invoke a revenue claw back mechanism.

Proposed RIIO-ED1 output methodology

9.83 For RIIO-ED1, Ofgem has extended the concept to also include criticality.

9.84 Health index and criticality index data is presented in a matrix which shows the number of assets that fall into each band as illustrated in table 6 below:

		Heath Index (Probability of failure)				
		HI1	HI2	HI3	HI4	HI5
Criticality	C1	27	16	30	8	6
	C2	35	5	43	12	13
	C3	13	8	9	2	10
	C4	2	-	3	-	6

Table 6: Example of Health Index/ Criticality Index matrix

9.85 The colour coding, proposed by Ofgem, is intended to represent graduations of risk. But, since the WPD assessment of condition based risk has been evaluated on a continuous scale there will be occasions where trigger points for replacement do not align with HI band mapping. This means that there will transitions in some categories in which not all assets will be replaced. For example if the optimum point for replacement is above the Ofgem threshold for the HI5 band, those asset above the band threshold, but below the replacement trigger will not be replaced.

9.86 WPD has populated the supporting BPDT tables for five different situations:

- the starting position at the beginning of RIIO-ED1;
- how the matrix will change as a consequence of degradation without any intervention at the mid-point of RIIO-ED1;
- the impact of proposed intervention programmes on the position at the mid-point of RIIO-ED1;
- how the matrix will change as a consequence of degradation without any intervention at the end of RIIO-ED1;
- the impact of proposed intervention programmes on the position at the end of RIIO-ED1.

9.87 Several sets of matrices have been produced; one set for each health index asset category. WPD has used the matrices to define the outputs that will be delivered as a result of asset replacement and asset refurbishment interventions.

9.88 The outputs are represented by the net difference (the delta) between the position at the end of the period with intervention and the position at the end of the period without intervention. Delivery of the WPD asset replacement and refurbishment programme will be assessed against the net position. Tables of these net positions are provided in the appendix to the Supplementary Annex (SA-04) Outputs.

Further evolution of the methodology in RIIO-ED1

9.89 Each matrix provides an indication of risk. Assets that are in poor condition with the greatest consequences of failure are deemed to be high risk.

9.90 Ofgem has indicated that it will work with the industry to develop a methodology to combine the risk positions for each asset category into an overall risk measure.

9.91 This work will be carried out following submission of the RIIO-ED1 Business Plans.

Impact of trigger points on the population of output matrices

9.92 The population of the Health Index and Criticality Index data for the BPDT uses data from WPD's asset replacement forecasts.

9.93 Assets are assigned into the Criticality Index bandings based on the consequences of failure determined from the CBRM model for each asset type.

9.94 Assets are assigned into the Health Index bandings based on the adjusted CBRM health scores.

9.95 The trigger values for the optimum point for replacement are determined from the WPD CBRM asset health scale, which is a continuous scale. This means that the trigger value for replacement may be 'part way' along the associated Ofgem Health Index Band.

9.96 This means not all assets in parts of the health and criticality matrix will be replaced.

Illustration

9.97 Consider an asset type such as 132kV Transformers in WPD West Midlands. The Health Index/ Criticality Index matrix for this asset, considering the position at the end of RIIO-ED1 without intervention, is shown in Table 7, below.

	End of RIIO-ED1 (31 March 2023) without investment					
	HI 1	**HI 2**	**HI 3**	**HI 4**	**HI 5**	**Total**
C1	27	16	30	8	6	**87**
C2	35	5	43	12	13	**108**
C3	13	8	9	2	10	**42**
C4	2	-	3	-	6	**11**
Total	**77**	**29**	**85**	**22**	**35**	

Table 7: Health Index/ Criticality Index matrix for 132kV transformers in WPD West Midlands

9.98 Assets are assigned into Health Index bandings based on their WPD CBRM asset health scores, which are translated in accordance with table 5.

9.99 For example, all assets with a WPD CBRM health score of greater than 7 are assigned to the Ofgem HI5 category, and all assets with a WPD CBRM health score between 6 and 7 are assigned to the Ofgem HI4 category.

9.100 The trigger values for replacement, determined from WPD's cost benefit analysis, for 132kV transformers in WPD West Midlands are shown in table 8, below:

WPD West Midlands - 132kV transformers	Consequence Banding			
	C1	C2	C3	C4
Trigger value (on WPD CBRM health scale) for replacement	7.42	6.72	6.21	6.08

Table 8: Optimum point for replacement of 132kV Transformers in WPD West Midlands

9.101 Assets in Criticality Index band C1 are forecast to be replaced when their CBRM asset health score reaches 7.42. Consequently, there are some assets shown in Criticality Band C1 and Health Index category HI5, in table 6, that are not forecast to be replaced, because they have yet to reach the optimum economic point for replacement determined from cost benefit analysis (i.e. an asset health score of 7.42).

9.102 This is illustrated in Table 9, which shows the asset movements planned for RIIO-ED1 for 132kV transformers in WPD West Midlands, due to asset replacement (in the first block of data). This shows three assets with a Criticality Index of C1 being replaced. These are all HI5 assets. These assets all have WPD CBRM asset health scores that exceed the trigger value of 7.42.

9.103 The second block of data in Table 9 shows that three of these assets are not planned to be replaced. These are assets that have met the criteria to be assigned to the Ofgem HI5 category, but not yet reached the trigger value for replacement.

	End of RIIO-ED1 (31 March 2023) planned investment (asset replacement only)						End of RIIO-ED1 (31 March 2023) assets not planned to be replaced					
	HI 1	**HI 2**	**HI 3**	**HI 4**	**HI 5**		**HI 1**	**HI 2**	**HI 3**	**HI 4**	**HI 5**	
C1	3	-	-	-	-3	**-**	27	16	30	8	3	**84**
C2	18	-	-	-5	-13	**-**	35	5	43	7	0	**90**
C3	11	-	-	-1	-10	**-**	13	8	9	1	0	**31**
C4	6	-	-	-	-6	**-**	2	-	3	-	0	**5**
	38	**-**	**-**	**-6**	**-32**		**77**	**29**	**85**	**16**	**3**	

Table 9: Planned asset replacement for 132kV Transformers in WPD West Midlands

Replacement of associated assets with lower HI values

9.104 For some Health Index Asset Categories, the asset replacement intervention forecast includes the replacement of small volumes of assets in lower Health Index bands.

9.105 These relate to assets that are in acceptable condition, but need to be replaced in order to facilitate replacement of poor condition assets. For example, where poor condition circuit breakers that form part of an extensible ground mounted switchboard are required to be replaced, it is likely that this will need the whole switchboard to be replaced in order for this to be achieved.

Asset data used for modelling and outputs

9.106 Asset information is recorded in WPD's CROWN asset management system or EMU mapping system. These are prime asset record systems that incorporate the means for recording data that is pertinent to understanding asset condition and its criticality. This information is utilised as an input into the CBRM model. CBRM is an asset replacement modelling approach that makes use of condition information to forecast how an asset's health and consequently the risk of failure is likely to change with time. CBRM analysis underpins WPD's asset replacement forecasts. For RIIO-ED1 CBRM analysis has been extended to cover the majority of assets.

9.107 The robustness of the CBRM process is dependent upon the accuracy of data inputs (as extracted from CROWN and EMU) as well as the validity of the assumptions built into the CBRM model itself. Condition information has been collected for a number of years. The range of information collected is monitored and refined as the link between condition measures, asset health and probability of failure become better understood.

9.108 CROWN has a number of control features that operate to assist data quality management. Internal KPIs are used to manage the completion of asset related work activity. Work activities are not counted for KPI purposes until the CROWN job is closed. The closing of a CROWN job requires the completion of mandatory data fields. This assists in ensuring that all relevant information is captured.

9.109 Analysis of asset records against expenditure records is carried out to gain assurance over the completeness of asset records updates. Policy initiatives have been implemented to extend the range of condition information captured on-site.

9.110 As new technology permits, further initiatives will be pursued to improve the quality of data capture. These include:

- on-site data capture using handheld devices;
- real time smart assessment of test / inspection results to identify and challenge unusual data entries;
- refining condition assessment to move from subjective interpretation to evidence based fact gathering.

9.111 The CBRM outputs will be validated through assessment and review of proposed candidate replacements by local engineering management. This will help to refine the assumption values used within the model. The CBRM model will continue to be developed and refined as more data is collected and analysed.

Summary of asset replacement forecasting

9.112 WPD has used consistent data in its modelling of asset risk, forecasting of asset volumes and reporting of asset health and criticality.

9.113 WPD's asset replacement forecast for RIIO-ED1 has been developed using both:-

- long term projections to deliver relatively stable activity levels over the longer term; and
- risk based modelling to cost effectively manage of condition based risk through the asset replacement activity.

9.114 WPD's risk based forecasting of asset replacement volumes, derives forecast activity levels that will lead to the cost effective optimisation of condition based network asset risk, whilst maintaining sustainable activity levels in the longer term.

9.115 Since the approach is new for RIIO-ED1, it does not presuppose that the prevailing level of risk is correct or cost effective.

9.116 Overall, the optimisation of risk in the RIIO-ED1 forecast has reduced the forecast expenditure to 88% of the forecast produced by survivor modelling.

Forecasting approach for each asset category

9.117 The approach used to determine the RIIO-ED1 asset replacement programme for each asset category is shown in the table below:

Forecasting approach for each asset category	
Asset Category	**Forecasting Approach**
UG – LV main (Consac)	Forecast fault rates/ historic activity levels
UG – LV main (Paper)	Forecast fault rates/ historic activity levels
UG – LV main (Plastic)	Forecast fault rates/ historic activity levels
UG – LV service replacement	Survivor model
UG – LV service transfers	Derived from forecast LV main asset volumes
UG – HV cable	Combination of CBRM/ survivor model
UG – 33kV, 66kV and 132kV cable (non-pressurised)	Combination of CBRM/ survivor model
UG – 33kV, 66kV and 132kV cable (oil)	Combination of CBRM/ survivor model
UG – 33kV, 66kV and 132kV cable (gas)	Combination of CBRM/ survivor model
OH – Services	Survivor model
OH – LV, HV, 33kV, 66kV and 132kV conductor	Combination of CBRM/ survivor model
OH – LV, HV, 33kV, 66kV and 132kV pole	Combination of CBRM/ survivor model
OH – Pole refurbishment	Combination of asset replacement forecast/ historic activity levels
OH – Tower replacement	Survivor model
OH – Tower refurbishment	Combination of asset replacement forecast/ historic activity levels
OH – Tower fitting replacement	Survivor model
OH – Tower painting	Historic activity levels for routine activity
OH – Tower foundation refurbishment	Combination of asset replacement forecast/ historic activity levels
SG – Cut-out replacement	Survivor model
SG – LV pillar replacement	Combination of CBRM/ survivor model
SG – UGB and pillars not at substations	Combination of CBRM/ survivor model
SG – HV switchgear	Combination of CBRM/ survivor model
SG – 33kV, 66kV and 132kV switchgear	Combination of CBRM/ survivor model
TX – HV ground mounted transformers	Combination of CBRM/ survivor model
TX – HV pole mounted transformers	Combination of CBRM/ survivor model
TX – 33kV, 66kV and 132kV transformers	Combination of CBRM/ survivor model
PR – Batteries	Historic activity levels
Civil driven by asset replacement	Derived from forecast plant asset volumes
Civil driven by civil aspects	Historic activity levels

10 Asset replacement and refurbishment

Background

10.1 The existing network has developed over many years with a large proportion being installed during the 1950s and 1960s.

10.2 Generally as assets get older they deteriorate, but the rate of degradation is dependent upon many factors including quality of manufacture, whether they are installed indoors or outdoors and local environmental conditions (e.g. assets close to the coast suffer from salt corrosion).

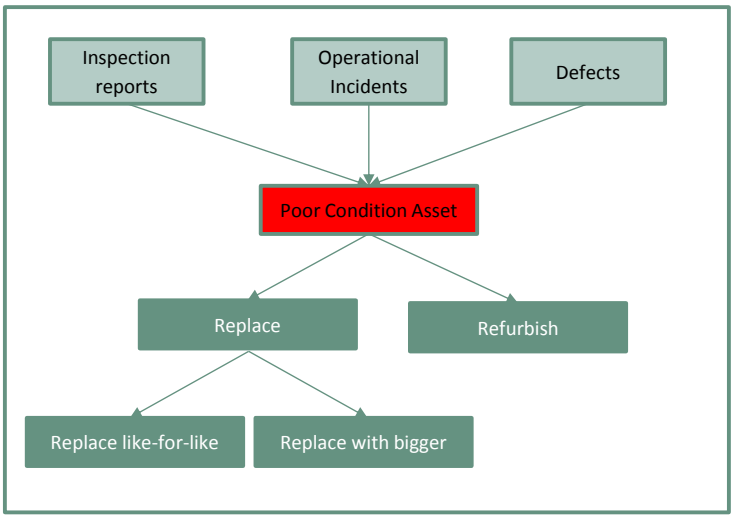
10.3 Actual asset replacement is therefore not undertaken on the basis of age, but on the basis of condition assessment. Condition assessment is carried out during routine inspection and maintenance and is supplemented by more detailed assessments once assets approach expected average lives.

10.4 Equipment, particularly switchgear, may also become embargoed with operational restrictions applied where defective components can lead to dangerous situations. Minor modifications can eliminate some defects, but where defective components cannot be easily remedied the equipment is replaced.

10.5 Generally assets will be replaced on a like-for-like basis using modern equivalents, but refurbishment will be considered where lower cost actions can extend the useful life of an asset by several years.

10.6 In addition, the anticipated load growth from the increased uptake of LCT means that consideration will be given to installing greater capacity assets where there is a strong indication that load growth will take place. This opportunistic reinforcement should negate the need for subsequent reinforcement as load increases. The small incremental increase in material costs will reduce long term costs particularly for cable assets where the majority of the costs arise from excavation and reinstatement.

10.7 In summary, condition and defect information will be used to develop work programmes that are targeted to replace poor condition assets and those with operational restrictions. The overall programme will be a mix of cost effective solutions consisting of like-for-like replacement, refurbishment and opportunistic reinforcement. This can be summarised in a flowchart:

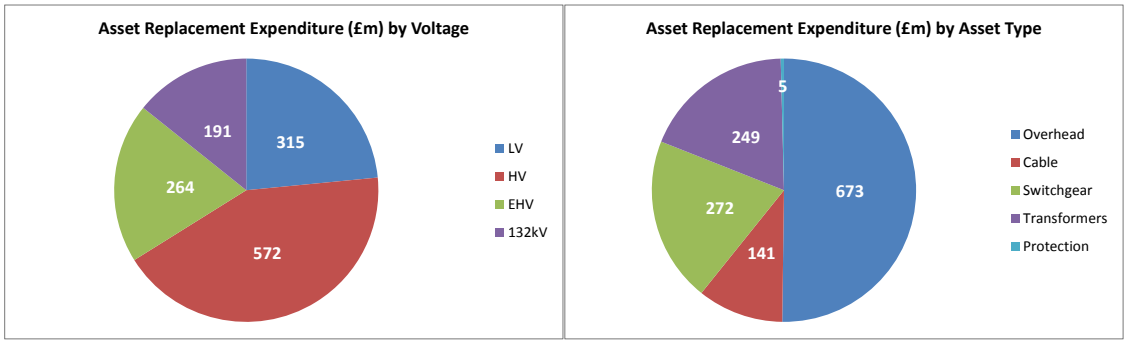


Expenditure forecast summary

10.8 The following tables and charts summarise how much will be spent on each type of asset for asset replacement and asset refurbishment over RIIO-ED1.

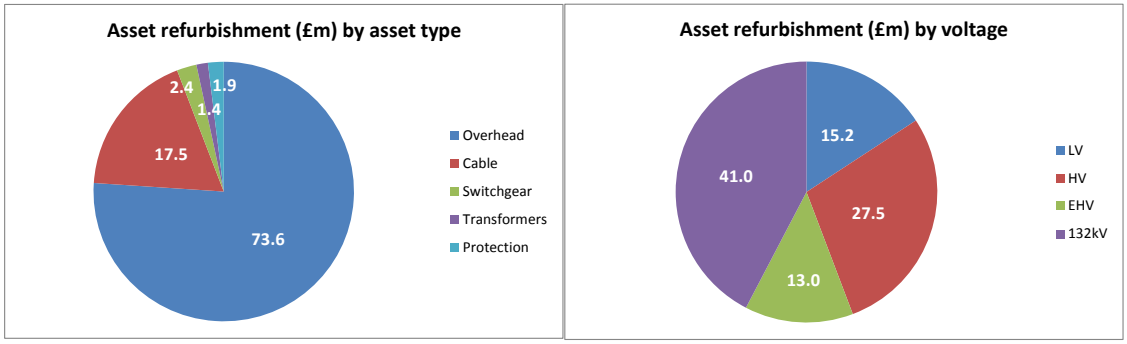
Asset Replacement Expenditure RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
LV Overhead Pole Line	72.1	40.4	39.9	77.1	229.5
LV Cable Consac	2.9	0.0	0.0	3.8	6.7
LV Cable Paper/LV Service	6.3	7.6	2.5	4.4	20.8
LV Switchgear	23.3	16.5	7.0	10.6	57.4
HV Overhead Pole Line	86.7	58.7	84.9	87.0	317.3
HV Cable	6.4	15.2	7.1	7.7	36.5
HV Switchgear	43.3	41.7	12.7	33.0	130.6
HV Transformer	24.8	20.0	14.5	26.8	86.0
HV Protection	0.5	0.1	0.0	0.5	1.2
EHV Overhead Pole Line	22.3	13.2	15.4	22.2	73.1
EHV Overhead Tower Line	1.6	2.3	0.2	0.6	4.7
EHV Cable	2.9	15.5	5.8	18.5	42.7
EHV Switchgear	8.7	17.7	8.7	13.3	48.5
EHV Transformer	17.8	31.8	14.7	27.3	91.7
EHV Protection	0.5	1.0	0.4	1.1	3.0
132kV Overhead Pole Line	0.0	0.0	0.5	0.2	0.7
132kV Overhead Tower Line	13.0	18.4	8.8	7.7	47.9
132kV Cable	32.9	0.0	0.0	1.8	34.6
132kV Switchgear	15.1	11.8	2.0	6.2	35.0
132kV Transformer	24.5	26.9	12.2	8.1	71.6
132kV Protection	0.4	0.1	0.2	0.4	1.1
Other Protection	0.0	0.0	0.0	0.0	0.0
TOTAL	**406.0**	**338.9**	**237.5**	**358.3**	**1,340.6**

10.9 Asset replacement is spread broadly across all voltages with most expenditure at HV. The split across assets types shows that most expenditure will be on overhead lines:



Asset Refurbishment RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	Total
LV Overhead Pole Line	3.3	1.2	0.9	3.9	9.3
LV Underground service transfers	2.2	2.4	0.2	1.1	6.0
HV Overhead Pole Line	5.3	3.0	9.1	7.9	25.4
HV Switchgear	0.8	0.7	0.1	0.6	2.2
EHV Overhead Pole Line	1.9	0.4	1.2	2.5	6.0
EHV Overhead Tower Line	2.1	2.0	0.6	0.8	5.5
EHV Cable	0.0	0.0	0.0	0.0	0.0
EHV Switchgear	0.0	0.0	0.0	0.0	0.0
EHV Transformer	0.0	0.0	0.0	0.0	0.0
EHV Protection	0.2	0.6	0.3	0.3	1.4
132kV Overhead Pole Line	0.0	0.0	0.0	0.0	0.0
132kV Overhead Tower Line	5.8	9.8	5.1	6.5	27.3
132kV Cable	5.3	3.6	1.3	1.3	11.6
132kV Switchgear	0.1	0.1	0.0	0.0	0.2
132kV Transformer	0.6	0.4	0.2	0.1	1.4
132kV Protection	0.2	0.2	0.0	0.1	0.5
TOTAL	**28.0**	**24.4**	**19.1**	**25.3**	**96.8**

10.10 The majority of asset refurbishment will be on overhead line networks with the activity spread across the voltage range with work taking place on both wood pole and tower lines.



Longer term requirements

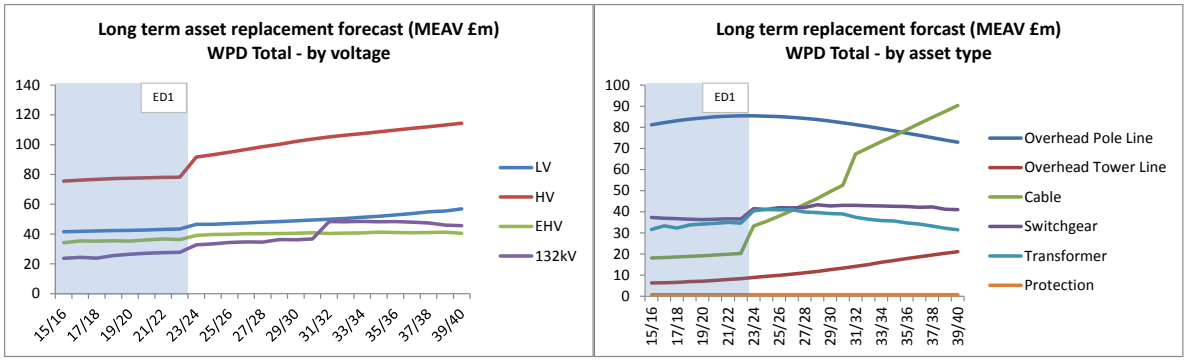
10.11 The volume of asset replacement has been increasing since DPCR3 across all asset types. By the end of RIIO-ED1, the survivor modelling indicates that the volume of replacement activity approaches a plateau for the majority of switchgear, transformers and overhead lines, with cables being the main category where volumes continue to grow from the current low levels.

10.12 The following charts illustrate how the financial expenditure, on asset replacement is forecast to evolve beyond the end of RIIO-ED3 (2040) for each of the licence areas.

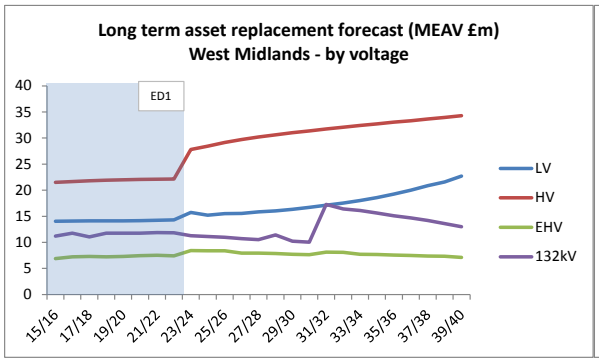
Longer term trends

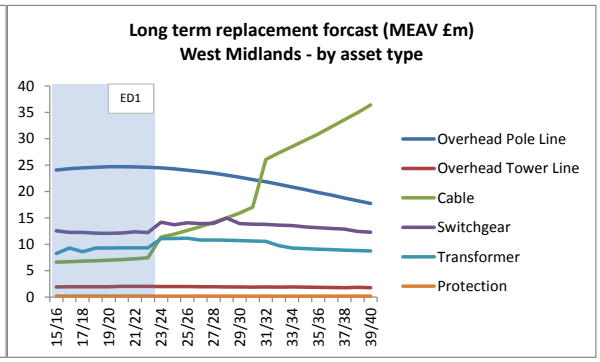
10.13 The following charts combine the forecasts for RIIO-ED1 with a longer term view informed by survivor modeling for subsequent periods. They show that over the next thirty years the main changes are dominated by increases in cable replacement.

WPD Total

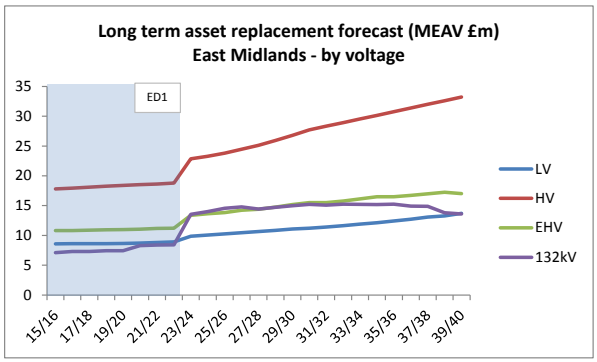


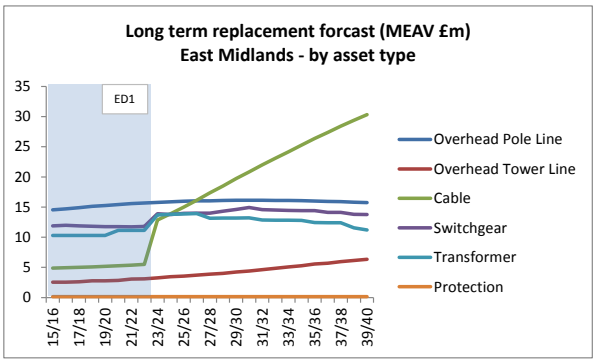
West Midlands



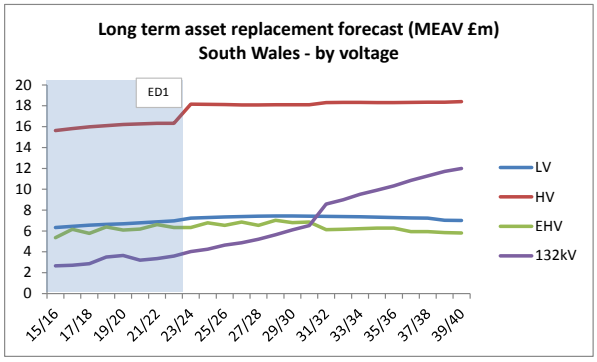


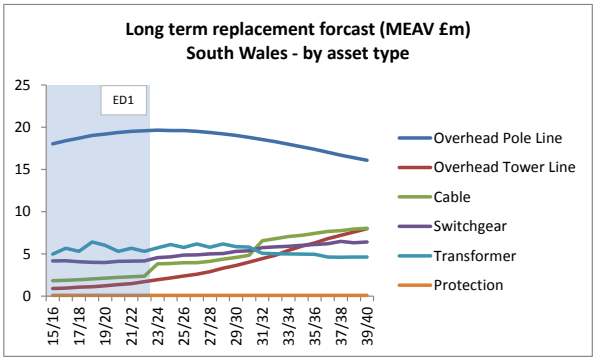
East Midlands



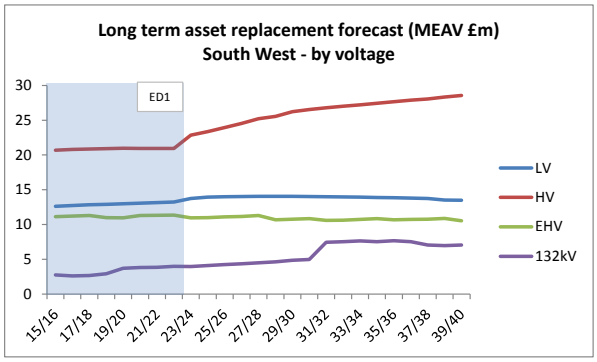


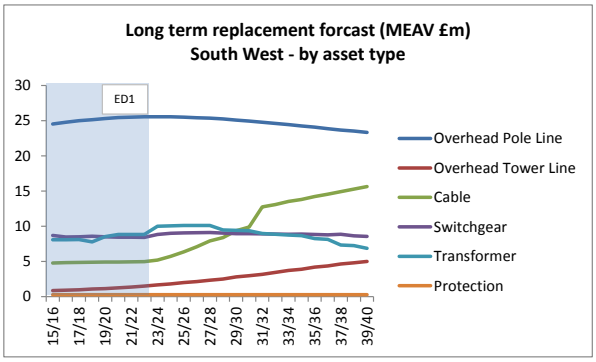
South Wales





South West





Asset replacement details

10.14 The following sections provide specific details, volumes and costs for each asset category.

Underground cables

LV main (underground Consac cable)

10.15 WPD has 6,400km of Consac cable predominantly installed in the West Midlands (3,700km) and the South West (2,700km). This aluminium cable was largely installed in the 1970s as a lower cost alternative cable. Consac cable is prone to faults, mainly caused by water ingress where cables are jointed together. Many joints on an individual cable were installed at the same time meaning faults can occur in geographical clusters causing repeat interruption and nuisance for customers.

10.16 In addition, the cable construction provides limited protection from damage. The outer neutral earth conductor is made from aluminium, covered in a thin layer of bitumen and a PVC oversheath. Protrusions from stones or third party excavations can damage the oversheath leading to corrosion. Where the corrosion affects the integrity of the neutral earth, there is a potential for higher operating voltages to occur that can cause damage to customers' appliances.

10.17 When circuits are beyond their useful life because of their condition (i.e. where there are multiple failures and neutral faults), they will be progressively replaced with modern plastic insulated cables.

LV Main (UG Consac) (Mean life 55 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	44	0.1%	0	2.9
East Midlands	0	0.0%	0	0.0
South Wales	0	N/a	0	0.0
South West	33	0.1%	0	3.8
Total	**77**	**0.1%**	**0**	**6.7**

LV main (underground paper insulated cable)

10.18 The majority of the low voltage network built before the 1970s is constructed using paper insulated cables. The robust construction of these cables incorporates lead sheaths and steel tapes wrapped around the lead providing good physical protection. It is expected that these cables will last a long time with average lives of 100 years.

10.19 There are pockets of the network where paper LV cables or the joints on the paper LV cables have deteriorated and cause repeat interruptions to customers. These generally occur during wet weather when water ingress leads to faults. The faults cause substation fuses to blow, but in many circumstances do not lead to a permanent open circuit fault (which means that the faults are difficult to locate). In practice, the fuses are replaced and all customers are restored until the next period of heavy rain where the circuit faults again. After several fuse operations permanent faults develop and only then can they be located, but in the meantime there has been significant nuisance for customers.

10.20 Historically these cables have not been overlaid until several permanent faults have occurred. The increasing reliance on electricity for heating, transport and distributed generation means that the volume of these repeat interruptions needs to be limited and replacement considered earlier. Even so, the volume of replacement is relatively low.

LV Main (UG Paper) (Mean life 100 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	39	0.0%	0	2.6
East Midlands	44	0.0%	0	2.9
South Wales	14	0.0%	0	0.9
South West	15	0.0%	0	1.7
Total	**112**	**0.0%**	**0**	**8.1**

LV main (underground plastic insulated cable)

10.21 There are two main types of plastic cables; with the main difference being the material used for the neutral earth waveform wire conductor. The cable currently used throughout WPD has copper as the neutral earth that is laid on top of soft plastic bedding used mainly to hold the waveform wires in place. The alternative (previously installed in South Wales and East Midlands) uses aluminium for the neutral earth, but since aluminium is more susceptible to corrosion it is totally encased in the bedding thereby giving it more protection from moisture. However, if the cable is damaged there can be progressive corrosion of the aluminium neutral earth wires that eventually leads to loss of continuity of the neutral conductor (albeit after a long time).

10.22 A very small volume of the conductor will be replaced where damage is found to have caused corrosion of the neutral.

LV Main (UG Plastic) (Mean life 90 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	0	0.0%	83	0.0
East Midlands	0	0.0%	44	0.0
South Wales	0	0.0%	14	0.0
South West	0	0.0%	48	0.0
Total	**0**	**0.0%**	**189**	**0.0**

LV service (underground)

10.23 Service work will generally be carried out in coordination with LV mains cable replacement. Most of the activity involves reconnecting the existing service cable to the new main (service transfers), usually by letting in a new short length of service cable. In some instances it may be found that the existing service cable is in poor condition and the service will be replaced in its entirety. The volume of replacement carried out is a very small proportion of the population.

LV Service (UG) (Mean life 100 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	2,974	0.0%	2,974	3.7
East Midlands	3,691	0.0%	3,691	4.7
South Wales	1,274	0.0%	1,274	1.6
South West	2,120	0.0%	2,120	2.7
Total	**10,059**	**0.0%**	**10,059**	**12.7**

LV Underground service transfers			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	5,232	0.0%	2.2
East Midlands	5,576	0.0%	2.4
South Wales	472	0.0%	0.2
South West	2,696	0.0%	1.1
Total	**13,976**	**0.0%**	**6.0**

Rising & lateral mains (RLM)

10.24 During DPCR5 negotiations, several DNOs forecast costs for the inspection and replacement of rising and lateral mains located in housing blocks constructed by local authorities. Ofgem recognised that the extent of issues with RLM varied widely across the licensed areas, as did the extent to which ownership of the RLM has been established. (Some RLM are owned by DNOs whilst others are owned by landlords or Councils but it is often not clear who owns them).

10.25 Due to this uncertainty, and with the understanding that the associated costs could be significant, Ofgem proposed to include an ex-ante allowance (for those companies requesting investment) to provide interim funding after which allowances would be reassessed through a reopener in July 2012. This did not apply to the four licences operated by WPD because no funding requests were made either at the start of DPCR5 or at the re-opener window.

10.26 To date, no issues have come to light and therefore there are no plans to carry out replacement programmes during RIIO-ED1.

HV underground cable

10.27 Before the 1990s most HV cable was paper insulated, but since then both cross linked polyethylene (XLPE) and ethylene propylene rubber (EPR) insulated cables have been used.

10.28 The main problems encountered in HV paper cables relate to the drying out of the oil based mineral from paper insulation, causing discharge to occur and a fault to develop.

10.29 XLPE cables can be susceptible to deterioration of the insulation. The deterioration weakens the insulating strength and leads to failure. The deterioration is accelerated where impurities have been introduced into the insulating material during the manufacturing process. The degree of contamination in the insulating will determine whether there are individual point defects or whether whole cable lengths are affected.

10.30 In the past 6.6kV networks have been uprated to 11kV by changing transformers but leaving old cables in situ, thereby providing greater network capacity without the cost of replacing cables. However due to prolonged increase in capacity these cables are now showing signs of stress and are also showing signs of insulation degradation.

10.31 HV cable replacement will be considered where there is a history of faults or where condition assessment at time of fault identifies that the insulation is in poor condition.

6.6/11kV UG Cable (Mean life 87 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	75	0.1%	75	6.4
East Midlands	176	0.2%	176	15.2
South Wales	82	0.2%	82	7.1
South West	66	0.1%	66	7.1
Total	**400**	**0.1%**	**400**	**35.8**

33kV, 66kV and 132kV underground cable (non-pressurised)

10.32 Older types of non-pressurised cables are constructed using paper insulation. Insulation degradation, such as observed in HV cables, is the main reason for any replacement. Most of the activity will however be replacing 33kV cable.

33kV,66kV and 132kV UG Cable (Non pressurised) (Mean life 75/70/65 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	15	0.5%	48	2.7
East Midlands	84	0.5%	84	15.5
South Wales	24	0.6%	28	4.3
South West	48	0.7%	93	8.5
Total	**172**	**0.6%**	**254**	**31.0**

33kV, 66kV and 132kV underground cable (oil filled)

10.33 A large proportion of 33kV, 66kV and 132kV underground cables are constructed using a biodegradable oil based fluid that enhances the insulating properties by filling any voids between paper insulation reducing the likelihood of electrical discharge. This construction makes the cables extremely reliable electrically but does pose the risk of fluid leakage. The potential environmental impact of fluid leakage necessitates proactive management of fluid filled cables.

10.34 Prioritised replacement programmes are derived using information on leakage rates, the cause of leaks and their environmental impact. Priority is given to those cables with condition deficiencies such as porous lead sheathing and those that pass through Environment Agency 'Source Protection Zones'.

33kV,66kV and 132kV UG Cable (Oil) (Mean life 70/70/65 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	24	0.8%	0	24.2
East Midlands	0	0.0%	0	0.0
South Wales	0	0.0%	0	0.0
South West	15	1.3%	0	4.3
Total	**39**	**0.5%**	**0**	**28.5**

33kV, 66kV and 132kV underground cable (gas filled)

10.35 As an alternative to using fluid, some cables use inert gas under pressure to fill any voids between papers within the insulation. Internal gas pressure cables incorporate porous pipes within their construction to distribute the gas along the cable length. The cable is prevented from bursting by being wrapped with springy metal tapes. These tapes corrode causing weak points and gas leaks. Leaks can also develop at joint interfaces.

10.36 An alternative construction uses an external steel pipeline with sections welded together to create a homogenous tube for the cores to be laid in. The whole pipeline is pressurised with the gas filling the voids between the paper insulation by external pressure on the cores. The main problem with this cable arises when the pipeline becomes depressurised as a result of damage, leaks or during a fault repair. Once depressurised, moist air may enter the pipeline and penetrate into the cores leading to increased likelihood of failure. Once a failure occurs, repeat failures become common causing severe risk to network security.

10.37 The proposals for RIIO-ED1 include:

- West Midlands – gas filled cable to be replaced in two circuits;
- East Midlands – no gas filled cables exist;
- South Wales – gas filled cable to be replaced in two circuits;
- South West – all gas filled cable to be replaced (fourteen circuits).

33kV,66kV and 132kV UG Cable (Gas) (Mean life 70/70/65 years)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	9	3.0%	0	8.9
East Midlands	0	N/a	0	0.0
South Wales	4	5.6%	0	0.8
South West	34	11.1%	0	6.0
Total	**47**	**7.0%**	**0**	**15.6**

Overhead lines

10.38 Overhead lines can be subdivided into five main sub elements:

- the conductor;
- the support, either a steel tower or wooden, metal or concrete pole;
- pole fittings, including pole top steelwork, insulators, stays and anti-climbing devices;
- tower fittings, including insulator strings, vibration dampers, shackles and clamps;
- tower access and security measures, including anti-climbing devices, access gates and step-bolts.

10.39 The wholesale replacement of conductor, a support (pole or tower) and tower fittings is classified as asset replacement.

10.40 Where pole top fittings are replaced at the same time as the pole itself this work is incorporated into the asset replacement costs.

10.41 Costs are classified as refurbishment where pole top fittings are replaced without changing the pole or where sections of tower steelwork are renewed without wholesale tower replacement or where components such as tower access and security measures are replaced.

10.42 Costs for both replacement and refurbishment activity are detailed below.

LV service (overhead)

10.43 Overhead line services provide connections to properties from overhead main lines. They are generally supported on wall brackets before being clipped down or along external walls for entry into service positions mounted on buildings. Overhead line services will be replaced where they are found to be in poor condition during main line replacement or where supports are found to be defective.

10.44 Some properties are serviced by undereave installations (sometimes referred to as house service overhead system (HSOS)) where a main line, either underground or overhead, terminates in a wall mounted distribution box and service cables are cleated along property walls, sometimes crossing a number of properties. The insulation on older cables is made from jute-covered or hessian-covered vulcanised india rubber that perishes, becomes brittle and cracks over time. The insulation can easily be dislodged by homeowners using ladders thereby causing a safety hazard. Undereaves services that are in poor condition will either be replaced with modern service cables or the service arrangements changed to feed them from underground cables.

LV Service (OHL) (Mean life 55 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	19,760	1.0%	19,760	7.5
East Midlands	7,487	0.7%	7,487	2.8
South Wales	28,764	1.1%	28,764	10.8
South West	47,098	1.3%	47,098	17.8
Total	**103,109**	**1.0%**	**103,109**	**38.9**

LV, HV, 33kV, 66kV and 132kV poles

10.45 The majority of the overhead network is supported on wooden poles. They have been impregnated with creosote to slow down the rate of degradation. Whilst this provides them with prolonged life they do progressively decay at ground level and are susceptible to woodpecker damage.

10.46 Within WPD, a very high priority is placed on the replacement of poor condition wooden poles. This activity removes weak points from overhead line networks that not only reduces safety risks and but also reduces the likelihood of failure during severe weather conditions (therefore limiting the impact of storms on customers).

10.47 WPD's target is to remove poor condition poles from the network within a year of them being identified. This activity forms one of the voluntary secondary deliverables for reliability outputs in RIIO-ED1.

10.48 When poles are replaced the associated steelwork, insulators, anti-climbing devices and stays are also renewed. Where a line is upgraded, not all poles will need to be replaced but the pole top equipment may be in poor condition: in these instances the replacement of pole top equipment will be treated as pole refurbishment.

10.49 EU legislation, The Biocidal Products Directive, has resulted in a review of the use of creosote as a wood preserver. Under current regulations, the electricity industry is allowed to use creosote impregnated poles up to 2018, but their use could be banned during the RIIO-ED1 period. One alternative may be a hybrid pole being developed in Sweden made from a fibreglass inner and UV protective polyethylene outer layer, but this is still under development and not ready for the UK market. The alternatives to wooden poles are more expensive; the hybrid pole is estimated to be two to three times the cost of wooden pole and concrete poles being five times the cost.

10.50 WPD's cost forecasts are based upon the continued use of the creosote impregnated poles. It does not include any additional costs for alternative types.

LV,HV,33kV,66kV and 132kV pole replacement (Mean life 60 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	78,139	2.3%	78,139	128.1
East Midlands	54,915	2.1%	54,915	89.7
South Wales	48,990	1.9%	48,990	81.5
South West	65,144	1.6%	65,144	105.0
Total	**247,188**	**2.0%**	**247,188**	**404.3**

LV,HV,33kV,66kV and 132kV pole refurbishment			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	45,050	1.3%	10.5
East Midlands	19,188	0.7%	4.6
South Wales	38,234	1.5%	11.2
South West	59,754	1.5%	14.4
Total	**162,226**	**1.3%**	**40.7**

LV main (overhead conductor)

10.51 Low voltage overhead lines have traditionally been constructed with bare conductors spaced in an open vertical formation supported on wooden poles. The bare conductor has been either been made up of one solid conductor or made from a number of strands. Whilst it is generally robust it can be prone to damage from trees and windborne materials.

10.52 WPD's current design standard is to use insulated conductors that are twisted together (known as Aerial Bundled Conductor (ABC)). ABC is used because it is safer and more resilient

10.53 Low voltage conductor found to be damaged or deteriorated will wherever possible be replaced with ABC.

LV Main (OHL) Conductor (Mean life undefined)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	1,134	2.4%	1,134	15.0
East Midlands	400	1.1%	400	5.3
South Wales	304	1.2%	304	4.0
South West	1,353	2.3%	1,353	18.1
Total	**3,191**	**1.7%**	**3,191**	**42.5**

HV main (overhead conductor)

10.54 HV conductor is generally robust and can last a long time. Strong winds can cause the conductor to vibrate which causes wear near to the points where the conductor is bound onto insulators. Conductors with small cross-sectional area can also be more prone to damage because of its lower tensile strength and this has been progressively phased out since snow storms caused severe damage to the UK network in December 1981.

10.55 Conductors will be replaced on those circuits delivering poorest performance or where the conductor has deteriorated significantly. Where economically viable, the opportunity will be taken to reconfigure networks (e.g. installing a remotely operated switch or interconnecting circuits) and increase network flexibility to improve the capability to restore customers' supplies under fault situations.

6.6/11kV OHL (conventional conductor) (Mean life undefined)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	1,443	1.2%	1,443	22.6
East Midlands	819	0.8%	819	12.8
South Wales	2,472	2.5%	2,472	38.8
South West	2,165	1.6%	2,165	34.1
Total	**6,898**	**1.4%**	**6,898**	**108.3**

33kV, 66kV and 132kV overhead (pole line) conductor

10.56 33kV, 66kV and 132kV conductor on wood pole supports can corrode and wear over several decades leading to broken strands and the increased risk of conductor failure. Excessively corroded and worn conductors will be replaced.

33kV,66kV and 132kV pole line conductor (Mean life undefined)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	279	1.9%	279	8.0
East Midlands	56	0.3%	56	1.6
South Wales	189	1.3%	189	5.4
South West	401	1.6%	401	11.6
Total	**924**	**1.3%**	**924**	**26.6**

33kV, 66kV and 132kV overhead (tower line) conductor

10.57 Where steel towers are used to support conductors the distance between towers (span length) is longer than the distance between wood poles. The increased span length makes the conductors more susceptible to wind-induced movement such as vibration, horizontal sway or 'vertical galloping'. This movement can lead to wear of the conductor where it comes into contact with fittings.

10.58 To limit the effect of movement vibration dampers are installed on the lines to dissipate the oscillations. However, the vibration dampers are also subject to corrosion and over time their effectiveness is reduced. When this happens wear occurs at the point of connection.

10.59 Aluminium Conductor Steel Reinforced (ACSR) conductor uses steel inner strands to provide mechanical strength and aluminium outer conductors to carry the current. The aluminium conductor can suffer from bi-metallic corrosion caused by the interaction of the different metals. In order to limit the corrosion the steel core is zinc galvanized and the aluminium strands are greased during manufacture. Over time these protective measures become ineffective and the aluminium degrades and breaks.

10.60 Conductors showing signs of excessive wear, fatigue or corrosion will be replaced.

33kV,66kV and 132kV tower line conductor (Mean life undefined)				
	RIIO-ED1 Period Assets Removed (km)	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed (km)	Forecast Expenditure £m
West Midlands	234	1.7%	234	11.0
East Midlands	291	1.0%	291	13.7
South Wales	101	1.0%	101	4.8
South West	99	0.7%	99	4.7
Total	**725**	**1.1%**	**725**	**34.1**

33kV, 66kV and 132kV tower replacement and refurbishment

10.61 Overhead tower steelwork is prone to atmospheric corrosion that is particularly aggressive near coastal regions. The acidity in bird droppings can also produce corrosion at the top of towers where birds roost.

10.62 Routine tower painting, which is carried out on a 20 year cycle, prevents most of the corrosion. Towers can often be refurbished by changing the individual sections of corroded steelwork. Where the corrosion is widespread or affects the main legs or cross arms the replacement of the whole tower will be considered.

10.63 Ground conditions can affect the stability of towers and a small number of towers have fallen over during strong winds. Examination of foundations may identify that there are cracks in the concrete, corrosion of the steel reinforcing bars or corrosion of the tower steelwork within the foundation. Where defective foundations are found they will be removed, tower steelwork refurbished and foundations recast. In the event of excessive steelwork corrosion the towers will be replaced.

10.64 Tower condition will be assessed during routine inspections and by using high-resolution photography taken by cameras mounted on helicopters.

33kV,66kV and 132kV tower replacement (Mean life 110 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	0	0.0%	0	0.0
East Midlands	53	0.1%	53	2.9
South Wales	33	0.1%	33	3.0
South West	35	0.1%	35	2.3
Total	**121**	**0.1%**	**121**	**8.2**

33kV,66kV and 132kV tower refurbishment			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	160	0.5%	0.9
East Midlands	232	0.5%	1.3
South Wales	112	0.5%	0.8
South West	144	0.4%	0.8
Total	**648**	**0.5%**	**3.9**

33kV,66kV and 132kV tower painting			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	1,536	4.4%	3.5
East Midlands	2,280	4.4%	5.3
South Wales	1,056	4.5%	2.5
South West	1,435	4.5%	3.3
Total	**6,307**	**4.4%**	**14.6**

33kV,66kV and 132kV tower foundations			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	160	0.5%	3.5
East Midlands	232	0.5%	5.2
South Wales	112	0.5%	2.5
South West	144	0.4%	3.2
Total	**648**	**0.5%**	**14.4**

33kV, 66kV and 132kV tower insulators and fittings

10.65 Tower insulators and fittings are subject to atmospheric corrosion that rusts components.

10.66 Fittings can also be affected by the movement of the line which causes the components to rub and wear. This leads to a reduction in the cross-sectional area of the component and affects its mechanical strength.

10.67 The wear can be exaggerated at support points when other components become seized up by rust. Insulator strings are made up from a number of individual insulators linked together by pin and socket arrangements. As the pin corrodes, the expanding rust causes the pin to jam in the socket reducing the flexing movement of the insulators. Where the links become rigid all the movement is transferred to the supporting fittings connecting the insulator string onto the tower. This transfer of movement causes excessive wear of the fittings leading to potential failure and the possibility of conductors falling to the ground.

10.68 It has been found that anti-fog insulators are particularly prone to rusting of the cap and pin because the extra length of the insulator sheds creates a micro-climate that accelerates the rusting process.

10.69 Damaged components identified by routine inspections and high-resolution photography will be replaced.

33kV,66kV and 132kV tower fittings replacement (Mean life undefined)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	2,683	3.9%	2,683	3.6
East Midlands	3,545	3.5%	3,545	4.8
South Wales	920	1.9%	920	1.3
South West	1,343	2.6%	1,343	1.7
Total	**8,491**	**3.1%**	**8,491**	**11.5**

Switchgear

LV Cutouts

10.70 The vast majority of low voltage supplies terminate in cutouts near the meter point. This means there are over seven million cutouts installed in houses, shops and industrial properties across WPD's area. To maintain safety to the public, damaged, defective and obsolete cutouts are changed when customers report problems or when defects are identified from data flow from suppliers and meter operators.

10.71 The smart meter rollout currently planned to start in 2015 will change meters at around four times the normal rate. It is anticipated that this will lead to a higher volume of defects being identified at service positions that may require the cutout to be changed. The volumes above the routine amount are separately identified in the section on Smart Metering costs.

10.72 The costs below represent the normal volume of cutout asset replacement.

Cutout (metered) (Mean life undefined)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	4,150	0.0%	4,150	0.8
East Midlands	3,620	0.0%	3,620	0.7
South Wales	2,780	0.0%	2,780	0.5
South West	3,000	0.0%	3,000	0.6
Total	**13,550**	**0.0%**	**13,550**	**2.6**

LV substation pillars

10.73 LV Substation pillars are either

- wall mounted with open busbars (installed indoors);
- free standing in metal housings (mostly outdoors);
- transformer mounted as part of package substations (either outdoors or within glass reinforced plastic (GRP) housings).

10.74 The pillars are prone to degradation where cable terminations can deteriorate or contacts can work loose that may cause arcing. Pillars installed outdoors may be subject to corrosion.

LV pillar replacement (Mean life 60/65 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	1,772	1.3%	1,772	12.6
East Midlands	1,351	0.8%	1,351	9.7
South Wales	748	1.1%	748	5.4
South West	993	1.0%	993	7.1
Total	**4,864**	**1.0%**	**4,864**	**34.9**

LV underground boxes, pillars (not at substations) and service turrets

10.75 The replacement programmes for link boxes and LV pillars not at substations (sometimes referred to as street pillars) will target the removal of those in poor condition or where there are operational safety concerns (e.g. absence of barriers between phase conductors and earthed metalwork). Where there is a high number of devices in close proximity, we will consider reducing the number of link boxes (to reduce maintenance costs), whilst still maintaining operational flexibility and the capacity to provide load transfer during substation maintenance and fault situations.

10.76 The development of link boxes that can be remotely operated will provide an alternative in circumstances where there is load growth due to LCTs. When link boxes are replaced in LCT hotspots, these new remotely controlled link boxes will be used to provide the means for automatic load transfer.

10.77 There are a small number of service turrets in service. These were used as an above ground alternative to underground service joints on some parts of the network. Their location on street corners can attract vandalism; some have been made unusable due to reinstatement of surfaces around access points; and some are installed in customers' gardens. It is proposed to replace all service turrets with underground joints to remove the risk of damage and improve safety to the public.

LV UGB & LV Pillars (OD not at Substation) (Mean Life undefined)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	2,448	1.4%	2,448	9.9
East Midlands	1,504	0.7%	1,504	6.1
South Wales	256	0.7%	256	1.0
South West	728	0.7%	728	2.9
Total	**4,936**	**0.8%**	**4,936**	**19.9**

Ground mounted (GM) HV switchgear -circuit breakers (CB), switches and ring main units (RMU)

10.78 Switchgear replacement will be focused on those items that have type specific operational restrictions, unit specific defects (such as leakage of the environmentally unfriendly SF_6 gas) or those that are in poor condition. This will remove potential safety risks and increase the availability of network switching points.

10.79 Operational restrictions may arise following a disruptive failure of an item of switchgear anywhere in the industry. The Energy Networks Association (ENA) provides an information sharing service where DNOs are informed of reported dangerous incidents and equipment defects. This allows each DNO to assess the impact on their network. As a consequence, operational restrictions may be applied to limit what can be done with the switchgear. In some cases the restrictions can be removed by changing components during maintenance. In others, it is more cost effective to replace the whole item of switchgear. Where operational restrictions affect a small number of items of equipment, the whole population will be replaced. If a large number is affected a structured programme will be developed.

10.80 Many circuit breaker installations, particularly those at Primary substations, include fixed housings that contain the electrical busbars and protection relays and moving parts that carry out the main fault breaking and switching operations. The moving parts are subject to more wear. It is possible to only replace the moving part with a modern equivalent unit or a factory refurbished exchange. This activity replaces part of the installation and so it is treated as refurbishment (as identified separately below).

HV GM switchgear replacement (Mean life 50/55 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	3,614	1.3%	3,356	36.7
East Midlands	4,138	1.4%	3,634	38.0
South Wales	1,235	1.1%	1,155	10.8
South West	3,329	1.9%	2,894	30.1
Total	**12,316**	**1.4%**	**11,039**	**115.5**

HV GM CB refurbishment			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	200	0.2%	0.8
East Midlands	137	0.2%	0.7
South Wales	24	0.1%	0.1
South West	69	0.2%	0.6
Total	**430**	**0.2%**	**2.2**

Pole mounted (PM) HV switchgear circuit breakers, switches, links and fuses

10.81 Pole mounted switchgear is subdivided into three broad categories:

- Circuit breakers – predominantly high speed auto reclosers (HSARs) and metal encased oil circuit breakers.
- Switches – metal encased remote control and manually operated switches.
- Other – including air break switches, drop out fuses and links.

10.82 Most of the metal enclosed equipment is less than 20 years old and the low volumes of replacement represent those units that will become defective and non-operational during RIIO-ED1. The replacement of other types of switchgear will be driven by those that are in poor condition or are removed after failure.

HV PM switchgear replacement (Mean life 45 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	2,641	2.0%	2,641	6.6
East Midlands	1,797	1.5%	1,797	3.7
South Wales	798	1.2%	798	1.9
South West	1,953	0.8%	1,953	2.9
Total	**7,189**	**1.3%**	**7,189**	**15.1**

33kV, 66kV and 132kV switchgear

10.83 Material deterioration, moisture ingress, mechanical defects and limited availability of spares can lead to switchgear problems. Whilst rare, catastrophic failures arising anywhere in the industry can lead to operational restrictions being applied to entire populations. In addition local defects (such as distorted housings) may lead to local operational limitations.

10.84 Stakeholders have supported the replacement of leaky SF_6 filled switchgear to reduce the amount of this greenhouse gas released. We will be adopting a "three leaks and replace" regime on higher voltage assets.

33kV switchgear replacement (Mean life 50 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	526	1.8%	526	7.2
East Midlands	708	1.4%	708	17.7
South Wales	364	1.2%	364	8.2
South West	927	1.2%	927	13.3
Total	**2,525**	**1.3%**	**2,525**	**46.5**

66kV switchgear replacement (Mean life 50 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	146	1.2%	146	1.5
East Midlands	0	N/a	0	0.0
South Wales	56	1.1%	56	0.5
South West	0	N/a	0	0.0
Total	**202**	**1.0%**	**202**	**2.0**

132kV switchgear replacement (Mean life 50 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	541	1.5%	541	15.1
East Midlands	411	1.2%	411	11.8
South Wales	66	0.4%	82	2.0
South West	236	1.3%	236	6.2
Total	**1,254**	**1.1%**	**1,270**	**35.0**

Transformers

HV transformers (ground and pole mounted)

10.85 There are over 180,000 distribution transformers across the four WPD licence areas, with two thirds of these being installed in ground mounted substations.

10.86 Ground mounted distribution transformers are robust items of plant that have limited moving parts. Therefore, the main problems encountered with ground mounted transformers are caused by external corrosion, insulation degradation caused by excessive loads or moisture ingress. Replacement decisions will be based upon condition assessments and oil test results.

10.87 Pole mounted distribution transformers are more susceptible to damage from inclement weather such as lightning strikes that cause internal failure or flash-over across insulators. Since the impact of an incident on pole mounted transformers affects a limited number of people they are generally run to failure and replaced once they experience a fault.

6.6/11kV transformer (GM) (Mean life 60 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	2,011	1.6%	2,011	16.1
East Midlands	1,675	1.1%	1,675	13.5
South Wales	870	1.3%	870	7.0
South West	1,529	1.5%	1,529	12.3
Total	**6,085**	**1.2%**	**6,085**	**48.9**

6.6/11kV transformer (PM) (Mean life 55 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	3,354	1.2%	3,354	8.7
East Midlands	2,048	1.1%	2,048	6.5
South Wales	3,927	1.6%	3,927	7.5
South West	5,582	1.8%	5,582	14.5
Total	**14,911**	**1.3%**	**14,911**	**37.1**

33kV, 66kV and 132kV transformers

10.88 The failure of grid and primary transformers can have a significant impact on network security. Degradation is driven by a combination of the demand placed upon transformers, the effect of moisture ingress, corrosion of steelwork and degradation of seals.

10.89 Transformer insulation is constructed from cellulose paper submersed in oil. Excessive loads on the transformer can lead to high operating temperatures that cause the creation of acids in the oil. In addition moisture ingress can occur. The moisture ingress combined with the acid can lead to degradation of the paper insulation. As the insulation weakens, discharges may arise causing further damage and potential failure.

10.90 Condition assessment is used to assess the external integrity of the oil tanks, coolers and connecting pipework. Oil testing is used to assess the internal condition of the insulation and measure the amount of acid, dissolved gasses (caused by discharges) and concentration of furfuraldehyde (released as a by-product of paper insulation breakdown).

10.91 Transformers will be changed where they exhibit excessive oil leakage or where oil tests suggest evidence of electrical discharge or significant insulation degradation.

10.92 In a limited number of cases transformers will be refurbished. This will be limited to repair of localised corrosion (e.g. changing cooling fins), stemming of leaks by replacement of seals or application of sealing agents and retrofitting of tap-changers.

10.93 Processes to remove moisture and acidity from the insulating oil may be used in limited cases, but these are very short term measures that temporarily improve the condition of the oil. Such actions would not have a marked impact on the health of the transformer.

10.94 We have considered returning transformers to manufacturers to be refurbished in their workshops but this will not be pursued because the costs of dismantlement, transport, fees and reconnection outweigh the benefits.

33kV,66kV and 132kV transformer replacement (Mean life 50/60 years)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	93	2.0%	93	42.3
East Midlands	131	1.6%	131	58.7
South Wales	68	1.8%	68	26.8
South West	106	1.7%	106	35.3
Total	**398**	**1.8%**	**398**	**163.2**

33kV,66kV and 132kV transformer refurbishment			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	6	0.1%	0.6
East Midlands	5	0.1%	0.5
South Wales	2	0.1%	0.2
South West	2	0.0%	0.2
Total	**15**	**0.1%**	**1.5**

Batteries (protection)

Batteries at HV, EHV and 132kV substations

10.95 Batteries are used for protection systems, switchgear tripping and closing functionality as well as for SCADA communications.

10.96 The consequences of insufficient battery capacity are that the protection of the network would be degraded and operation of switchgear would be unreliable. The absence of protection would mean that faults on the distribution networks will not be identified and disconnected which could endanger people and lead to catastrophic failure of equipment.

10.97 SCADA batteries enable remote control of switchgear and provide a means to communicate the status of the network to control rooms. Without remote control, site visits would be required to switch manually. The absence of information about network status could extend restoration times for faults and may also result in overloaded circuits.

10.98 Batteries can become defective and suffer from a range of problems, including:

- cracked cases;
- contamination of the electrolyte;
- build-up of sediment;
- internal short circuits;
- excessive corrosion.

10.99 Battery cells found to be in poor condition during routine testing will either be replaced or refurbished.

Batteries at GM HV substations (Mean life undefined)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	200	2.2%	200	0.5
East Midlands	56	0.6%	56	0.1
South Wales	16	1.8%	16	0.0
South West	192	10.7%	192	0.5
Total	**464**	**2.0%**	**464**	**1.2**

Replacement of batteries at 33kV,66kV and 132kV substations (Mean life undefined)				
	RIIO-ED1 Period Assets Removed	Average Population Removed (% per annum)	RIIO-ED1 Period Assets Installed	Forecast Expenditure £m
West Midlands	136	2.6%	136	0.9
East Midlands	160	1.9%	160	1.1
South Wales	88	2.8%	88	0.6
South West	224	6.1%	224	1.5
Total	**608**	**3.0%**	**608**	**4.1**

Refurbishment of batteries at 33kV,66kV and 132kV substations			
	RIIO-ED1 Period Assets Refurbished	Average Population Refurbished (% per annum)	Forecast Expenditure £m
West Midlands	17	0.3%	0.4
East Midlands	40	0.5%	0.8
South Wales	16	0.5%	0.3
South West	18	0.5%	0.4
Total	**91**	**0.4%**	**1.9**

Civil works

Civil works driven by condition of plant items

10.100 There will be a range of changes to civil structures resulting from replacement of electrical network assets (e.g. new plinths and structures for switchgear, modifications to trenches, and alterations to buildings). Changes may also be dictated by policy, for example, providing enclosures for switchgear that was previously installed outdoors.

10.101 The forecasts assume that the replacement of switchgear and primary transformers will require modifications to civil structures in all cases.

Civils expenditure driven by the condition of plant items summary (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.9	1.8	0.9	1.4	6.0
RIIO-ED1 Annual Average	1.4	1.9	0.7	1.3	5.3
RIIO-ED1 Total (8 years)	**11.1**	**14.2**	**5.5**	**10.2**	**41.0**

Civil works driven by condition of civil items

10.102 It is important that substation sites and buildings remain secure, protect network assets and provide a safe working environment for staff.

10.103 Substation land is segregated using different types of fences depending upon the local security requirements. Fences can become damaged and wooden fences may need replacement to the extent that they are decayed.

10.104 Defects in substation roofs can lead to water ingress affecting network assets. Damp can also affect roof structures and in some cases require the replacement of the full roof.

10.105 Defective substation doors provide a security risk, particularly where they are subject to vandalism. Whilst the majority of doors are repaired during site maintenance, some need to be replaced.

10.106 Many substation buildings are over forty years old and the electrical wiring for heating and lighting is from the original installation. Individual components (e.g. heaters) are replaced as part of building maintenance but in some cases complete rewiring of building services is undertaken where fitments have deteriorated or wiring is found to be in poor condition.

10.107 The infrequent but destructive nature of transformer fires has led to the installation of fire screens between primary transformers especially where a fire in one transformer could affect another. In some cases transformers have been enclosed within housings for either fire protection or noise reduction. Over time these structures can deteriorate and need to be replaced or refurbished.

10.108 Whilst rare, there have been occasions where subsidence has undermined concrete plinths causing damage to network assets. Where subsidence is identified the civil aspects will be rebuilt and equipment re-sited on a new plinth.

10.109 The following tables provide a snapshot view of the current health indices of civil structures in 132kV and EHV substations.

West Midlands – Civil asset Health Indices snapshot 2013						
	HI1	HI2	HI3	HI4	HI5	Total
Compound	46	125	30	42	7	250
Perimeter fence	43	134	29	28	15	249
Substation building	54	120	66	44	23	307
Transformer foundation and bund	46	115	16	6	64	247
Total	189	494	141	120	109	1,053

East Midlands – Civil asset Health Indices snapshot 2013						
	HI1	HI2	HI3	HI4	HI5	Total
Compound	112	244	98	85	23	562
Perimeter fence	116	231	89	75	50	561
Substation building	129	256	144	64	23	616
Transformer foundation and bund	213	272	67	44	25	621
Total	570	1,003	398	268	121	2,360

South Wales – Civil asset Health Indices snapshot 2013						
	HI1	HI2	HI3	HI4	HI5	Total
Compound	71	90	30	32	5	228
Perimeter fence	95	109	21	6	5	236
Substation building	89	98	37	42	5	271
Transformer foundation and bund	172	103	39	14	4	332
Total	427	400	127	94	19	1,067

South West – Civil asset Health Indices snapshot 2013						
	HI1	HI2	HI3	HI4	HI5	Total
Compound	31	237	64	32	6	370
Perimeter fence	48	258	43	15	3	367
Substation building	46	212	56	27	27	368
Transformer foundation and bund	76	207	52	18	8	361
Total	201	914	215	92	44	1,466

Cable tunnels

10.110 Some substations are located on former power station sites that included networks of tunnels for cable runs and these tunnels continue to be used for distribution cables. There are also tunnels where WPD still has a responsibility even though the assets have been decommissioned e.g. the tunnel under Portishead dock near Bristol that was used for a now abandoned 132kV internal pressure gas cable.

10.111 There are no known structural issues with cable tunnels and the asset replacement forecast is £nil.

Cable bridges

10.112 Cable bridges have been used extensively throughout the West Midlands to cross canals and rivers. Many are constructed from lattice steelwork encased in cladding.

10.113 Whilst they are generally secure, some have been subject to determined attempts of metal theft. Attempted theft can lead to many customers' supplies being affected, especially of several cables are damaged at the same time. Cable bridges will have any defective cladding refurbished or replaced to ensure they remain secure.

10.114 Where lattice steelwork has corroded, it will be replaced but there are no know structural issues with cable bridges and the forecast is £nil.

Forecast expenditure

10.115 The expenditure forecasts for civil work driven by condition of civil assets is shown in the table below. The costs take account of the size of substation building and compounds so for example whilst the volume of poor condition EHV and 132kV civil assets is higher in East Midlands the costs in West Midlands are higher due to the larger nature of the assets.

Civil expenditure driven by the condition of civil assets in RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
HV indoor substation – doors only	2.1	0.4	1.8	4.2	8.5
HV indoor substation – roofs only	6.4	1.3	0.9	2.1	10.7
HV indoor substation – other civil works	4.1	0.8	1.8	4.2	10.9
HV indoor substation - enclosures and surrounds	2.3	0.5	4.1	9.4	16.3
HV indoor substation - plinths and groundworks	0.3	0.1	0.5	1.0	1.9
HV outdoor substation - surrounds	20.2	20.0	1.8	1.7	43.8
HV outdoor substation - plinths and groundworks	2.2	2.2	0.8	0.7	5.9
EHV substation civil works	8.0	11.8	4.5	8.3	32.6
132kV substation civil workds	5.5	3.3	1.8	1.5	12.1
Cable tunnels	-	-	-	-	-
Cable bridges	-	-	-	-	-
LV street furniture	-	-	-	-	-
Total	**51.3**	**40.2**	**18.0**	**33.1**	**142.6**

Civils expenditure driven by the condition of civil assets summary (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	4.1	2.7	1.3	2.5	10.6
RIIO-ED1 Annual Average	6.4	5.0	2.2	4.1	17.7
RIIO-ED1 Total (8 years)	**51.3**	**40.2**	**18.0**	**33.1**	**142.6**

Total civils expenditure

Total civils expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	6.0	4.6	2.2	3.9	16.7
RIIO-ED1 Annual Average	7.8	6.8	2.9	5.4	22.9
RIIO-ED1 Total (8 years)	**62.4**	**54.4**	**23.4**	**43.2**	**183.5**

11 Quality of supply

11.1 WPD has improved network performance more than any other DNO group.

11.2 Stakeholders have indicated that current performance is good but they have also made clear that they would like to see improvement.

11.3 Ofgem has indicated that there will be no ex-ante allowances for performance improvement in the RIIO-ED1 period; continuing with its position that investment decisions should be determined by the value of reward available from the Interruption Incentive Scheme (IIS). WPD will therefore use some of the rewards earned during DPCR5 to invest in further network performance improvement initiatives in anticipation that this will continue to lead to rewards generated by outperforming regulatory targets.

11.4 Preliminary regulatory targets published by Ofgem in the Strategy Decision document suggest that future targets will be tougher, making it harder to outperform them. Our proposals produce performance that continues to be better than the targets derived from industry benchmarking.

11.5 WPD's investment programme will increase the number of automated devices, to enable computer controlled reconfiguration of the network when a fault occurs, reducing the number of customers affected by faults and speeding up the restoration of supplies.

11.6 Network automation is a valuable tool for improving network performance. The use of high speed auto-reclosing circuit breakers introduces additional protection stages that subdivide circuits into smaller sections, which reduces the number of customer affected by faults. Remotely controlled switches enable speedy network reconfiguration to restore supplies. These devices can be controlled centrally by automated sequence switching schemes in the network management system. These schemes learn the state of the network in real time and automatically reconfigure running arrangements to isolate faulty sections within minutes.

Quality of supply expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	3.7	3.7	2.4	2.8	12.5
RIIO-ED1 Annual Average	1.9	1.1	0.4	0.4	3.7
RIIO-ED1 Total (8 years)	**15.3**	**8.6**	**2.9**	**2.9**	**29.7**

11.7 In response to supplementary questions from Ofgem , WPD confirmed that the expenditure on quality of supply was to be included within allowed Totex for RIIO-ED1.

12 Worst served customers

12.1 There are a small number of customers that experience high numbers of faults. These customers are generally located on the end of long circuits or on remote parts of the network, with limited alternative networks available to provide supplies when faults occur.

12.2 Ofgem has redefined a worst served customer to be one that experiences 12 or more (previously 15 or more), higher voltage interruptions over a three year period, with a minimum of three in each year. This means that worst served customers are those that have sustained poor network performance. For WPD there are approximately 20,000 worst served customers meeting the new definition.

12.3 Stakeholders have indicated they support investment to reduce the number of worst served customers by 20%. They have also stated a preference that where investment is carried it should yield a 20% reduction in the number of faults and that the expenditure should be limited to £800 per benefiting worst served customer.

12.4 Combining the change in definition and the expected improvement means that more customers will benefit from this investment.

12.5 During RIIO-ED1 WPD will target reducing the number of worst served customers by 20% to 16,000.

12.6 WPD will Invest in additional protection equipment to prevent faults affecting worst served customers. Where low cost solutions can be found, network reconfiguration, interconnection and refurbishment will also be carried out to enable supplies to be re-routed quickly when faults occur.

Worst served customer expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.0	0.0	0.2	0.1	0.3
RIIO-ED1 Annual Average	0.1	0.0	0.1	0.1	0.4
RIIO-ED1 Total (8 years)	**1.0**	**0.2**	**1.0**	**1.0**	**3.1**

13 Operational information technology and telecommunications (IT&T)

Introduction

13.1 WPD uses a dedicated communication infrastructure and a network management system to monitor the loads flowing through the electricity network, in order to understand its operational state and also to remotely control devices. This operational IT&T system consists of three elements:

- the devices installed at substations that collect information locally and link to the communications network;
- the communication infrastructure that carries the data between the substations and central control rooms;
- the control centre hardware and software that collates the information and allows engineers to control the network in real-time.

13.2 The proposed expenditure will maintain the integrity of systems, whilst incorporating necessary network expansion and improving reliability and security.

Operational IT&T expenditure in RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD**
Substation RTUs, marshalling kiosks, receivers	0.3	0.3	3.2	1.1	4.9
Control Centre hardware & software	10.9	11.2	10.5	11.4	44.0
Communications for switching & monitoring	13.2	13.9	9.1	10.9	47.0
Total	**24.3**	**25.4**	**22.9**	**23.4**	**95.9**

Operational IT

13.3 Operational IT incorporates the network management system and remote data collection systems.

13.4 The network management system contains a network model that is used to mimic the real-time state of the higher voltage (6.6kV and above) distribution network. Any work that takes place on the higher voltage network is carried out under permission or instruction from Control Engineers, who use the network management system to assess what actions are required to ensure that staff working on the network are safe and the supplies are maintained.

13.5 It is important that the network model is kept accurate and up-to-date at all times. The system is updated either automatically from Remote Terminal Units (RTUs) in substations or by manual changes by Control Engineers following confirmed reports of manual operations from staff in the field. The network management system records the changes to the network and the related impact on customers.

13.6 The network management system used by WPD is GE Network Solution's ENMAC system. The control of the network is managed through ENMAC, and WPD uses ENMAC as the single point of data capture and analysis of all aspects of network management and the impact of outages on customers. The system provides full co-ordinated facilities to:

- direct, approve and control all operations on the higher voltage electricity network;
- update the network model to mimic changes on the actual network;
- manage the deployment of the operational staff associated with network operation at all voltages;

- provide all of the underlying details associated with faults and planned interruptions on the electricity network so that customers can be kept up to date on progress;
- provide accurate historic information about the performance of the electricity network so that customer queries can be assessed, informed investment decisions can be made and external reporting obligations can be fulfilled.

13.7 The forecasts for Operational IT are focused on two areas:

- Substation RTUs, marshalling kiosks and receivers;
- Control Centre hardware and software.

Substation RTUs, marshalling kiosks and receivers

13.8 Remote Terminal Units (RTUs) are the devices installed at major substation sites that provide vital monitoring information to ENMAC and allow remote operation of the network by Control Engineers.

13.9 RTUs have a life expectancy of approximately 15 years and since an extensive replacement programme across West Midlands and East Midlands was completed in 2012, no further expenditure will be required until RIIO-ED2 in these areas. The replacement of RTUs in the South West and South Wales will be carried out over a five year period between 2014 and 2018. The work in the first half of RIIO-ED1 will include the replacement of 100 RTUs in the South West, together with all 350 RTUs in South Wales.

13.10 In addition to the replacement programme, we install additional devices at substations identified as becoming more strategically important. Experience has shown that on average two such substations are identified every year, and we expect this to continue through the RIIO-ED1 period.

Substation RTUs, marshalling kiosks, receivers RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Replacement of existing RTUs	0.0	0.0	3.0	0.9	3.8
Additional RTUs/Radio Modems at existing sites	0.3	0.3	0.3	0.3	1.1
Total	**0.3**	**0.3**	**3.2**	**1.1**	**4.9**

Control centre hardware and software

13.11 Control centre hardware comprises the various computer servers and devices required for the effective and secure operation of the ENMAC software. It allows Control Engineers, Contact Centre staff and Despatchers to understand and manage events on the electricity network.

13.12 The forecast included in this Business Plan is based upon the operational IT and telecoms in place at the end of the DPCR5 period becoming 'business as usual', which includes some of the elements of the LCNF Project FALCON.

Control centre hardware

13.13 ENMAC is operated in three instances or 'environments': the live environment, a development environment and a training environment. Hardware servers are required to support ENMAC in all three of these environments.

13.14 The servers are associated with the following ENMAC software elements:

- Network Management System (NMS): enables the day to day activities to manage and control the electricity network;
- Outage Management System (OMS): allows effective management of staff and the impact of fault conditions on customers;
- CallTaker - Allowing staff to take and record telephone calls from customers;
- Geoview - a geographically based view of fault information;
- Communications Management with the RTUs.

13.15 In order to ensure resilience and to reduce operational risk, each of the four WPD licence areas has its own individual ENMAC system. To enhance system availability and performance, each ENMAC system operates on a number of servers placed in different physical locations. They are inter-connected by high speed data links supplied via the telecommunications infrastructure.

13.16 Due to its strategic importance, the hardware used for the WPD control system is upgraded at least every five years, to take advantage of technological developments in processing speed and capability. The replacement of hardware also ensures that the latest versions of ENMAC function properly because as ENMAC is developed older hardware is not able to support it.

13.17 It is anticipated that the next generation of hardware will allow continuous calculation of network parameters such as dynamic load flows and fault levels, which will set the foundation for smarter network operational control.

13.18 The server costs represent those that will be incurred by replacing the individual elements currently in place with the next generation equivalent equipment. The costs forecast are based upon recent experience of hardware upgrades in the Midlands licence areas. The replacements will be in 2017/18 and 2022/23.

13.19 It should be noted that there are subtle variations in costs associated with the hardware requirements in each licence area. This is because, although each area uses the same basic software the data quantities, number of users and number of connected RTUs differ between installations.

Hand held devices

13.20 One of the innovations adopted by WPD is the use of ENMAC Mobile on hand held devices. This allows the automatic reporting of progress on network operations and fault restorations direct from the field. This ensures that customers are always provided with the most up-to-date information and also increases the effectiveness of both the Control Centre and field staff in their day to day activities. This system is used extensively in the South West and South Wales and will be implemented in the Midlands before the end of DPCR5.

13.21 Hand held devices have an operational life of 3-4 years, and there is a systematic programme of replacement. Devices purchased during the last refresh in 2011/12 are due for replacement in 2015 and again in 2019.

Software

13.22 GE regularly incorporates the feedback from users of ENMAC to enhance its functionality. WPD monitors the development of the product and adopts them where it is appropriate to business needs. Each extension to functionality is subject to revised licencing charges.

13.23 WPD has a long and successful record of incurring minimal costs for these developments by collaborating with GE. A typical example of such collaboration is the development of the hand held facilities, where WPD took an active role in specifying and subsequently testing both software and hardware.

13.24 The forecast costs are in line with previous developments and licence costs over the past 10 years.

Control centre hardware & software RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Replacement control centre hardware	7.0	7.0	7.1	7.6	28.7
Hand held devices	1.0	1.4	0.7	1.0	4.0
Software changes / enhancements / licences	2.9	2.8	2.8	2.8	11.3
Total	**10.9**	**11.2**	**10.5**	**11.4**	**44.0**

Operational telecommunications

Communications for switching and monitoring

13.25 WPD has developed its own internally managed telecommunications infrastructure for operational data communication. This approach is cost effective, reliable and more resilient than that available from third party providers.

13.26 The main elements of the operational telecommunications infrastructure are as follows:

- supervisory control an data acquisition (SCADA) and Trunk Network for communication to major substations;
- secondary SCADA for communications to distribution substations and devices on the distribution network;
- Network Data Communications to provide data and voice communications between the Control Room and field staff.

Primary SCADA trunk network

13.27 WPD uses a scanning telemetry network to provide real-time monitoring and control of its higher voltage system. This involves the transmission of data from radio transmitters located remotely on a range of network assets to base-stations located at major substations. Microwave and fibre optic communications then transfers the data between the base-stations and our Control centres.

13.28 In order for this communications network to remain operational, we will need to change much of the equipment as it reaches its end of life. In 2018, after a twelve year life, the trunk communication network in the South West and South Wales will be at the end of its life and will be unsupported. An upgrade of the base stations and trunk communications network is planned to start in 2018.

13.29 In addition, as new substations are added to the system to facilitate the connection of distributed generation and to manage load growth, it is expected that a number of the scanning base-stations will reach full capacity. Additional sites will need to be established, and additional capacity will also be required on the communications infrastructure in order to handle the additional data.

Migration from unlicensed radio, PAKNET and mobile systems

13.30 There are a series of smaller RTUs installed on the 6.6kV and 11kV switchgear to assist in monitoring and control of the overall network. These devices use different communications techniques to pass information to ENMAC.

13.31 In the South West and South Wales, data is transmitted on unlicensed radio frequencies between the RTUs and base stations. Other users can broadcast on the same frequencies and may cause interference that causes failure in the communication of data. Cases of interference are increasing and it is therefore proposed that these unlicensed installations will be changed either when they suffer from local interference, or when they reach their end of life. This will prevent deterioration of current levels of reliability. It is estimated that the 4,500 units currently in service would be replaced at the rate of 250 per annum which equates to a cost of £300k each year. This programme will continue through the RIIO-ED1 period and into subsequent price control periods.

13.32 In the Midlands, two separate techniques have been used to return data to ENMAC from remote switchgear. An out-of-date technology known as PAKNET has been in use in the West Midlands since 1994 and is now at the end of its useful life. In the East Midlands GPRS mobile phone technology has been in use since 2004. Both techniques are reliant upon services

outside of WPD's direct control, and the technologies on which they are based are forecast to be removed before the end of the RIIO-ED1 period. In addition, WPD's cyber security work with Idaho National Laboratories has identified both PAKNET and GPRS as insecure and posing significant risks. There are 7,500 devices using these communication techniques in the Midlands, and because of the age profile they will all be replaced in the first three years of the RIIO-ED1 period.

13.33 WPD intends to replace both of these systems with the directly managed standard scanning radio network to create a more secure common platform across the whole of the WPD.

Network data communications

13.34 We operate our own, network data communications systems that provide data and voice communications from the Control Centres and local offices to field operatives and static devices.

13.35 WPD is one of very few companies who continued with these private mobile radio (PMR) communications when others were disposing of PMR assets and replacing them with public mobile phone connectivity.

13.36 The advantages of a self-owned data network include:

- limited or no reliance on 3rd party networks;
- provision of storm, civil emergency, and Black Start resilience;
- faster response and fix times for faults by using in-house resources;
- better reliability from a dedicated system.

13.37 Mobile phone facilities obtained from a third party network do not provide resilience to emergencies or terrorist attacks. The length of time that third party systems remain operational following a power cut can be as low as ten minutes. In addition, geographic coverage is not complete, especially in some of the rural areas in which WPD operates, and when the mobile network is busy calls can be held up or lost.

13.38 The Midlands communication base stations were installed in 2013, however the systems in the South West and South Wales will reach the end of their life in 2018 and require replacement.

Radio traffic encryption

13.39 Work with Idaho National Laboratories regarding security of communications (see section on Cyber security) identified the need to encrypt the radio traffic moving between the major RTUs and ENMAC to prevent unauthorised interception of the data. It is considered that the risk of interception is increasing and it is proposed to install systems that encrypt all radio communication traffic.

Communications for Switching and Monitoring (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD**
Migration from GPRS/Paknet	8.8	8.8	0.0	0.0	17.5
Migration from unlicenced radio	0.0	0.0	1.1	1.1	2.2
Primary SCADA and trunk comms network	1.5	2.3	3.0	3.7	10.5
Encryption of major RTU traffic	1.9	1.9	1.3	1.4	6.6
Network data comms system	0.0	0.0	2.8	2.8	5.6
Additional comms for smart grids	0.9	0.9	0.9	1.8	4.6
Total	**13.2**	**13.9**	**9.1**	**10.9**	**47.0**

Cyber security

13.40 WPD recognises the increasing threat from cyber security issues. Our simple corporate IT premise that no device connected to core data systems can have direct access to the Internet has meant that the number of cyber-attacks experienced by WPD is currently minimal. As ENMAC is vital to the business, the cyber security associated with it and its associated communications infrastructure needs to be of the highest standard.

13.41 In 2011/12, WPD volunteered to take an active role in a joint evaluation of the ENMAC product in conjunction with Idaho National Laboratories (INL), GE and the Centre for the Protection of National Infrastructure (CPNI). The initial work on ENMAC security was done in the laboratory and then WPD provided a live environment in which to carry out a full evaluation. This live test involved the whole of WPD's internal communications and computer infrastructure as well as the product.

13.42 The major elements of the work in WPD included an evaluation of the ENMAC implementation and the level of general cyber security throughout the company by INL. The following is an extract from INL's report:

> *"During the cyber assessment, the team recognized that WPD had a security-minded philosophy that permeated the entire company, which employed competent staff. Overall, WPD has spent a lot of time analyzing and intentionally configuring their security posture based on a belief that a robust outside barrier would provide the best protection from attackers."*

13.43 There were a number of suggestions for improvements and most of them have been completed in DPCR5. In RIIO-ED1 we will continue with the security enhancements, increasing the security of our radio networks.

13.44 This work was considered to be of such significance and importance that it was submitted to the SANS EU SCADA and Process Control Summit where WPD received an award for Security Innovation.

13.45 WPD also has representation on the Council for the Protection of National Infrastructure (CPNI) SCADA Control System Information Exchange (SCSIE) panel and takes part in the SCSIE Assessment for security.

13.46 It is within this context that our proposals for increased operational IT&T security measures have been developed.

Expenditure summary

Operational IT&T expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	5.0	5.7	1.2	2.2	14.1
RIIO-ED1 Annual Average	3.0	3.2	2.9	2.9	12.0
RIIO-ED1 Total (8 years)	**24.3**	**25.4**	**22.9**	**23.4**	**95.9**

BT 21st Century (BT 21CN)

13.47 WPD rents a number of telecommunication circuits from BT which are used for electricity network protection systems and SCADA.

13.48 Dedicated circuits have been used to provide fast fault clearance times to protect network equipment and to maintain the stability of the transmission system, distribution networks and connected generators. They have also been used for SCADA to send analogue status information from substations to ENMAC and allow equipment and switchgear to be controlled remotely.

13.49 These circuits are based on analogue four wire technology operating on dedicated copper cables. Whilst this is old technology it has been generally reliable and proven to be adequate for use.

13.50 BT is in the process of converting these circuits and others to a more modern internet protocol system known as the BT 21st Century Network (BT 21CN). BT states that BT 21CN should improve the resilience of the overall communication network by introducing multiple communication paths. However, since the communication path is not determined, there could be time delays which may cause electricity distribution network protection systems to function incorrectly.

13.51 BT has confirmed that their network will be unable to meet the requirements of the Energy Networks Association Technical Specification 48-6-7 'DNO and TNO requirements for communication circuits for teleprotection services'.

13.52 Whilst BT is making the transition, it has confirmed that the existing circuits will remain available and supported until 2018 after which they will be replaced by the BT 21CN network.

13.53 WPD proposes to replace all telecommunication circuits affected by BT 21CN with circuits owned and operated by WPD's own telecommunication company, Surf Telecoms. Three generic solutions have been proposed using fibre optic, microwave and UHF radio.

13.54 It is proposed that all work will be completed in South Wales and South West by the end of DPCR5.

13.55 In West Midlands and East Midlands priority has been given to 75 'high impact' protection circuits and these are due to be completed by the end of DPCR5, with the remaining 75 protection circuits and 200 SCADA circuits being completed during RIIO-ED1.

BT 21CN expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.1	2.1	0.8	0.2	4.2
RIIO-ED1 Annual Average	0.7	1.1	-	-	1.8
RIIO-ED1 Total (8 years)	**5.9**	**8.8**	**-**	**-**	**14.7**

14 Flood defences

14.1 Widespread flooding in 2007 affected network assets, interrupting electricity supplies to thousands of customers in Gloucestershire and Yorkshire thereby,highlighting the potential vulnerability of electricity substations to flooding. There are also general concerns over rising sea levels due to global warming which brings into question the adequacy of existing levels of flood protection in coastal areas. Furthermore, climate change predictions suggest that flooding could become a more regular occurrence with an increasing risk from surface water during heavy rains.

14.2 In response to the floods in 2007, the government commissioned an investigation (The Pitt Review) that called for urgent and fundamental changes in the way the country is adapting to the increased risk of flooding and requested a comprehensive assessment of the resilience to flooding of primary and higher voltage substations.

14.3 The Energy Networks Association (ENA) formed the 'Substation Resilience to Flooding Task Group' to lead this work and report to the Energy Emergencies Executive committee (E3C). The ENA produced Engineering Technical Report 138 (ETR 138) to provide guidance on how to improve the resilience of electricity substations to fluvial flooding from coastal and river water to a level that is acceptable to all stakeholders whilst taking into consideration the cost/benefit assessment for each site. The ENA is seeking to extend the scope of ETR 138 to also include pluvial flooding from surface water.

14.4 WPD has been working with the Environment Agency to identify the substations at greatest risk by considering the likelihood of a flood along with the impact, by taking into account the number of customers who would lose supply if the substation were to be shut down and the effect of supply loss to critical infrastructure sites.

14.5 This analysis has led to the identification of a number of substations that require enhanced flood protection and the installation of such defences was started in 2010 and will continue into the RIIO-ED1 period.

14.6 Stakeholders have indicated that investment in flood defences is a high priority and consequently WPD has completed more sites than originally planned for DPCR5. This leaves 75 sites to be completed in the RIIO-ED1 period. Further sites may be identified once more detailed analysis of surface water flooding is available.

Flood defence expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.6	1.5	1.3	0.8	4.2
RIIO-ED1 Annual Average	0.1	0.6	0.9	0.1	1.8
RIIO-ED1 Total (8 years)	**1.1**	**4.9**	**7.5**	**1.1**	**14.6**

15 Black start

Background

15.1 Whilst highly unlikely, a major disturbance to electricity supply could lead to a partial or even total shutdown of the GB transmission system and the associated distribution networks. The actions required to re-establish normal operation of the electricity network, following such an event, are referred to as a 'Black Start'.

15.2 Successful recovery from a Black Start event requires sections of the transmission and distribution networks to be re-energised and reconnected, in a predetermined sequence. These actions need to be undertaken in a co-ordinated and controlled manner, in order to ensure that the reconnection of load and generation remain balanced.

15.3 Following a series of major blackouts across the world, the UK government and the electricity industry, through the Electricity Task Group (ETG) of the Energy Emergencies Executive Committee (E3C), have reviewed the resilience of the GB electricity network to a Black Start event. This has identified that the recovery time for a Black Start, from a total shutdown of the transmission system, is likely to be in the order of 72 hours.

15.4 Engineering Recommendation G91 ('Substation Black Start Resilience') was issued in 2012. This Engineering Recommendation has introduced a requirement upon DNOs to ensure that suitable measures are established at major substations, such that adequate protection and control systems shall be available to permit safe re-energisation of these substations during a Black Start. Such measures must be suitable to cater for a partial or total shutdown of the electricity network lasting up to 72 hours.

Substation resilience

15.5 132kV, EHV and some major HV substations use low voltage supplies for the recharging of batteries. These batteries are used:

- for the operation of power system protection and tripping of circuit breakers at the substation; and
- by substation located telecommunications equipment for SCADA purposes.

15.6 The battery systems used for SCADA equipment are separate to those used for protection and tripping purposes.

15.7 Under Black Start conditions the low voltage supplies to these battery systems would be unavailable. As a consequence the associated batteries would drain due to the standing load of the connected equipment. Typically, batteries installed on the WPD network have sufficient capacity for 24 hours. After this time, without restoration of low voltage supplies, protection, tripping and communications at the major substation may be compromised.

15.8 In order to meet the requirement for 72 hours resilience at major substations, load disconnection schemes shall be installed as part of the battery systems used at each major substation site for power system protection and operation of circuit breakers.

15.9 The resilience of battery systems used for SCADA purposes shall be addressed by increasing the battery capacity at each site to meet the 72 hour requirement.

Resilience of substation protection and tripping batteries

15.10 Load disconnection schemes automatically disconnect the standing load on the battery system during a sustained loss of supply at a substation, removing the drain on the batteries. With the standing load disconnected, the batteries retain their charge and can be reconnected when re-energisation of the substation is required.

15.11 WPD has worked in conjunction with a manufacturer to develop a load disconnection unit that can be fitted as a standalone device, without requiring the replacement of the existing batteries. Field trials have been undertaken in WPD South Wales to develop and prove the design of these units and their interaction with operational control and network management systems. WPD has shared the knowledge gained from this work with other DNOs, by hosting a workshop event in the summer of 2011 that incorporated a site visit to one of the trial installations.

15.12 The load disconnection schemes that have been developed can be controlled via the SCADA system, enabling the protection and tripping batteries to be remotely reconnected prior to the requirement to re-energise a substation.

15.13 The unit cost for installation of the load disconnection unit is £3.1k at EHV sites and £4.1k at 132kV sites. This is less than the increase in cost required to upgrade to a 72 hour capacity battery system (as shown in table below).

Unit cost comparison (£k)				
	Installation Of 24 Hour Capacity Battery & Charger	Installation Of 72 Hour Capacity Battery & Charger	**Differential For Installation Of Larger Capacity Batteries**	**Load Disconnection Scheme**
EHV Site	5.5	9.1	**3.6**	**3.1**
132kV Site	9.5	26.0	**16.5**	**4.1**

15.14 Therefore the load disconnection scheme represents the most cost effective way of establishing Black Start resilience for protection/ tripping batteries, even in cases where the associated battery system requires replacement. In addition, the load disconnection solution offers the capability to ensure resilience of protection/ tripping batteries for events that last longer than 72 hours, because the battery system retains charge whilst the standing load is disconnected.

15.15 The requirements of each major substation site have been examined and the following works for resilience of protection/ tripping batteries during the RIIO-ED1 period identified:

Black start resilience of protection batteries at 132kV sites in RIIO-ED1					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Number of 132kV sites requiring work	77	113	61	54	302
Number of load disconnection schemes to be installed	97	166	61	60	384
Total cost (£m)	**0.4**	**0.6**	**0.2**	**0.2**	**1.4**

Black start resilience of protection batteries at EHV sites in RIIO-ED1					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Number of EHV sites requiring work	163	508	175	312	1149
Number of load disconnection schemes to be installed	167	508	175	314	1164
Total cost (£m)	**0.5**	**1.4**	**0.5**	**0.9**	**3.3**

Resilience of substation SCADA batteries

15.16 During a Black Start event it is essential that remote supervision and control of substations can be maintained via the SCADA system. This ensures that:

- restoration of supplies can be undertaken in an expedient manner following any request from National Grid;
- network arrangements can be preconfigured in advance of restoration requirements;
- the requirement for deployment of staff to site is minimised;
- the status of each substation can be continuously monitored, assisting coordination of the actions required to deliver successful restoration.

15.17 Consequently, load disconnection schemes do not offer an appropriate solution for the resilience of SCADA batteries. Works will be undertaken during the RIIO-ED1 period to increase the capacity of SCADA batteries at each major substation, to meet the requirement for a minimum of 72 hours resilience. Additional capacity can be added to existing SCADA battery installations, generally without modification to the existing equipment.

15.18 The requirements of each major substation site have been examined and the following works for resilience of protection/ tripping batteries during the RIIO-ED1 period identified :

Black start resilience of SCADA batteries at 132kV sites					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Number of 132kV sites requiring work	91	106	44	55	293
Total cost (£m)	**0.5**	**0.8**	**0.2**	**0.3**	**1.8**

Black start resilience of SCADA batteries at EHV sites					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Number of EHV sites requiring work	163	480	146	348	1,120
Total cost (£m)	**1.0**	**2.1**	**0.7**	**2.1**	**5.9**

Telecommunications resilience

15.19 Alongside substation resilience, the Black Start resilience of the key telecommunications systems is required for successful recovery from a Black Start event. These are the telecommunications systems that are essential to the organisation and the coordination of resources in order to implement restoration plans under Black Start conditions.

15.20 The key telecommunications systems include:

- mobile voice communications for the coordination of field staff;
- telephone land lines to key strategic sites, including Control Centres and Customer Contact Centres;
- telecommunications infrastructure for SCADA systems.

15.21 Under Black Start conditions, many third party telecommunications systems do not have suitable resilience to ensure availability for the likely full duration of a Black Start. WPD operates its own independent telecommunications networks, ensuring that the essential communications systems have suitable resilience to cater for major network events. These are the networks used for SCADA and the PMR voice communications system used by field staff.

15.22 In order to meet the 72 hours resilience requirements of a Black Start it is necessary to improve the backup supply capabilities at a number of the telecommunications sites during RIIO-ED1 period. Works are required at 43 telecommunications sites in WPD West Midlands and 66 sites in WPD East Midlands. No works are required during the RIIO-ED1 period at telecommunications sites in WPD South Wales and WPD South West.

15.23 Many of the sites, where resilience works are required, provide a number of telecommunications services. For example a single telecommunications site may provide services for both internal telephony and SCADA. Therefore works to provide resilient power supplies at a single site may provide resilience for mobile voice communications, SCADA and telephony at the same time.

15.24 The works required to secure telecommunications infrastructure for a Black Start event are shown in the table below:

Volumes and costs for black start security of telecommunication infrastructure				
	West Midlands		East Midlands	
	No. of sites	Expenditure (£m)	No. of sites	Expenditure (£m)
Upgrade Of existing site generation	13	0.3	19	0.4
Increased fuel storage facilities	0	0.0	3	0.0
Installation of new generation	12	0.4	14	0.5
Ancillary works	18	0.2	30	0.4
Total	**43**	**0.9**	**66**	**1.3**

15.25 The table below shows the number of sites where the telecommunications usage shall be secured by the resilience works.

Telecommunications services at the sites where resilience works are required		
	West Midlands	East Midlands
Internal telephony	22	39
Mobile voice communications	23	38
SCADA	42	58

Expenditure summary

15.26 The costs for Black Start resilience will be mostly be incurred during RIIO-ED1. The following tables summarises the total costs.

Black start resilience expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Protection batteries at 132kV sites	0.4	0.6	0.2	0.2	1.4
Protection batteries at EHV sites	0.5	1.4	0.5	0.9	3.3
SCADA batteries at 132kV sites	0.5	0.8	0.2	0.3	1.8
SCADA batteries at EHV sites	1.0	2.1	0.7	2.1	5.9
Telecommunications	0.9	1.3	0.0	0.0	2.2
Total	**3.3**	**6.4**	**1.6**	**3.5**	**14.8**

16 Substation and network security

Background

16.1 WPD has legal obligations to operate its distribution networks in a safe and reliable manner. In addition to the protection of the general public from dangers of electricity and the reduction of the risk of personal injury to staff there is also a requirement to ensure sites and assets are secure to prevent third party trespassing, vandalism and theft.

16.2 Whilst it is virtually impossible to prevent access by a determined thief, improved measures are required to deter unauthorised access and to make it more difficult to force entry.

16.3 Substation sites and cable bridges/tunnels are managed in line with the requirements of ENA recommendations and a risk based approach is used. The effects of vandalism or theft are rated, along with the potential further risk to the public should vandalism or theft occur.

Major substation security

16.4 Bulk supply substations and primary substations have a concentration of high value plant and assets, where the risk is both the effect of the theft on customer supplies and the residual risk of an unsecured site being accessed by the public after the theft.

16.5 WPD works with the security services and the CPNI to take even more stringent security measures at sites which are key to the UK. All of WPD's security works are planned so that they fit within CPNI guidelines and would allow the easy enhancement of our sites should they become added to the CPNI listings.

16.6 During DPCR4, work was completed in the South West and South Wales areas to enhance the security of all substation sites at 33kV and above. As a minimum, intruder alarms were installed at all primary substations, with CCTV being added to higher risk sites and electric fences being added to very high risk sites. Security specification doors were also added to these sites.

16.7 The pinning of earthing conductors was also employed as a deterrent. This involved increasing the number of fixing points (pins) to make it more difficult to prise the conductor away and cut it.

16.8 The works completed in the South West and South Wales will be extended into the West Midlands and East Midlands during the RIIO-ED1 period.

16.9 The number of sites where enhanced security measures are to be applied are detailed in the table below:

Number of 132kV and EHV substation sites to have security enhancements in RIIO-ED1					
	West Midlands	East Midlands	South Wales	South West	WPD Total
132kV sites	89	154	0	0	243
EHV sites	283	399	0	0	682

132kV & EHV site security expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.6	1.0	1.6	1.0	5.2
RIIO-ED1 Annual Average	0.8	1.4	-	-	2.2
RIIO-ED1 Total (8 years)	**6.3**	**10.8**	**-**	**-**	**17.1**

Application of theft deterrent measures at distribution substations

16.10 At ground mounted distribution substations, of which we have over 56,000 locations in the WPD area, it is more difficult to provide a suitable and proportionate increased set of security measures. For these sites it is more effective to provide measures which deter theft by using higher security fencing and doors.

16.11 Innovative tagging and identification systems can easily be applied to substation assets to deter opportunist thieves. We have been very successful with one system that is applied like paint, making it useful for a variety of situations. Each application is unique and it can be traced to the exact item, location and date it was applied. Other identification methods will also be trialled to ensure that we are using the most effective approaches. The deterrent is enhanced by using signage to inform potential thieves that tagging products are being used and that items with markings can be traced. Scrap metal dealers have been informed that the systems are in use so that they become more reluctant to buy stolen electricity assets. The basic underlying principle is that if the thief cannot sell the stolen property they will not steal it.

16.12 We have begun research work on a system which aims to identify stolen overhead conductors by using the properties of the verdigris which forms on the wire when it is in the air. This is at a very early stage but, if successful, will provide more assistance to the police when stolen conductors are recovered.

Distribution substation security expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.2	0.2	0.0	0.0	0.4
RIIO-ED1 Annual Average	0.3	0.2	0.1	0.1	0.7
RIIO-ED1 Total (8 years)	**2.3**	**1.4**	**0.7**	**0.7**	**5.1**

Cable bridges and tunnels

16.13 Cable bridges or tunnels are structures which are used specifically to get cable routes across roads and waterways. The risk at these sites is the fact that the cables are not buried and become more accessible. As a cable bridge may also have a concentration of cables that serve a wide geographical area so the risk of customer interruptions is heightened.

16.14 All cable bridges have anti-access devices fitted and some are also cladded to prevent access. Where there is evidence of attempted access or the risk of damage will cause major disruption to supplies the security measures will be enhanced.

17 Metal theft remedial actions

Background

17.1 Significant increases in the prices of commodities such as copper and aluminium have resulted in increased incidence of theft, especially that of copper low voltage overhead lines and earthing conductors located within primary and distribution substations.

17.2 In addition to safety risks the consequences of theft are the need for remedial works to replace the stolen assets, repairs to damaged fences and doors, interruptions to supply and inconvenience for customers.

Repair to network equipment

17.3 Where bare copper overhead lines are stolen they are replaced, in most cases, with insulated aerial bundled conductor (ABC) to minimise the likelihood of repeated theft. ABC reduces the likelihood of theft as it requires the insulation to be stripped before it can be sold and it is made using aluminium conductor which has a lower commodity value.

17.4 Missing substation earthing can lead to dangerous voltages arising on equipment, fences and at customers' premises and is therefore reinstated as soon as thefts are identified.

17.5 In some circumstances, thieves are disturbed or they do not find anything they can steal. Whilst these attempted thefts do not cause interruptions to supply, they do require site visits to establish the extent of possible damage and to make sites secure. Costs associated with metal theft are therefore categorised as either causing interruptions to supply or other occurrences that are not covered by the Interruptions Incentive Scheme. Within Business Plan Data Templates, the costs for metal theft remedial measures have been incorporated into the overall costs for Trouble call in line with regulatory guidance.

Repair to customers' equipment

17.6 The theft of neutral conductors can lead to high voltages and the subsequent damage to appliances in customers' properties. Since this occurs as a consequence of third parties interfering with equipment, WPD is not legally liable and does not accept responsibility for any damage. But because the damage to equipment may not be the customer's fault and the customer is being inconvenienced, WPD provides, as a minimum, a 'Heat and Eat' service where damaged boilers and cookers will be repaired or replaced at no cost to the customers. The cost of this service is incorporated into insurance claims expenditure reported against finance and regulation in business support costs.

Working with police forces to reduce theft

17.7 WPD has been working with police forces within the WPD area to assist in crime prevention. We have provided guidance to improve the identification of recovered stolen materials and facilitated meetings with neighbouring forces to ensure that intelligence is shared across police area boundaries. Although this has led to a number of arrests and prosecutions, theft continues to be a problem.

17.8 WPD has been instrumental in getting police forces across the East Midlands and West Midlands to work together to identify suspects and makes arrests. Clothing, tools, mobile phones and vehicles found at the sites of theft have been provided as evidence which have

enabled police forces to be better informed about the thieves. Staff have also accompanied the police in visits to scrap yards to help to identify potentially stolen materials.

17.9 Booklets and charts have been produced to inform the police and scrap merchants about the types of cable and conductor used by the industry. By being more aware, scrap dealers are deterred from handling stolen material and police can quickly make investigations where theft is suspected. Scrap dealers have also been made aware that WPD uses tagging and identification systems that allow stolen equipment to be traced and the location of theft to be identified.

17.10 WPD will continue to work collaboratively with the police to reduce the likelihood of theft. This proactive action will minimise the disruption to customers and consequential costs of repairs.

18 Security of Critical National Infrastructure (CNI)

18.1 WPD works with the security services and the Centre for the Protection of the National Infrastructure (CPNI) to take even more stringent security measures at sites which are key to the UK. The assessments consider the number of customers connected to a specific site, its criticality to the network in general or its role in supporting key installations or customers. When a site is defined as being part of the CPNI list, additional security works are undertaken to increase the protection of the site.

18.2 The measures include the installation of enhanced and electrified fences, alarm systems and CCTV systems. Proposed enhanced security measures need to be approved by the CPNI and once completed an audit is required to demonstrate that the measures have been completed to the appropriate specification.

18.3 Expenditure expectations are forecast to be in the region of £5m during the RIIO-ED1 period with costs being recovered once work is completed. At present there are no firm requirements and therefore this funding will either be requested during a re-opener window or logged up for recovery during RIIO-ED2.

19 High Impact Low Probability (HILP) events

19.1 Although the loss of supply is inconvenient, the majority of faults have a limited impact do not last long. There are, however, situations where an accident, vandalism or a terrorist act could cause widespread impact and long duration outages, particularly if there is a lot of damage to electrical equipment. When such events impact upon the electricity supplies to central business districts (CBDs) there could be a significant detrimental effect on the local economy.

19.2 The risk of such high impact low probability events is mitigated by enhancing network security with additional capacity and reconfiguring existing arrangements to limit the impact of the loss of one site.

19.3 Extensive replacement works are ongoing at a central Birmingham site, and the opportunity is being taken to introduce more physical separation between assets to reduce the impact of a single event.

19.4 Security arrangements will be enhanced at a number of sites and should Government intelligence identify sites at greater risk of attack they will be made more secure under our CNI security programme.

19.5 During RIIO-ED1, WPD does not propose any specific expenditure on HILP events.

20 ESQCR regulation 18

20.1 The Electricity Supply, Quality and Continuity Regulations 2002 govern many DNO activities. When the regulations were launched they introduced a number of new obligations some of which took immediate effect. The requirements of all the regulations have already been embedded within routine inspection and maintenance programmes.

20.2 Regulation 18 of the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 specifically deals with the clearances of overhead lines to structures. It requires overhead lines to be clear of buildings and other obstacles to reduce the risk of inadvertent contact. Where existing lines are close to buildings, the regulations require that lines are modified to remove the risk. Longer timescales were allowed for compliance with this regulation to identify the locations and deliver the remedial work.

20.3 WPD has identified the locations where work is required and the majority of the programme will be completed in DPCR5, but, as previously agreed with the HSE, there will be part of the programme in the South West that will continue into RIIO-ED1 and will be completed by March 2018.

ESQCR horizontal clearance expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	2.0	1.3	1.1	4.1	8.5
RIIO-ED1 Annual Average	-	-	-	1.8	1.8
RIIO-ED1 Total (8 years)	**-**	**-**	**-**	**14.1**	**14.1**

21 ESQCR regulation 17 – overhead line clearance to ground

21.1 The ESQCR specifies ground clearance requirements for overhead lines that cross roads. This is to ensure that vehicles passing under the lines have sufficient clearance without the risk of coming into contact with the lines.

21.2 Advances in line height measurements techniques allow staff to measure the height of road crossings from the side of the road. These new instruments have identified that around 20% of road crossings, mainly overhead services, are non-compliant with clearance requirements.

21.3 Overhead lines that do not meet the requirements will be rebuilt to increase the height across roads. This will require taller poles and overhead line re-conductoring.

21.4 The work to correct any shortcomings will carry on throughout DPCR5, but there will be requirement to continue into RIIO-ED1. The following table shows the costs specifically for this activity.

Legal and safety – overhead line clearance to ground expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.7	0.6	0.5	1.0	2.8
RIIO-ED1 Annual Average	1.8	1.4	1.2	2.3	6.7
RIIO-ED1 Total (8 years)	**14.2**	**11.6**	**9.3**	**18.4**	**53.5**

22 Visual amenity and undergrounding in National Parks and AONBs

22.1 WPD's geographic area includes numerous National Parks and Areas of Outstanding Natural Beauty (AONBs) e.g. the Isles of Scilly, Dartmoor, Pembrokeshire, the Cotswolds, the Peak District and the Lincolnshire Wolds.

22.2 Electricity supplies in rural areas are predominantly provided using overhead lines and this means that overhead lines are installed within National Parks and AONBs, sometimes near important sites. Many overhead lines have been in place for a long time, but there are locations, especially at popular tourist sites, where the removal of selective overhead lines can enhance the visual amenity.

22.3 Stakeholders see value in preserving the visual amenity particularly where this benefits local communities and contributes to tourism, but they do not expect expansive undergrounding of all existing lines stating that the focus should be on important areas.

22.4 WPD will continue to work collaboratively with National Parks, AONB and appropriate interest group representatives, to identify the areas that would benefit the most from the undergrounding of overhead lines. Regular discussions will be held with established steering groups to identify and prioritise projects of this kind.

22.5 The undergrounding projects undertaken during DPCR5 have made it clear that in some parts of the UK interest groups are better placed to promote works than in others parts of the UK. It is a significant task for interest groups to manage the individual projects, including those which do not eventually proceed. Some groups find the scale of the task is a barrier to benefiting fully from the programme. In WPD, this has mostly been a problem for groups in our Midlands area.

22.6 We will try to assist those who find it difficult to participate in the process or those National Parks or AONBs who have not benefitted from this initiative to date. We will work with our stakeholders in this area and we will set out our strategy in a policy document that will also make clear our approach for assessing candidate projects and for supporting and interacting with relevant stakeholders.

Undergrounding in National Parks and AONBs expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.4	0.4	0.1	0.2	1.2
RIIO-ED1 Annual Average	0.3	0.1	0.2	0.4	1.0
RIIO-ED1 Total (8 years)	**2.3**	**0.9**	**1.4**	**3.0**	**7.7**

22.7 In a limited number of instances we will underground overhead lines to improve visual amenity in areas outside AONBs and National Parks. The forecast for general visual amenity expenditure is shown below.

General visual amenity expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.1	0.1	0.1	0.1	0.4
RIIO-ED1 Annual Average	0.1	0.1	0.1	0.1	0.4
RIIO-ED1 Total (8 years)	**1.1**	**1.1**	**0.8**	**0.8**	**3.8**

23 Oil pollution mitigation

Reducing leakage from fluid filled cables

23.1 The design of very high voltage underground cables has evolved over many years and our new cables use a solid plastic insulation. Old designs of 33kV and higher voltage cables used insulation oil inside the cable. Although these cables are normally very reliable, if they are damaged the oil may leak out. The oil is biodegradable in the long-term, but leaks can cause short term environmental damage to land use and water courses.

23.2 The cables are monitored so that we can respond quickly in the event of leaks. Pressure gauges connected to the cable monitor fluid pressure and send alarm signals to control centres when the pressure falls below set thresholds. When alarms are raised, staff are dispatched to make arrangements to top up the oil level. Where the level continues to fall, leak location is instigated.

23.3 Traditional methods of leak location can be slow and expensive. They use liquid nitrogen to freeze the oil so as to determine which side of the frozen position is leaking. This process is combined with pressure calculations to determine where the leak is and usually has to be repeated several times to locate the leak.

23.4 WPD has developed an innovative technique to help pinpoint leaks more quickly, thereby reducing the amount of oil lost in the environment before a cable is repaired. We have been trialling a new techniques called PFT tagging. A tiny amount of perflurocarbon tracer is added to the fluid in the cable and if a leak occurs it can be detected from pavement level with a sensitive detector. This helps to locate a leak quickly and to within a few metres, reducing both the amount of fluid leaking into the environment and the extent of any related excavation. The programme of tagging will be extended to all fluid filled cables that have a history of leakages.

23.5 In addition, the asset replacement programme will target the replacement of the 1% of cables that have the highest leak rates, especially where the leaks are due to the deterioration of the cables.

Oil pollution mitigation from fluid filled cables expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.0	0.0	0.1	0.3	0.4
RIIO-ED1 Annual Average	0.2	0.3	0.1	0.1	0.7
RIIO-ED1 Total (8 years)	**1.8**	**2.3**	**0.8**	**0.6**	**5.5**

Oil pollution mitigation – bunding on operational sites

23.6 A light oil is used in UK DNOs' plant for insulation and for cooling. It is found in all transformers and in older switchgear on the network. At primary sites and above, the transformers hold a significant volume of oil.

23.7 There is the risk that this oil could leak out as a result of a catastrophic failure of the plant item, vandalism or theft.

23.8 At primary sites where the volume of oil used is higher, transformers are bunded so that any loss of oil is contained on the site.

23.9 During RIIO-ED1, bunds that have deteriorated and are no longer effective will be repaired or rebuilt as necessary.

Oil pollution mitigation on operational sites expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.2	1.6	0.2	0.6	3.6
RIIO-ED1 Annual Average	0.1	0.1	0.0	0.1	0.3
RIIO-ED1 Total (8 years)	**0.6**	**0.6**	**0.3**	**0.5**	**2.0**

Oil pollution mitigation – non-operational sites

23.10 At non-operational sites such as local area depots there is a risk associated with the storage of equipment containing oil. Oil will be found within new equipment (e.g. distribution transformers), old equipment that has been returned from operational sites following replacement or failure as well as the barrels of insulating oil used during switchgear maintenance.

23.11 Each depot has an environmental management plan detailing local procedures for dealing with oil and identifying specific environmental considerations such as outfalls into water courses or public drains. Bunded storage areas are used for returned equipment and interceptors are installed between the site and discharge points to capture any oil in the event of an uncontrolled spill.

23.12 Non-operational sites have long-established procedures and systems to deal with oil pollution. As many of the West Midlands and East Midlands sites were extensively refurbished in 2011 and 2012 the further measures required in RIIO-ED1 are limited and the majority of costs incurred in RIIO-ED1 will be to undertake routine inspection, maintenance and interceptor cleaning. No capital expenditure is therefore proposed for the RIIO-ED1 period.

Oil pollution mitigation expenditure summary

Oil pollution mitigation expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Fluid filled cables	1.8	2.3	0.8	0.6	5.5
Operational sites	0.6	0.6	0.3	0.5	2.0
Non-operational sites	0.0	0.0	0.0	0.0	0.0
Total	**2.4**	**2.9**	**1.1**	**1.1**	**7.5**

24 Sulphur Hexafluoride (SF_6) losses

24.1 Sulphur Hexafluoride (SF_6) is a gas which is used throughout the electricity industry as an insulation medium in switchgear. The use of SF_6 has has allowed switchgear to be designed into smaller packages, reducing the amount of materials used in the production of switchgear and reducing the physical space needed to build a substation. Although SF_6 has excellent insulating properties, it is a potent greenhouse gas. There is no suitable replacement for this gas at distribution voltages and so it remains in widespread use in the electricity industry.

24.2 When switchgear containing SF_6 is retired from the network, the gas is recovered and recycled in the same way as gas is recovered from old fridges. We are actively supporting research into the replacement of SF_6 as an insulant with the switchgear manufacturing industry.

24.3 During DPCR5 we have been replacing items of switchgear that have proved to be prone to leaks. This includes specific types of pole mounted switchgear with small amounts of gas and larger 132kV substation equipment with large volumes of gas. As this type-specific replacement programme comes to an end, there is currently no next make or model of switchgear that requires a specific targeted replacement programme. In RIIO-ED1, we plan to implement a “leak and replace” regime on 11kV distribution assets and a “three leaks and replace” regime on larger or higher voltage assets.

24.4 The replacement of SF_6 filled switchgear will be carried out under asset replacement so there are no specific additional costs within the environmental expenditure area.

25 Reducing technical losses

What are losses?

25.1 The amount of energy that enters an electricity network is usually greater than the amount that is delivered to customers. The principal reason for this is that an electricity network uses energy in the process of delivering power to customers. This is known as a technical loss.

25.2 Another reason for electricity losses is where there is no meter or supplier at the final connection to record the usage. There are situations where a connection has been made to our system without authority. The energy used in these connections is not metered and does not feature in volumes that suppliers register. As a result it is shown as a loss on our network. This is known as theft in conveyance or illegal abstraction.

25.3 All Distribution Network Operations (DNOs) are obliged to run an efficient and economic system as a condition of their Distribution Licence. Losses are one measure of this efficiency. In addition to the requirements of the Licence, reducing losses is also a key part of the WPD strategy to help us manage our carbon footprint.

Technical losses

25.4 Of the amount lost, a fixed amount is lost dependent upon the network itself, irrespective of the usage of the network and then a further amount is lost depending on the level of load on the network. The energy lost as a result of the network and its usage is usually called “technical losses”. This can further be categorised into fixed losses and variable losses. Variable losses will change as load alters on the network and is further impacted by the effect of network imbalance or power factor.

Fixed losses

25.5 The fixed element of losses is made up of the energy which is required when transformers are energised. As transformers require electrically produced magnetic fields to operate the energy used creating these fields is essentially fixed while they are switched on.

Variable losses

25.6 The variable element of losses is created due to the heating effect of energy passing through cables and wires. These conductors all have a small resistance and when currents are passed through they heat up. This heating effect is logarithmic and the effect of high load (when an item of equipment is running near or at full capacity) is very much more significant than in an item which has a low or part load.

25.7 The resistance of a cable reduces as its cross sectional area increases so the effect of losses is reduced in larger cable sizes. There is a very similar variable element created through the wires and windings which are found in all transformers.

Imbalance

25.8 A network which is not balanced across all three phases will have higher currents than expected in at least one phase. Due to the logarithmic relationship to variable losses, these higher currents can have a significant effect on losses.

25.9 Imbalance is found on all parts of the network due to customers using one or two phases having different load consumptions. In order to rebalance the network there are physical actions that are required on the network. For example, a rural high voltage overhead network could be rebalanced relatively simply by moving the overhead service connection to a different

phase of the overhead main. This is more difficult on an urban underground low voltage network which requires existing service joints to be excavated and new joints made to move customer supplies to different phases.

Power factor

25.10 Another characteristic which will increase losses by increasing currents on the network is the power factor. Where the power factor is less than unity the current has to increase to deliver the required amount of power. This has historically been an issue for installations used by industrial and commercial customers where most motor loads or power electronic loads were seen. Developments in domestic power electronics and the adoption of heat pumps means we will start to see this issue on our domestic networks.

Theft in conveyance

25.11 The detection of situations where there is no registered supplier at a final connection point or no meter installed is very difficult. Often detection comes as a result of investigations for another reason. In many cases theft in conveyance is connected to other illegal activities, which prompt investigation and detection. The normal routine of our visits to premises and the routine of supplier visits to collect meter readings will often expose cases of theft.

Which parts of the network produce the most losses?

25.12 The distribution of electricity at low voltage produces the most losses on our network. The local network supplying electricity to properties and the transformers which support it at 11,000 volts (11kV) account for around 50% of our total losses. The 33,000 volt network (33kV) which sits behind this accounts for another 44% of losses and the higher voltages (EHV) make up the remaining 6% of the total.

Our plans for losses reduction in RIIO-ED1

Improved understanding of losses

25.13 Most of the work undertaken on losses to date has been to better understand network losses rather than the practical options for reducing losses. During the RIIO-ED1 period we will reach a stage where we can apply this knowledge to ways that we can actively reduce losses. In order to see the effect of reducing losses we need to be able to set a baseline of current losses. We plan to do this by using the established highly monitored network in South Wales which supported the Low Carbon Network Fund (LCNF) LV Templates project.

25.14 The LV Templates project provides us with a monitored network covering a wide area of South Wales. It can measure the power supplied into this network at HV and also measure the power delivered from the LV substations. The losses in this section of network will be due to technical losses, as inaccuracies caused by illegal abstraction or meter data issues generally occur at LV. We will investigate ways of extrapolating this data to provide reliable loss baselines for different network types.

Addressing losses in transformers

25.15 To reduce the variable losses in a transformer the resistance of the wires needs to be decreased, which can be done by increasing the cross sectional area of the wires or using materials with a lower resistance. To reduce the fixed losses the efficiency of the magnetism needs to be improved, which can be done by using materials with better magnetic properties.

25.16 Improving both of these elements can result in much bigger transformers. Many of the transformers that we buy are installed as replacements for existing units and so it is usually not

possible to fit larger transformers into the space vacated by their predecessors. We have worked with manufacturers to develop more efficient transformers which retain the same footprint and dimensions as existing units, but since these are significantly more expensive they have not been used.

25.17 The EU are considering a regulation to implement Directive 2009/125/EC regarding the Ecodesign of electrical equipment and if introduced this would lead to a requirement for us to install more efficient transformers. These units are much more expensive and at larger distribution substation level can lead to a doubling of the cost of a transformer. We have not incorporated these increased costs into the forecast because it is uncertain when the regulations would be implemented. We will manage the risk of the impact of the new legislation and therefore do not require an additional uncertainty mechanism.

25.18 The variable losses in a transformer are much lower when the unit is partially loaded and increase greatly as a unit becomes fully loaded. It is therefore possible to reduce the overall losses by oversizing transformers when they are installed. It is not appropriate to do this in all cases, because the societal benefit alone arising from reduced losses is not sufficient justification for the expenditure. However there is a case for oversizing transformers in a targeted way and benefitting from a short term reduction in losses. Using data from the CSE we forecast that there is around 7% of our network where the uptake of LCTs would be likely and the investment to oversize transformers can be justified. We would aim to oversize 109 transformers per annum at a cost of around £0.11m per annum.

Addressing losses in cables

25.19 To reduce the variable losses in a cable the cross sectional area of the conductors needs to be increased. Once a cable is laid and the ground is reinstated, it is uneconomical to make alterations to the cable. Our opportunity to reduce losses only exists at the time that the cable is initially installed. The resistance of a 185mm^2 low voltage cable is around half that of its 95mm^2 equivalent. The additional cost of the cable is less than £10 per metre which is marginal compared to the excavation costs which can be between £50 and £100 per metre.

25.20 Whilst this cost is marginal, it is not appropriate to oversize cables in all of our work. Assuming that 7% of the network will be subject to LCT hotspots, using larger cable in these situations would lead to around 75km per annum being installed with a higher rating and lower losses. The incremental cost is £0.31m per annum.

Network design

25.21 We have completed research into losses with Imperial College and SOHN Associates. The early indications are that we can address losses on new developments by reducing the number of customers per substation and also by increasing the size of the service cables.

Asset replacement

25.22 The majority of our network is already established and there is no cost benefit in replacing it wholesale purely as a method of reducing losses. When we add new assets to the network or replace existing ones we do have an opportunity to consider the effect of losses and take them into account. We have used research from the CSE to show us areas of our network that are highly likely to see an increase in demand as a result of LCTs.

Demand side management (DSM)

25.23 Due to the logarithmic nature of variable losses, assets working at their maximum capacity will lead to significantly more losses than those with a reduced loading. The scale of variable losses can therefore be reduced by simply reducing the demand on the network or by reconfiguring networks to transfer loads from highly loaded circuits to lower loaded circuits.

25.24 In our Lincolnshire Low Carbon Hub, FALCON and FlexDGrid LCNF projects we are trialling methods to monitor and automatically reconfigure networks. Where these networks can be meshed (operated in parallel) and loads transferred it will be possible to reduce the overall losses. We will identify areas of our network where the techniques can be replicated.

Imbalance and power factor

25.25 We are developing a project with a solar generation customer that will investigate the feasibility of addressing imbalance and power factor issues on the 33kV network. The project will use the customer's inverter equipment to alter the phase angle of the generated power. It will also use local storage to set the generated power per phase to reduce overall network imbalance. The storage can also be used to manage the overall utilisation of the network.

Theft in conveyance

25.26 Theft of electricity from our network adds to the level of recorded losses, but is difficult to detect exactly where it is occurring.

25.27 The majority of methods available to detect theft in conveyance relied on visits to the premises to establish the theft. It has not been easy to complete a desktop office based survey of our network to establish which properties were connected to the network and had a registered electricity supplier and those which were not.

25.28 We plan to use the "addresspoint" standard to produce a list of premises which do not have an electricity supply registered to them. By starting from the assumption that most premises in the UK have an electricity supply, we can use this list to establish a subset of premises without a registered supply and which would require a physical inspection. This desktop analysis will make the targeting of potential theft a much more efficient system.

Expenditure

25.29 We propose to cover the cost of the larger size assets through efficiency savings. We therefore have not requested any specific allowances for this activity.

26 Installation of noise/vibration barriers

26.1 Substation assets can be close to residential properties. In some cases, customers find the humming noise from transformers disturbing or equipment may be prone to vibration. This disturbance can be transmitted through the air or via the ground. Simple solutions, such as damper pads, can be installed under transformers, but in some cases more extensive noise barriers/deflectors are erected. Where the equipment is noisy, asset replacement may be carried out especially if other poor asset condition is evident.

26.2 There are rare occasions where customers have built extensions to properties close to substation boundaries that cause the transfer of vibration through building foundations. In these cases it may be necessary to install foundation isolation to limit the transfer of vibration.

Noise mitigation expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.0	0.0	0.0	0.3	0.3
RIIO-ED1 Annual Average	0.1	0.1	0.0	0.1	0.3
RIIO-ED1 Total (8 years)	**0.6**	**0.6**	**0.3**	**0.5**	**2.0**

Network operating costs

27 Inspection and maintenance

Legal obligations

27.1 WPD has a legal obligation to maintain the safety and reliability of the assets that constitute the electricity distribution networks. These legal obligations are contained in the:

- Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002;
- Electricity at Work Regulations 1989; and
- Health and Safety at Work Act 1974.

Inspection and maintenance objectives

27.2 WPD owns and operates an extensive network of assets that have a long working life, with many lasting over 40 years. These lifetimes are achieved by inspecting and maintaining the assets to ensure that they remain in safe operational condition.

27.3 The objectives of inspection are to identify safety and security issues and check the condition of assets.

27.4 The objective of maintenance is to leave the equipment in a condition that will keep it safe and operational until the next maintenance.

Inspection and maintenance strategy

27.5 WPD's overall inspection and maintenance strategy is to:

- undertake proactive time based inspection and maintenance interventions that facilitate the delivery of lowest life time costs;
- collect and record asset "as found" condition data when inspection and maintenance tasks are undertaken. This condition data is subsequently used to inform future interventions, such as reactive maintenance, enhanced inspections, asset refurbishment and asset replacement at the end of the asset's life;
- undertake reactive actions to remedy defects identified during time based inspections.

27.6 WPD's policy documents detail all of the elements of inspection and maintenance required to manage the electricity network. When read together they become the "workshop manual" for maintaining a network.

Life-time cost minimisation

27.7 WPD's maintenance frequencies have been optimised by the consideration of:

- content of maintenance interventions;
- failure mode analysis;
- long run asset condition data;
- knowledge of the deterioration of assets;
- Reliability Centred Maintenance studies;
- the range of maintenance practices in the four DNOs that now comprise the WPD Group.

27.8 We have undertaken research work that has allowed us to determine maintenance activities and their frequency such that we preserve asset condition but do not undertake additional unrequired maintenance tasks.

27.9 An example of this is our investigation of the maintenance intervals that should be applied to certain types of oil filled 11kV switchgear. This switchgear is found in many distribution substations on our network and, in some cases, is only operated on a very small number of occasions between maintenance visits. The main focus of the maintenance is the oil insulation and the switch contacts and with the low level of usage, should remain in a very good condition throughout their lifetime.

27.10 We began to investigate the potential to extend the maintenance intervals from the standard of 12 years. Some selected items of switchgear were left on the network without maintenance being carried out, but were subject to annual oil sampling and analysis to ensure that the integrity of the oil and switch remained intact. This sampling approach has allowed us to move the maintenance interval on this switchgear to 18 years. Some of the switchgear remains on the network for further testing and analysis to establish if the maintenance intervals can be extended further.

WPD asset management system

27.11 We use an in-house asset management system (called CROWN) to manage the inspection and maintenance for all our assets. Although CROWN is our asset database, the system also holds site risk data which is used to increase maintenance and inspection frequencies where there are increased risks e.g. evidence of vandalism.

27.12 Condition data and test results collected on site are recorded in the CROWN system, and these are used with the other asset data to inform condition based replacement requirements.

27.13 When an asset is commissioned in CROWN, the tasks for its first inspection and maintenance visits are generated. This ensures that there is always a record of the work that needs to be completed and allows forward work programmes to be established. When tasks are completed in CROWN, the next task based on interval or condition is applied.

Increases in inspection and maintenance activity

Electronic systems on switchgear

27.14 As networks become more automated there is a greater amount of electronic control equipment in use. Although the maintenance of the actual switchgear is becoming less frequent there is a need to check the automatic actuators, radios and control equipment fitted on the switchgear. This electronic computer based equipment requires testing to ensure it works correctly and whether backup batteries need to be changed. It is also very likely that the computer systems will become redundant and require replacing within the lifetime of the electrical asset.

27.15 Our maintenance tasks will change to include more site visits for testing and reprogramming of electronic control equipment.

Cutouts

27.16 The smart meter roll out provides an opportunity to gain information about the condition of cut-outs and service position equipment.

27.17 We will work with suppliers and their meter operators to capture information about the cut-out, its condition and location, which will help influence condition assessment decisions.

27.18 We will establish a record of this data in our asset register and will supplement it with data provided when new cutouts are installed and when cutouts are visited as a part of our works. Our register will include details of cutout type, fuse size, age, service type and earthing.

Oil regeneration in transformers and tapchangers

27.19 Maintenance of transformers and tapchangers will normally only require oil to be replaced in the tapchanger units. For certain transformers, using a criteria based on age and condition, it is beneficial to recondition (or regenerate) the oil within the main transformer body. The transformer oil is taken from the unit on site and passed through processes to clean it and add an inhibitor. The oil is then replaced into the transformer.

27.20 This process does not improve the health index of the transformer as the physical condition of the transformer is not altered. The regeneration processes improves the condition of the oil by removing moisture and acidity that degenerates the insulation and can extend the life of the asset by around 10 years.

Inspection and maintenance expenditure

27.21 The table below provides a summary of WPD inspection and maintenance expenditure for DPCR5 and RIIO-ED1:

Inspection and maintenance expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	12.8	12.0	5.7	6.5	37.0
RIIO-ED1 Annual Average	8.0	7.2	4.1	5.4	24.8
RIIO-ED1 Total (8 years)	**64.2**	**57.6**	**33.0**	**43.5**	**198.4**

28 Tree cutting to meet industry standard requirement ENA TS 43-08

Overall Objectives

28.1 Overhead lines are susceptible to damage from growing trees, falling trees and windborne vegetation. Climbable trees near overhead lines also pose a danger where physical contact with conductors is possible. Tree clearance is therefore carried out to reduce the risk of injury to the public and to prevent damage causing interruptions to supply. Clearance distances are specified within industry standard ENA TS 43-8, which requires a minimum of 3m clearance for climbable trees and 0.8m for all others.

Options for maintaining tree clearance

28.2 The majority of tree cutting is a cyclical activity that clears sufficient length from trees to maintain minimum clearance distances between cuts. The activity requires due recognition of different growth rates of tree and shrub species. Tree felling removes the need for repetitive visits, but this is often not acceptable to customers or landowners.

28.3 Where tree preservation orders exist or customers place a high value on the presence of trees, permission to cut may not be granted or severely constrained. Statutory powers are available to oblige the cutting of trees, but WPD favours a collaborative approach with customers. In some cases the cut achieved may not be adequate to maintain clearance distances until the next cyclical cut, so repeat visits and additional cuts may be required.

28.4 Alternatives to cutting the trees include replacing open wire LV lines with Aerial Bundled Covered Conductor, diverting lines (assuming alternative wayleaves can be obtained) or replacing the overhead lines with underground cables. Tree cutting remains the most practical and effective alternative in most cases.

Tree cutting policy

28.5 In South Wales and South West proactive tree cutting programmes associated with 132kV, EHV and HV overhead lines have been in place for many years and is carried out every five years. Prior to 2005/06, tree cutting associated with LV overhead networks was undertaken on a reactive basis. In 2005/06, a proactive tree cutting programme was introduced, on the basis of a seven year cycle. This cycle will be reduced to five years in RIIO-ED1 to make all tree clearance cycles consistent.

28.6 In West Midlands and East Midlands, prior to 2005/06, all tree cutting was undertaken on a reactive basis. The consequence of this reactive approach was that a significant tree cutting backlog had developed. During 2005/06 proactive tree cutting programmes associated with 132kV, EHV and HV overhead line networks were introduced in order to address the tree cutting backlog. Following acquisition by WPD, cyclical tree clearance was implemented at LV to clear the remainder of the backlogs by the end of DPCR5.

28.7 During the RIIO-ED1 period, all cutting in all areas will be completed using a cyclic approach with all voltages being on a five year cycle.

Forecast activity levels

28.8 The current plan is to clear the tree cutting backlogs in West Midlands and East Midlands by the end of 2014/15.

28.9 As stated above, from the start of the RIIO-ED1 period, all circuits will be inspected and cut every five years. Our contractors will inspect each span and either declare it clear of tree proximity or undertake cutting to achieve the required clearance. In the majority of cases, and especially where the circuit has been previously cut, most of this work can be carried out without the need to switch the power off and affect customers' supplies.

28.10 The forecast annual number of spans to be cleared to ENA 43-8 requirements is shown in the table below.

Annual average number of spans to be cut in RIIO-ED1 for ENA 43-8 requirements					
Overhead line voltage	**West Midlands**	**East Midlands**	**South Wales**	**South West**	**WPD Total**
LV	10,550	8,753	7,925	19,868	47,241
HV	13,089	7,409	13,273	14,705	48,476
EHV	1,017	920	1,182	1,567	4,681
132kV	335	448	363	367	1,510

Expenditure forecast

28.11 The table below provides a summary of WPD tree cutting to meet industry standard ENA 43-8 requirements for DPCR5 and RIIO-ED1:

Tree cutting – ENA 43-8 expenditure (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DPCR5 Annual Average	13.1	9.3	7.0	9.2	38.6
RIIO-ED1 Annual Average	5.7	4.2	5.7	7.9	23.5
RIIO-ED1 Total (8 years)	**45.5**	**33.6**	**46.0**	**63.2**	**188.2**

29 Tree clearance to meet industry standard requirement ETR 132

29.1 Following the storms of October 2002, where some customers were left off supply for up to five days, the government embarked on changing legislation to drive DNOs to prevent supply interruptions caused by trees. The changes required DNOs to operate progressive tree cutting and felling programmes to improve network performance in abnormal weather conditions. Working closely with Government, the industry developed standard ENA ETR 132 which outlines a risk-based methodology for targeting resilience tree clearance on strategic overhead line routes.

29.2 The Regulatory Impact Assessment for the amendment to the ESQCR suggested resilience clearance in accordance with ETR 132 should be applied on a modest yet progressive basis, circa 0.8% of 11kV and 33kV networks per annum resulting in 20% of the combined length of these networks meeting the ETR 132 resilient standard after 25 years (by 2034). The main rationale being 80% of issues can be resolved by applying ETR 132 to 20% of the network.

29.3 Stakeholders agree that a tree cutting programme to reduce the risk of power cuts during storms should be a high priority and more clearance should be carried out. WPD will therefore accelerate the programme to deliver the 20% within 20 years.

29.4 There is a slight backlog in the current programme and it is proposed to catch this up by the end of DPCR5. This means that 4.8% (6x0.8%) of the HV and EHV network will be resilient. This will leave 15.2% to be cleared over the following 14 years in RIIO-ED1 and RIIO-ED2.

29.5 Current resilience volumes and cost forecasts are aligned with this requirement and the cutting will primarily be focused on the complete 33kV network and strategic 11kV interconnecting circuits.

Tree cutting – ETR 132 expenditure (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DPCR5 Annual Average	1.3	0.7	1.0	0.8	3.8
RIIO-ED1 Annual Average	2.0	1.8	1.6	2.3	7.6
RIIO-ED1 Total (8 years)	**15.6**	**14.0**	**12.9**	**18.1**	**60.6**

30 Trouble call (faults)

Background

30.1 Although investment programmes seek to minimise their likelihood, there will inevitably still be network faults. Fast and effective fault response is paramount to minimising the impact of supply interruptions.

30.2 WPD uses network automation and additional network protection to reduce the number of customers affected by a fault and the length of time that those customers who are affected are without power. These devices and associated communication infrastructure enable remotely controlled switching, thereby speeding up network reconfiguration during fault switching.

30.3 When faults occur the priority is the restoration of supply so that customers experience minimal inconvenience. Staff are mobilised quickly and internal target mechanisms (e.g. Target 60 - the WPD target to restore as many customers as possible within one hour of an HV fault) are used to drive improvements in response and restoration. Local teams with local knowledge based at local depots respond quickly to faults.

30.4 Fast response minimizes the duration of interruptions, particularly where all supplies are restored following transient faults that cause fuses or circuit breakers to operate.

30.5 Where permanent faults are found the focus remains on supply restoration. Where appropriate, generators and temporary arrangements are provided to restore supplies when a quick repair is not possible. Additional mobile generation will be used during RIIO-ED1 to reduce the number of customers affected by faults lasting longer than 12 hours.

30.6 WPD carries stocks of replacement items so that if repairs are required the network can be rebuilt quickly. Some items are held locally, others within central stores and some are subscribed to via spares clubs.

30.7 Under regulatory reporting there are two main categories of Trouble call activities: incidents covered by the Interruption Incentive Scheme (IIS) and Occurrences Not Incentivised (ONIs).

Incidents under IIS

30.8 The majority of incidents that cause customers to go off supply are included within the IIS (the minor exception being incidents at cut-outs). The extensive nature of the network means that there are around 50,000 incidents each year that are incentivised under IIS.

30.9 The investment programme in the Business Plan has been designed to keep the volume of incidents broadly the same over the DPCR5 and the RIIO-ED1 period, albeit there will be annual variations caused by different weather conditions.

30.10 Some reduction to overhead line faults will result from proactive tree clearance across all voltages.

30.11 The expenditure for IIS incidents includes assets replaced following a fault and remedial action following metal theft that causes interruption to supply.

Expenditure on Trouble call incidents incentivised under IIS (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	26.8	28.3	10.5	19.7	85.3
RIIO-ED1 Annual Average	23.9	28.2	9.6	18.1	79.8
RIIO-ED1 Total (8 years)	**191.0**	**225.3**	**76.8**	**144.8**	**637.9**

Occurrences not incentivised

30.12 Occurrences not incentivised (ONIs) are situations where WPD staff have to attend site in response to reports from customers made via the contact centre. They include where customers have a problem with the supply but they are not off supply (such as reports of flickering lights), call outs to reports of potential break-ins to substations, falling trees that might be near electricity equipment, damaged gates or access doors.

30.13 Each year there are around 80,000 ONIs where some form of site visit is required. The costs of this response and the associated repairs to the network are shown below.

Expenditure on ONIs (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	4.7	3.8	1.5	2.7	12.7
RIIO-ED1 Annual Average	3.8	2.6	1.7	2.3	10.4
RIIO-ED1 Total (8 years)	**30.0**	**20.9**	**13.3**	**18.5**	**82.7**

Total expenditure

30.14 The total expenditure for trouble call is shown below.

Total Trouble call expenditure in RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Incentivised incidents	191.0	225.3	76.8	144.8	637.9
ONIs	30.0	20.9	13.3	18.5	82.7
Total gross expenditure	**221.0**	**246.2**	**90.0**	**163.3**	**720.6**
Cost recoveries	(23.7)	(16.7)	(3.3)	(7.5)	(51.2)
Total net expenditure	**197.3**	**229.5**	**86.7**	**155.8**	**669.4**

30.15 Net expenditure after cost recoveries (e.g. for cable damages) is funded through DUoS. The following table summarises the DPCR5 and RIIO-ED1 net expenditure.

Total Trouble call net expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	28.6	30.4	11.6	21.4	91.9
RIIO-ED1 Annual Average	24.7	28.7	10.8	19.5	83.7
RIIO-ED1 Total (8 years)	**197.3**	**229.5**	**86.7**	**155.8**	**669.4**

31 Responding to 1 in 20 year storms

31.1 The South West and South Wales coasts are regularly buffeted by prevailing south-westerly winds and the network is constructed to withstand these weather conditions.

31.2 Each year there are periods of poor weather where storms can lead to network damage, but generally the impact is dealt with quickly even though activity levels are several times normal daily volumes. The impact of these storms may be classes as exceptional events, but the effects are generally dealt with by using WPD staff.

31.3 In very rare cases, the magnitude of the storms can be very severe leading to widespread network damage that requires additional resources to be drafted in from other DNOs to assist in the restoration of supplies. These rare events are known as 1 in 20 year storms.

31.4 Whilst the increased size of WPD helps us to lower our reliance on other DNOs (as we would normally be able to redirect resources internally), the costs for network repairs can be very high. The following table shows the forecast cost for 1 in 20 year storms. The costs have been derived from 8/20th of the estimated cost of a 1 in 20 year event.

1 in 20 year storm expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
RIIO-ED1 Total (8 years)	**12.6**	**12.6**	**6.3**	**10.3**	**41.8**

Strategic spares

31.5 The failure of major items of equipment can affect the supplies to thousands of customers.

31.6 Over the many years that the network has developed, a wide variety of different assets have been installed and it is not possible to keep spares for all possibilities. This is especially the case for older cable networks, using gas and oil insulated designs that require bespoke repair joints which are only very rarely used.

31.7 For specialised cables and fittings it is proposed to remain a part of the 'spares club' which is managed by National Grid on behalf of the member DNOs. This is a more cost effective way of having access to materials when compared to holding a dedicated stock of equipment.

31.8 Items like transformers are high in value and have long lead times from manufacturers. It is proposed to continue to hold a range of larger transformers in reserve to ensure we have the ability to effect a quick replacement in the case of a failure. This will effectively be a buffer stock where transformers for projects are pre-ordered and available ahead of projects being carried out. This allows them to be available for when a fault occurs but ensures that they do not become redundant as they will be used for routine investment works.

31.9 We will also retain a selection of containerised emergency switchboards at 11kV and 33kV which can be quickly deployed as required in the case of a catastrophic failure of a substation.

32 Other network operating costs

Substation electricity costs

32.1 WPD has contracts in place for the purchase of unmetered electricity consumed at substations. Forecasts assume that expenditure levels will continue in line with current levels; approximately £6m per annum across the WPD Group.

32.2 Future electricity prices are assumed to rise in line with the retail price index.

Substation electricity expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.9	2.2	1.0	0.7	5.8
RIIO-ED1 Annual Average	1.8	2.3	0.9	0.7	5.7
RIIO-ED1 Total (8 years)	**14.4**	**18.3**	**7.4**	**5.5**	**45.6**

Remote location generation

32.3 There are two locations within WPD where the provision of permanent standby generation is needed to provide security of supply to remote networks.

32.4 In South Wales the generation provides security of supply support to the single transformer 33kV substation at Tregaron where there is only limited 11kV interconnection.

32.5 In South West the generation provides security of supply support to the Isles of Scilly, which are connected to the mainland by a single 58km long 33kV submarine cable.

32.6 Although actual costs are subject to the fluctuations in fuel costs, the forecast for operation and maintenance of these generators remains in line with current costs at approximately £1m per annum.

Remote generation expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.0	0.0	0.1	1.0	1.1
RIIO-ED1 Annual Average	0.0	0.0	0.1	1.0	1.1
RIIO-ED1 Total (8 years)	**0.0**	**0.0**	**0.8**	**7.9**	**8.7**

Dismantlement

32.7 In limited situations assets are dismantled, permanently removed and no alternative assets are installed. This can arise where there is no longer a need for an electricity supply or where the progressive development of the network renders other parts as being unnecessary.

32.8 Expenditure within this category is low within South West and South Wales at around £0.1m per year, but within the Midlands, where there is more change of land usage, cost are approximately £1m per annum.

32.9 Historical averages have been used to forecast future costs and no forecast increases have been projected.

Dismantlement expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.5	0.5	0.0	0.1	1.1
RIIO-ED1 Annual Average	0.7	0.7	0.1	0.1	1.5
RIIO-ED1 Total (8 years)	**5.2**	**5.2**	**0.8**	**0.8**	**12.0**

Total expenditure on other network operating costs

Substation electricity, remote generation and dismantlement RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Substation electricity	14.4	18.3	7.4	5.5	45.6
Remote location generation	0.0	0.0	0.8	7.9	8.7
Dismantlement	5.2	5.2	0.8	0.8	12.0
Total	**19.6**	**23.5**	**9.0**	**14.1**	**66.2**

Closely associated indirect costs

33 Introduction

33.1 The costs of physically carrying out the work on the network are included in the Network Investment sections. This 'direct' work could not go ahead without the support of other 'indirect' engineering management activities such as planning, project management, system records, stores and transport. The expenditure in these support areas is classified as closely associated indirect (CAI) costs.

33.2 Ofgem has suggested that there are eleven categories of CAIs some of which vary in line with work volumes and others that remain broadly static.

33.3 The CAIs that vary with work volumes represent the activities that exist to solely support the delivery of direct activities. They include:

- network design and engineering;
- project management;
- vehicles and transport;
- operational training;
- small tools, equipment, plant and machinery.

33.4 The CAIs that represent the activities that more broadly support the delivery of work and are essentially fixed costs incurred irrespective of the volume of work include:

- engineering management and clerical support (including wayleaves payments);
- control centre;
- contact centre;
- stores;
- network policy;
- system mapping – cartographical.

33.5 The costs for vehicles and transport CAIs are described in the section for vehicles, IT, property and tools. This is to allow comparison of the operational costs of maintenance and hiring vehicles against purchase of vehicles under non-operational capital.

33.6 Small tools, equipment, plant and machinery are also described in the section for vehicles, IT, property and tools.

33.7 Operational training includes workforce renewal and training of additional staff for higher work volumes. The potential requirements for new recruits, training and training facilities are described separately, after the other closely associated direct costs.

33.8 Whilst expenditure for dealing with Traffic Management Act costs for road works are included within the direct costs described under investment, a summary of the impact of these costs and the potential increases to these costs is included towards the end of this chapter.

33.9 The following table summarises the engineering management closely associated indirect costs that are forecast for RIIO-ED1.

Engineering management expenditure RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
Network design and engineering	34.9	34.3	16.5	24.3	110.0
Project management	51.5	49.5	24.6	39.4	165.0
System mapping	11.4	11.6	5.7	9.4	38.0
Engineering management and clerical support	122.7	126.5	64.8	85.8	399.7
Control centre	32.2	33.2	18.2	26.4	110.0
Contact centre	10.9	10.9	5.5	9.0	36.3
Stores	20.5	20.4	10.3	16.8	68.0
Network policy	4.4	4.5	2.2	3.6	14.8
RIIO-ED1 Total (8 years)	**288.5**	**290.9**	**147.8**	**214.7**	**941.8**

33.10 The following sections provide more details about each of the relevant CAI costs.

34 Network design and engineering

34.1 Network design and engineering activity covers both high level planning and detailed project design up to the point of project approval.

34.2 Specific planning and design necessary for individual projects is by far the greater element of network design and engineering cost. The projects relate to all network activities and include examples such as the design for new connections, asset replacement, load reinforcement and quality of supply improvements.

34.3 Within WPD these activities are carried out by central design teams for the primary network and locally based planners (11kV planners, planners, assistant planners and craft planners) who deal with all aspects of secondary network design from substation replacement to new connections for street lights. These planning costs are directly related to the activity volumes.

34.4 High level planning includes the development of network wide analysis, demand forecasting, network modelling and identification of network deficiencies. This activity forms a small part of the network design and engineering costs and is less volatile to the levels of network investment. The costs of this element will remain broadly the same across the RIIO-ED1 period, with some growth in the analysis associated with the assessment of the impact of low carbon technology on the network.

34.5 Since the vast majority of the costs vary with work volumes, the cost forecast for the RIIO-ED1 period rolls forward the current levels of expenditure increasing them in proportion with the overall investment programme volumes.

Network design and engineering expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	5.4	5.5	2.6	3.3	16.8
RIIO-ED1 Annual Average	4.4	4.3	2.1	3.0	13.8
RIIO-ED1 Total (8 years)	**34.9**	**34.3**	**16.5**	**24.3**	**110.0**

35 Project management

35.1 Project management indirect expenditure relates to the activity of managing network investment projects. It covers all phases from project authorisation, work preparation, construction and physical connection through to ensuring all technical records and projects costs are updated.

35.2 The preparation phase includes the identification of resources, ordering of materials, production of work instructions, liaison with contractors and scheduling of work elements.

35.3 The construction phase requires on-site supervision of staff and contractors, tracking progress against construction timetables, checks on quality of work and liaison with members of the public that may be inconvenienced by the work.

35.4 The physical connection phase includes arranging any shutdowns, issuing of electrical safety documents, organising and carrying out commissioning tests, issuing of completion certificates and coordinating the final connection to the network.

35.5 Following construction, technical closure requires a review of the physical installation and recording of installation details. Financial closure requires the collation of all related costs and correct allocation to budget codes enabling accurate reporting.

35.6 Whilst project management does not include any direct work on the assets, the work would not be able to proceed, or be completed without it and therefore there is a clear link between the volume of work and associated project management costs. The RIIO-ED1 expenditure forecasts therefore roll forward current costs in proportion to the scale of the future work programmes.

Project management expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	5.6	5.9	3.0	4.3	18.8
RIIO-ED1 Annual Average	6.4	6.2	3.1	4.9	20.6
RIIO-ED1 Total (8 years)	**51.5**	**49.5**	**24.6**	**39.4**	**165.0**

36 System mapping - cartographical

36.1 System mapping - cartographical is the activity of updating network geographical records. The volume of record updating is related to the level of network investment in overhead lines, cables and new connections.

36.2 Whilst there are some fixed costs such as paying licence fees to the Ordnance Survey, other costs are dependent upon the volume of third party requests e.g. providing copies of records under NRSWA requests. It is assumed that these remain at current levels.

36.3 There are some uncertainties about the scale of records required for smart grid deployment, but the impact is assumed to be minimal. Likewise as independent connection providers start to carry out part funded reinforcement there will be an increased need to record details from and interact with third parties, but again the impact is assumed to be minimal.

36.4 It is assumed that the impact of any increased requirements will be minimal and where increases arise they will be accommodated through efficiency savings. The forecast costs for RIIO-ED1 are in line with current expenditure.

System mapping expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.6	1.5	0.7	1.1	4.9
RIIO-ED1 Annual Average	1.4	1.4	0.7	1.2	4.8
RIIO-ED1 Total (8 years)	**11.4**	**11.6**	**5.7**	**9.4**	**38.0**

37 Engineering management & clerical support

37.1 Engineering management and clerical support relates to a wide range of office based activities managing or assisting employees undertaking direct activities, but not directly involved with either planning projects or project managing.

37.2 It includes executive managers, engineering managers, work programmers, resource planners, clerical staff, steetworks administration, wayleave payments and wayleave administration.

37.3 Typical work carried out in this area is:

- Development of strategic network business plans, investment priorities, resourcing requirements, work programme planning and budgeting;
- Line management of staff undertaking direct work;
- Operational performance management including site safety and operational checks, quality compliance checks, authorisation of staff and investigation and reporting of incidents;
- Promoting health and safety policy, establishing procedures, maintenance of health and safety records and provision of advice;
- Street works administration, processing notifications, permit applications, liaison for defect repairs and processing of fines;
- Wayleave payments made to the landowners to cover the financial impact of having equipment on their land and substation rent payments;
- Wayleaves administration costs for obtaining, negotiating, managing and administering wayleaves, substation rents and easements;
- Clerical support including processing of time sheets, customer liaison, preparation of shut down notifications, updating asset inventory and condition databases, preparing plans and other general office duties to support direct activity work.

37.4 Whilst the volume of transactions may change in line with the volume of activity on the network, it is envisaged that any increased requirement will be absorbed through process improvements and efficiencies.

37.5 Significant savings have been achieved through the reorganisation of the East Midlands and West Midland to the WPD operating model and costs will be lower than those in DPCR5.

37.6 There are however two areas of activity where there will be increases in expenditure.

- there will be a requirement to administer a higher volume of service position defects as a result of the smart meter rollout. The activity and processes will be in line with existing processes and it is anticipated that the additional costs of managing this activity will be relatively small;
- there will be increases in expenditure for wayleave payments.

Wayleave costs

Background

37.7 Wayleave payments are negotiated with landowners but as WPD has approximately 800,000 wayleave agreements, we have chosen to use the 'guidance' wayleave rates recommended by the Energy Networks Association (ENA) to its members. These rates are based on statutory compensation principles and negotiated by the ENA with some of the main bodies representing landowners and tenants in England & Wales (these being the Country Landowners Association, National Farmers Union and the Farmers Union for Wales).

37.8 Annual wayleave payments (made to landowners and occupiers where WPD has assets on private land) are made up of two elements: 'owners' payment (also known as 'rental') and 'occupiers' payment (also known as 'compensation').

Owners payment

37.9 WPD pays landowners an annual sum or rent for the wayleave agreement (or licence) to keep, access and maintain equipment on private land.

Occupiers payment

37.10 WPD also makes a separate payment to the person who occupies the land (this is often the owner or could be the owner's tenant) to compensate them for the disturbance and losses which arise from WPD's equipment creating difficulties in farming or use of the land. The degree of disturbance varies depending on land use and the two predominant payments are for losses or disturbance associated with arable land use and also where land is used for grassland pasture or grazing.

37.11 The compensation payments are determined by using a well-founded methodology based on statutory compensation principles. The ENA and the bodies representing landowners use ADAS as an independent environmental and agricultural consultant to assist with setting values.

37.12 The loss and disturbance associated with arable land use is much higher than that associated with land used for pasture.

37.13 The losses on pasture, are mainly associated with the loss of grass crop and yield and the disturbance electricity equipment creates for grazing operations.

37.14 The main factors ADAS considers in assessing the loss and disturbance to the use of arable land are:

- area and yield loss – where the landowner can't grow crops in certain areas due to the obstruction of a pole or tower. This is an area which is greater than just the basic size of the pole or tower, as the size and shape of the electricity equipment will restrict the movement of arable farm machinery such as crop sprayers;
- wasted material inputs – e.g fertilisers and other materials will be wasted in the area around electricity equipment;
- weed control;
- wasted labour and fuel costs – landowners will incur additional time and effort in farming the land due to electricity equipment.

37.15 The compensation payment is therefore heavily influenced by factors affecting the above such as average inflation, but also crop and food prices as well as raw material costs such as oil, fertiliser and fuel which are subject to more volatile price changes and which have a greater affect on the occupier compensation rates than general inflation pressures.

Future increases to wayleave rates

37.16 Prior to DPCR5 and until around 2008, annual wayleave payment rates (both the owner and occupier rate) had been rising closely in line to average longer term inflation.

37.17 Since 2008, there has been an accelerated rise in annual payments and WPD has seen annual increases to its wayleave spend of between 4% and 6% per year over the last four years. This has resulted in an average rise of the wayleave payments over the last 4 years of approximately 2% above inflation. This level of above inflation increases is expected to continue into RIIO-ED1 and the average percentage above inflation is expected to increase even further by another 0.5% to 1% (over the RIIO-ED1 period). The reasons for these increases are described below.

Owners payment

37.18 The Owners payment rates (rental) recommended by the ENA were established in the mid 1990s as a combined payment reflecting statutory compensation and a commercial expediency element to ensure the right level of payment for both parties. The payments have been indexed by negotiation since then. WPD has always opted to use the recommended ENA rates to ensure good relations with landowners. This allows efficient conduct of the day to day distribution activities of accessing and maintaining equipment on private land. It also avoids the additional and unnecessary costs associated with the breakdown of relations with landowners and the ultimate need to utilise statutory powers to access land.

37.19 The rental payment has some relationship to land rents and land values and over a longer term has been rising in line with average RPI. This, to a certain extent, was convenient and made future forecasting more certain.

37.20 In recent years, farming and rural land values have seen large price increases and the prediction is that this will continue. In the last 5 years, the rental element of the wayleave payments has risen by up to 0.5% above the average RPI for the same period.

37.21 The prediction for the coming years is that annual owners (rental) payment increases will continue to exceed inflation. Land value and rents are influenced by a shortage of land, growing populations and increasing demand for food, both in the UK and across the world. There is also a continuing keen demand for agricultural land as an investment. In addition land use is changing, with more and more agricultural land being used for solar farms and energy crops to support UK targets for carbon reduction.

37.22 Agricultural land values have increased by 200% in the last decade (source Knight Frank & Savills) and there was an approximately 8% rise in arable land values in 2012 (according to Savills). A 10% year on year increase is predicted to 2015 (£7.5k/acre in 2012 to £10k/acre in 2015) according to Strutt & Parker (FT article 2012) although in some areas an average £10k/acre has already been reached.

37.23 Farm rents for arable land also rose by 8 to 10% per year over the period 2008 to 2010 (source: Defra). Between 2007-11 the average rise has been 24% for arable land rents (source: Smith Gore).

37.24 Whilst wayleave owners payments are not expected to rise at the same rate (as they are a combination of inflation and land value factors), the high increases in land values and rents is expected to continue the upwards pressure on the payments.

Occupiers payment

37.25 The occupiers (compensation) payment is determined by a number of factors associated with the use of the land and the impact of the distribution assets.

37.26 The payment is heavily influenced by a number of external factors such as oil price, fuel costs, fertiliser prices, crop yields and crop prices. Since 2006 payment rates have been rising above the rate of inflation due to unprecedented and volatile increases in raw materials input costs (oil, fertiliser etc) and crop/food prices.

37.27 Over the last 4 to 5 years, occupiers payments for poles on arable land have increased on average by 13% per annum. The rate on pasture land has also started to rise with the increase over the last year being 8%. We predict a continued rise in these rates at approximately 10% per annum and this will have a large influence on the overall annual percentage rise in total wayleave payments in the future.

37.28 Further increases are expected due to the high prices of crops in 2012/13 caused by extremely wet weather that severely affected crop yields in the UK.

37.29 Pressure of population growth, alternative uses of land to meet climate change, as well as upward pressures on input costs and continued high demand for food is likely to keep the 'compensation' element of annual wayleave payments high and so will continue to increase. Therefore the historic trend is expected to continue and is predicted to continue to increase above RPI.

37.30 In addition to the main issues above, we are also aware that the main organisations representing land users continue to raise other matters that they feel should equate to enhanced compensation in the future. The principal one of these, being the trend for larger farming machinery, which land users feel is likely to create further difficulties in farming operations if they have distribution assets on their land.

Expenditure summary

Engineering management and clerical support (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	20.9	20.8	7.9	10.3	59.9
RIIO-ED1 Annual Average	15.3	15.8	8.1	10.7	50.0
RIIO-ED1 Total (8 years)	**122.7**	**126.5**	**64.8**	**85.8**	**399.7**

38 Control centre

38.1 Control centre activities include the real time operational control and monitoring of the network, outage planning and management, dispatching resources in response to network faults and safety issues, updating network control diagrams, completing fault reports and major incident emergency planning.

38.2 The number of control rooms across WPD will be reduced from three to two during 2013. This consolidation will lead to one control room serving the South West and South Wales and another serving West Midlands and East Midlands. No further major changes are proposed during RIIO-ED1 and therefore once the new structure is established costs will remain generally fixed.

38.3 With the control centres, the majority of activity relates to the volume of faults being experienced on the network and since these will broadly remain the same as a result of the various network investment activities there should be little change in the costs associated with control centre activities.

38.4 Increased work programmes will lead to more planned outage transactions but the impact will be at the margins and will be accommodated by revising processes where necessary.

38.5 During network emergencies, planned work will be suspended to prioritise resources on dealing with the faults. The alternative would be to have more resources available to accommodate all work, but under normal conditions this leads to an underutilised workforce and therefore has been dismissed as an option.

38.6 As networks become smarter control centre staff will carry out different duties. They will need to analyse new forms of data, interact with independent local smart grids and initiate demand side response requests. Whilst these activities will require new skills to be developed they should not lead to the requirement for additional staff. Advances in Control Centre network management systems will enable greater amounts of automation of processes which will offset any additional requirements for resources.

38.7 The expenditure forecasts are in line with current levels with no adjustments for future changes to work volumes. Costs have been allocated across licence areas using the standard cost allocation proportions.

Control centre (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	4.4	4.4	2.2	3.1	14.1
RIIO-ED1 Annual Average	4.0	4.2	2.3	3.3	13.8
RIIO-ED1 Total (8 years)	**32.2**	**33.2**	**18.2**	**26.4**	**110.0**

39 Contact centre

39.1 As previously stated WPD distributes electricity to over 7.8 million customers. It is important for these customers to have the means to contact the company when they go off supply, have a general enquiry or want to complain.

39.2 The contact centre activity relates to managing the main incoming telephone lines used by customers, taking the initial calls, recording details, providing information and forwarding customers on to the relevant parts of the organisation.

39.3 It also incorporates handling and processing Guaranteed Standards of Performance compensation payments, ex gratia compensation payments and ombudsman payments.

Impact of smart meter rollout programme

39.4 During RIIO-ED1 the smart meter roll out programme will lead to additional interactions between Suppliers and customers, resulting in increased volumes of calls where network problems are identified or where customers are unsure who to contact and erroneously call WPD. It is anticipated that this will require an additional two staff in each contact centre.

39.5 One of the benefits of smart meters will be the potential for smart meters to inform DNOs that power has been lost. In the long term, this may reduce incoming call volumes, but this is not anticipated to happen until there is a high number of smart meters installed and when customers gain confidence that the new systems are providing the right information about power outages to DNOs.

39.6 WPD is proposing to offer call backs to all customers who make contact to ensure that their supplies have been restored. Again in the long term this service may be replaced by pinging smart meters to determine if they are back on supply. Staff who may have previously been involved with taking calls and making call backs will become increasingly involved with the interrogation of smart meter reports and use of smart meter related systems.

39.7 Smart meters will also start to provide the information about phase connectivity. Contact centre staff dealing with smart meter data will be redeployed during low call volume activity to update customer records from the smart meter data. This will include allocating customers to feeder phases and updating appropriate records.

39.8 Whilst smart meters may lead to lower volumes of calls in the future, it is unlikely that cost reductions will materialise during RIIO-ED1 due to existing staff carrying out additional duties.

Vulnerable customers

39.9 There will be some increased costs for a new team dedicated to contacting vulnerable customers every two years to ensure that records are accurate. This activity will update the priority services register to ensure that appropriate services are provided for different types of vulnerable customers. Cost forecasts include an addition £0.5m per annum for this activity.

Contact centre expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.4	1.4	0.7	1.1	4.6
RIIO-ED1 Annual Average	1.4	1.4	0.7	1.1	4.5
RIIO-ED1 Total (8 years)	**10.9**	**10.9**	**5.5**	**9.0**	**36.3**

40 Stores

40.1 The majority of work on the network requires the use of a wide range of materials. These can be large items such as transformers, switchgear, underground cable, overhead line conductors and poles, or smaller items such as joints, gaskets, connectors, tapes, rolls of barbed wire and danger notices.

40.2 The materials are held in local depot stores supplied from two central warehouses. Supporting the stores activity are storekeepers, stock checkers and delivery drivers.

40.3 WPD also belongs to the 'NGT spares club', a facility provided by National Grid, for low-volume high-value components. Membership is more efficient than holding and managing dedicated stock for items that are needed infrequently.

40.4 The development of smart grids will expand the range of materials required to be held, with more monitoring and analysis equipment and new types of assets.

40.5 The volume of network investment drives the amount of throughput in the stores, but the facilities do not change. Likewise the increase in the types of materials driven by smart networks can be accommodated within existing facilities. As work volumes increase there may be an impact on deliveries but any increased requirements will be accommodated through efficiencies.

40.6 The stores arrangements in West Midlands and East Midlands were reorganised following the acquisition of Central Networks by WPD. This reduced costs by moving away from an expensive contracted out service. During RIIO-ED1 the expenditure will remain in line with these lower costs.

Stores expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	3.9	4.0	1.3	1.9	11.0
RIIO-ED1 Annual Average	2.6	2.5	1.3	2.1	8.5
RIIO-ED1 Total (8 years)	**20.5**	**20.4**	**10.3**	**16.8**	**68.0**

41 Network policy

41.1 Network Policy relates to the development and review of environmental, technical and engineering policies that set out what needs to be done and the procedures to follow.

41.2 Network Policy can by influenced by:

- changes to legislation;
- improved condition information;
- operational experience;
- investigation of defects;
- learning from incidents;
- development of new equipment and materials;
- research and development;
- changes to contracts.

41.3 Consequently, all WPD policies are reviewed periodically or in response to new issues.

41.4 The network policy activity was previously treated as a business support cost in DPCR5, but as it is related to the direct activity on the network it will be treated as a closely associated indirect in RIIO–ED1.

41.5 During RIIO-ED1 there will be a need for the development of new policy resulting from the learning from Low Carbon Network Fund projects and Network Innovation Competition projects. It is anticipated that the majority of policy requirements will be developed within the projects. This will reduce the impact on resources within network policy.

41.6 During RIIO-ED1 expenditure on network policy will be in line with current levels with any increases in activity due to the adoption of smart grids being integrated through efficiency savings.

Network policy expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.9	0.8	0.3	0.4	2.4
RIIO-ED1 Annual Average	0.6	0.6	0.3	0.5	1.8
RIIO-ED1 Total (8 years)	**4.4**	**4.5**	**2.2**	**3.6**	**14.8**

42 Workforce renewal (operational training)

Introduction

42.1 Working and operating on the electricity network requires a strong awareness of potential dangers. Staff need to be trained and competent to undertake the required activities following prescribed procedures.

42.2 In addition to the specific training received when staff first join WPD, the introduction of new equipment or revised procedures requires that we also provide regular updates and refresher training to our staff.

42.3 As staff change roles their responsibilities change and additional operational and upskill training may be required to allow them to fulfill a wider range of responsibilities.

42.4 The costs of attending training courses and the provision of trainers, course material and training centres are therefore dependent upon the level of recruitment and the need for refresher and upskill training.

42.5 Routine recruitment and training of new staff is managed on the basis of periodic assessment of the numbers of staff who are predicted to leave the business in the next three to four year period.

42.6 New apprentices, students and skills trainees are appointed into training schemes so that they are competent and ready to fill these predicted future vacancies as and when they arise.

42.7 Predominantly our craft staff (jointers, fitters and overhead line staff) are trained through our apprenticeship scheme.

42.8 We have recruited 225 apprentices in the last two years.

42.9 We invest in further education and training for staff who have the potential to fill more technical roles and we operate a formal Technical Staff Trainee (TST) scheme to meet identified succession needs. Staff required for higher technical roles also come from our graduate development programme utilising the Institute of Engineering and Technology (IET) 'Power Academy' combined with our own in-house training.

42.10 We recruit a number of staff as skills trainees who generally replace staff that have left the business unexpectedly. These trainees will undertake similar training to that received by craft staff. They will initially become craft support staff with a number having the opportunity to progress to the full craft role over a period of time and in line with business need.

42.11 Using this simple methodology WPD South West and WPD South Wales have a proven track record of successfully managing workforce renewal since 2000. In the last five years from 2007 to 2012 WPD South West and WPD South Wales has recruited and trained 307 new staff to replace retirees and natural wastage. A further 265 additional staff were recruited and trained in order to deliver the increased work programmes for DPCR5.

42.12 These staff were all trained in craft or operations skills at our own training facilities in Taunton.

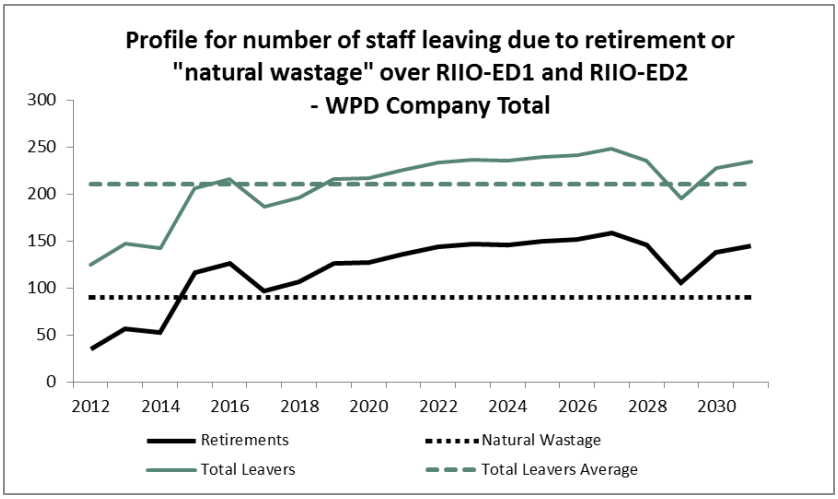
Overall planning

42.13 WPD staff resource planning looks through both RIIO-ED1 and into the early years of RIIO-ED2 (in particular 2023/24/25). This is to ensure that we recruit sufficient numbers of new staff through RIIO-ED1 and train them such that we have the right number and mix of craft and technical skills for RIIO-ED1 and into the early years of RIIO-ED2.

42.14 In addition to specific changes in workload volumes (which are discussed later) there are two key sources of data that are regularly reviewed in respect of workforce numbers;

- the forward age profile of staff across our business and the skill sets that they possess (allowing the future anticipated number of retirees to be assessed);
- the long run average number of staff that have left WPD through natural wastage with any forward adjustment for significant known events e.g. an “Olympic Park” type development. (At this stage we do not anticipate any major change in our natural wastage numbers going forward and the line is therefore flat throughout RIIO-ED1).

42.15 These requirements are combined to establish the staff resource requirement and are used to feed into our recruitment and training plans.



The solid green line is the sum total of retirees and staff who leave through natural wastage.
The dashed green line is the average total of all leavers over the period - representing a smoothing of the actual annual numbers.

42.16 In total we need to recruit and train 210 staff per annum (1,680 staff through the RIIO-ED1 period) to allow us to maintain our current DPCR5 staff numbers. As we currently recruit and train 190 staff per year in DPCR5 this represents a small additional replacement need of 20 staff per year (or 160 staff through the RIIO-ED1 period).

42.17 To meet this additional need through RIIO-ED1 and into RIIO-ED2 we plan to increase our recruitment of apprentices from 100 to 120 per annum.

42.18 In addition to these apprentices we will also continue to recruit and train a further 80 new skills trainees each year to replace the average number of people who leave the business through natural wastage.

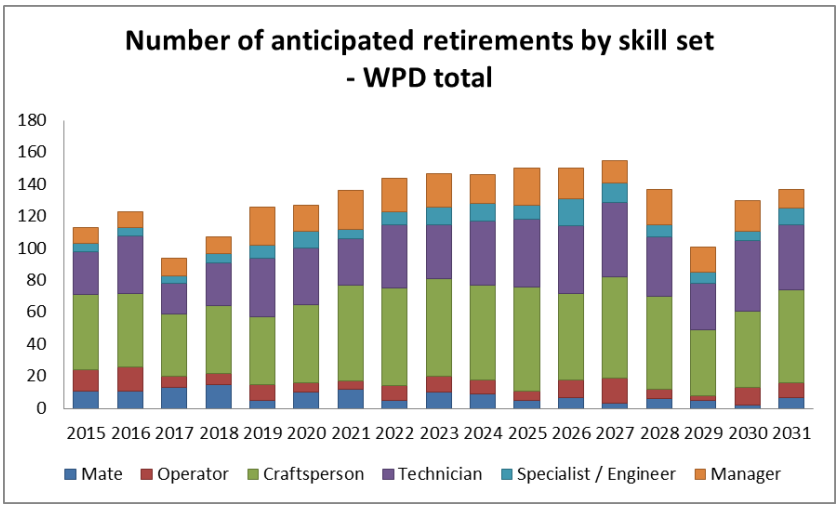
42.19 Through DPCR5 we have provided upskill training to an average of 80 staff per year (predominantly training craft staff to technician or technician to specialist/team manager roles). This number will remain constant throughout RIIO-ED1.

42.20 Our graduate recruitment will continue at the same rate as that in DPCR5 at around 10 per annum.

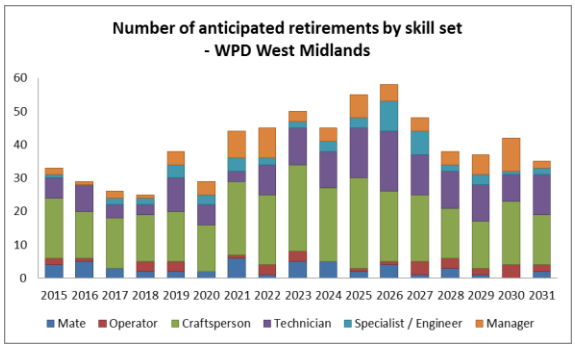
42.21 All of these staff will be trained in the skills sets as appropriate for replacing those who have left or who are forecast to leave WPD.

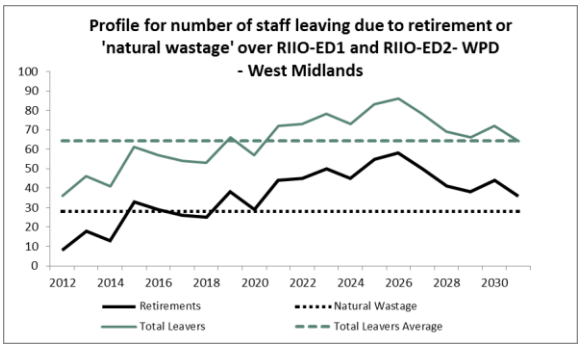
Skills planning

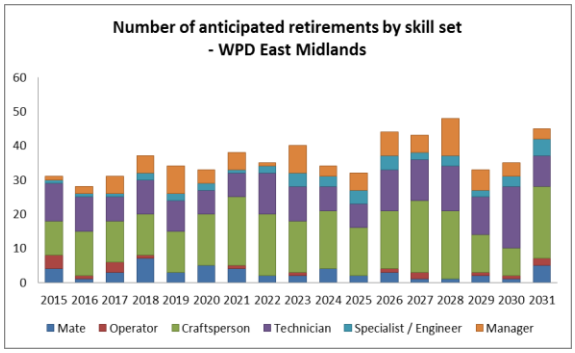
42.22 To ensure the overall business has the right numbers of staff with the right skill sets the overall analysis is broken down further to determine the skills of the staff due to leave through retirement.

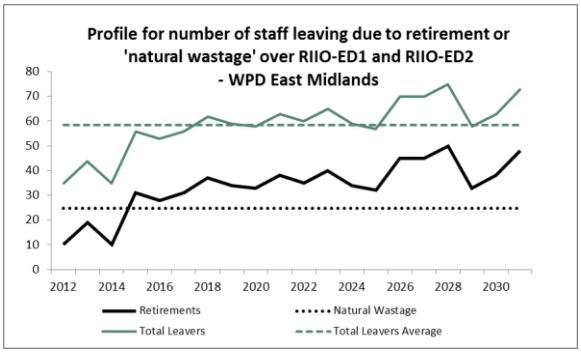


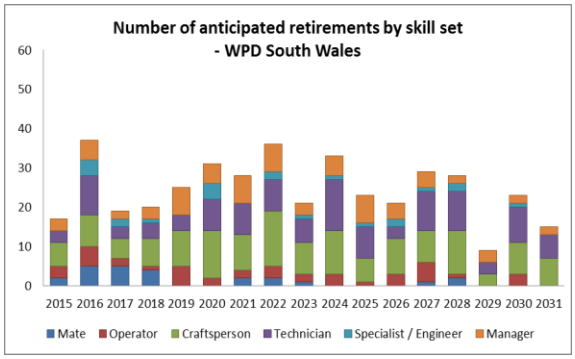
42.23 Our recruitment plans are also checked to take account of any regional variances across our four areas. We have completed analysis on an individual WPD licence basis to ensure that there are no specific skill sets or staff number issues that would give rise to the requirement for any special or area specific training.

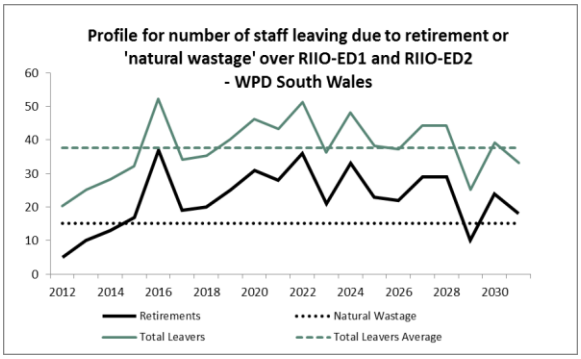


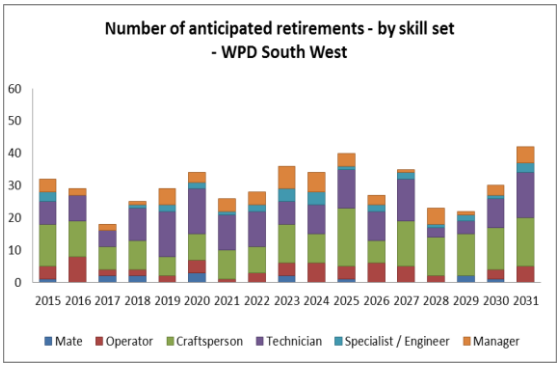


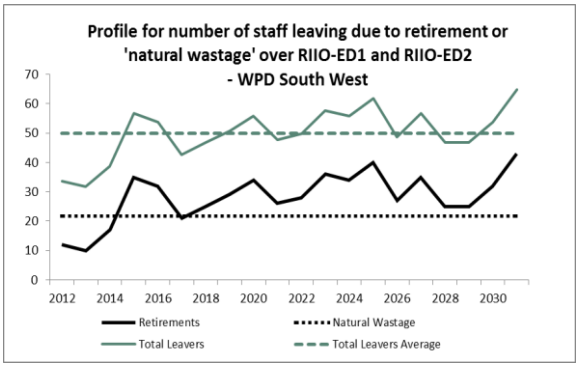












Impact on workforce renewal requirements due to workload changes

42.24 In addition to the requirements to ensure sufficient resources are employed to align with the number of retirees and natural wastage we must also consider any changes in workload demand placed on resources as we transition from DPCR5 into RIIO-ED1 and RIIO-ED2. Our plans are established against two differing scenarios.

42.25 The first scenario is the business model developed for our Business Plan and is referred to as the WPD 'Best View' scenario. This best view scenario plan sets out the position that WPD has established as the most likely to occur over the RIIO-ED1 period. From this we are able to establish the forward workforce requirements for all categories of work including the impact of Low Carbon Technology (LCT) uptake.

42.26 The second scenario we have modelled for RIIO-ED1 is the workload requirement of the 'Ofgem Reference Case' (DECC 'Scenario 1') . This establishes the forward workforce requirement for all categories of work but also takes account of the highest change in workload resulting from the much greater forecast uptake of LCTs under that scenario.

42.27 By analysing these scenarios we can establish the staff resources required to ensure we can deliver the workload demands irrespective of the eventual uptake of LCTs in RIIO-ED1.

42.28 For both scenarios we have also factored in the requirement of the 'one-off' activity of the smart meter rollout.

42.29 The roll out of smart meters requires electricity suppliers to offer to install a new meter in all of their domestic customer's premises. These new meters allow significant additional functionality over the types of meter currently installed. The installation programme is planned to commence in 2015 with and complete by 2020.

42.30 As a consequence of this programme there will be additional workload for DNOs as a result of any issues found at service positions in properties. This workload will be significantly higher than the normal rate of work due to the shortened timeframe of five years to complete all meter

installations (as compared to the traditional meter change programme of approximately 20 years).

42.31 Analysis undertaken by the National Skills Academy for Power (as part of an industry wide evaluation) concluded that WPD would need an additional 120 cable jointers as a direct result of the smart meter rollout programme. This assessment is based on an anticipated defect rate of 4% of all installations. The National Skills academy report can be found at the following link http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Supporting-Expenditure-information/National-Skills-Academy-Workforce-renewal-report.aspx

42.32 Based on knowledge of our assets at the meter position we believe that a more accurate forecast of locations requiring remedial work to be 2%. This would equate to a requirement for an additional 60 cable jointers if this activity were to be undertaken in isolation.

42.33 Given the volume of meters per area this would equate to around 20 staff in both the WPD West Midlands and WPD East Midlands licence areas, 12 in WPD South West and 8 in WPD South Wales in total. This represents a 1% increase in overall operational staff numbers.

WPD 'Best view' scenario

42.34 The analysis of asset replacement, general network reinforcement and LCT reinforcement required during RIIO-ED1 combined with the relatively small impact of smart metering results in a resource demand that remains broadly in line with our existing requirements for delivery of our work programme for DPCR5.

42.35 With respect to phasing of work, whilst towards the latter years of RIIO-ED1 the LCT workload shows some increase this coincides with the completion of the ESQCR works required to ensure horizontal safety clearances to buildings.

42.36 This ESQCR work will be completed in WPD South Wales and in both the WPD Midlands licence areas in 2015 and in WPD South West in 2018. Resources that become available from the ESQCR works can be readily deployed to meet increased LCT workload or other programmes as appropriate with minor geographical adjustments made to replace staff following retirements or natural wastage as necessary to meet specific work demands.

42.37 It should also be noted that the level of upskill training also remains broadly flat through RIIO-ED1 and in line with the DPCR5 period.

'Ofgem Reference Case' scenario

42.38 For this scenario the difference in work volumes and the consequential impact on workforce requirements is driven by the requirement to complete additional LCT reinforcement work.

42.39 Based on this scenario (which creates the highest level of potential work) we will require an additional 770 field staff over and above our existing DPCR5 numbers.

42.40 Analysis of the nature and types of additional works required allows us to establish the following additional skills requirement;

- 200 overhead line staff;
- 345 plant fitters;
- 135 cable jointers;
- 90 additional graduates or technical trainees.

42.41 Within this number we have also made allowance for the promotion of 180 existing staff who will upskill from their craft roles into technician, technical planning or project management roles as follows;

Additional staff and upskill training required for 'Ofgem Reference Case'					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
Overhead	16	125	55	4	200
Fitting	28	212	98	7	345
Jointing	13	77	42	3	135
Graduate / Technical Trainee	7	43	40	0	90
Total	**64**	**457**	**235**	**14**	**770**
Plus Technician (upskill existing craft)	*15*	*83*	*82*	*0*	*180*

42.42 Under the Ofgem Reference Case the additional staff required would be recruited over 6 years commencing 2015. This provides for sufficient time to ensure that resources are trained and in post ready to meet the forecast increase in the demands of the LCT.

42.43 Regular reviews will continue to allow us to match the numbers of new recruits required to meet general variations that occur year on year. This also ensures that we can adjust the recruitment numbers to cater for the additional unpredictability created by the recent removal of a 'default retirement age' (i.e. some staff may choose to stay in work longer).

Recruitment

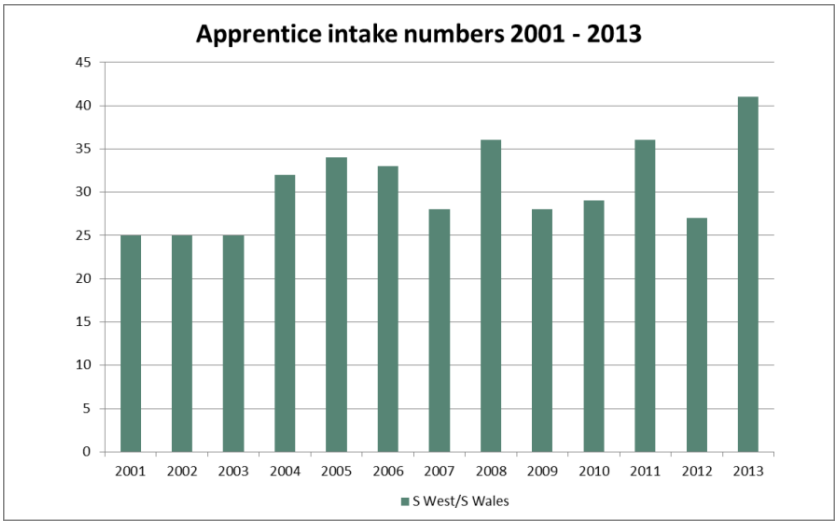
42.44 Recruitment is undertaken in three main ways;

- apprentices - via the WPD apprenticeship scheme;
- graduates - generally via the IET Power Academy;
- skills trainees - via local recruitment initiatives.

42.45 In addition to external recruitment we also ensure existing staff are given opportunities to develop within the business and to develop new skills and capability. We conduct upskill training of staff from craft to technician, planning or project management roles.

Apprentices

42.46 WPD has consistently recruited apprentices throughout the last decade. Since 2001 WPD South West and WPD South Wales have recruited 400 new staff as apprentices. This has ensured that we have retained the ability to train and deliver motivated and competent craft staff into our business.



42.47 This approach has continued since the acquisition of the Midlands businesses with the total recruitment numbers for 2012 and 2013 combined reaching 225 new apprentice starters.

42.48 Our approach to the apprenticeship scheme is to make sure that it meets the needs of our business. Following an initial induction programme, which includes an introduction to the business, health and safety training, customer service awareness and a week-long practical community project (to develop team building and social skills awareness) our apprentices go through a series of formal training courses.

42.49 These formal training courses are interspersed with hands-on practical experience on the distribution network working under the guidance and supervision of our experienced craft staff. The apprentices experience, knowledge and overall competency is developed over time as they complete a series of relevant practical tasks in the field whilst continuing to work under the guidance of experienced staff.

42.50 During this time apprentices are required to log all of their work through a diary based record book which allows their progress to be monitored on a weekly basis. They are also required to complete a series of formal reports to demonstrate the work that they have done. These reports include details of both the practical aspects of that work and also how it relates to specific safety, policy and procedural requirements.

42.51 Apprentices will be assigned to a WPD team and their Team Manager will conduct weekly reviews of the apprentice diary sheets and task reports. Distribution Managers are required to conduct reviews with their apprentices on a quarterly basis or more frequently if additional guidance or help is required. 'Diaries' and 'Task Reports' are reviewed and assessed by our training assessment staff to ensure they achieve a level of consistency. Appropriate support is provided to all of our apprentices as required.

42.52 When apprentices are judged to have reached a suitable standard they are able to apply to be tested via a formal 'Trade Test'. This test is undertaken at either Taunton or Tipton and is supervised and monitored by our training centre staff. Apprentices who are judged to have sufficient skills and overall competency are then progressed into a craft development role.

42.53 This craft development role provides the opportunity for the apprentice to continue to develop their skills as part of a WPD team but also to provide further hands-on training which prepares them to receive appropriate authorisations to work independently on the WPD network.

42.54 We have facilitated visits by other DNOs, engineering based companies, HSE representatives and Ofgem to demonstrate our approach and to discuss our philosophy to apprentice training.

Graduates and technical skills trainees (TST)

42.55 WPD has recruited around 5 to 10 graduates each year to fill highly technical roles within the business. These staff are generally appointed through the IET Power Academy but we have also sought out candidates directly through universities.

42.56 The graduate development programme consists of formal training-school courses interspersed with practical field experience where graduates are able to gain an appreciation of the nature of the works undertaken within the business.

42.57 Graduates will also spend significant time working under the guidance of experienced electrical engineers who are typically based in one of our three major offices at Bristol, Tipton or Castle Donington. In addition they will spend time with the Project Engineers who have responsibility for delivering EHV major projects across our geographical area.

42.58 In addition to recruiting and developing new graduates we also develop a number of our existing staff into the higher technical roles through our TST programme. These staff generally already have significant experience of more complex engineering work and often possess higher technical qualifications which have been gained as part of our on-going training and development programme.

42.59 Staff on the TST programme are provided with additional training and development and are given the opportunity to undertake further education as necessary to help them fulfill the defined future roles. In addition, wherever possible, they are appointed to the TST programme with sufficient time to allow them to overlap with the experienced staff they are due to replace.

Skills trainees

42.60 In addition to the development of our staff via our apprentice programme we also recruit a number of new staff to fulfill lower skilled support roles such as operators or mates. In these roles staff undertake a more limited range of hands-on skills work and provide support to the craft staff (including being a second trained person on site as required during live working operations).

42.61 Generally we make use of external recruitment agencies to find these potential operators and mates for interview by relevant WPD managers. The agencies are tasked with providing people with existing skills that are readily deployable into WPD. Examples of these skills would include being HGV authorised, trained for use of mechanical excavation machinery or people with general mechanical and other hand skills.

42.62 We have negotiated special rates with the relevant recruitment companies. This ensures that we only pay a small fee during the first 14 weeks of employment of the new staff whilst they are initially employed by the agency. At this point, subject to satisfactory performance by the new staff, WPD then employ them directly as WPD employees and cease paying any fees to the agency.

42.63 This recruitment process has proven to provide an effective and efficient source of new staff and is an innovative way of providing us with a low risk, low cost process for employing people who are right for our business.

Training resources

42.64 To support the additional resources being recruited it is important that WPD has sufficient trainers and training facilities.

Trainers

42.65 The following table shows the number of WPD trainers, their skill and their base location.

Number of training staff		
Skill	**Taunton**	**Tipton**
Overhead	5	6
Fitting	3	3
Jointing	3	5
Metering / Other	1	1
Operations	2	3
TOTAL	14	18

42.66 Training for new staff is generally delivered by one trainer per group of eight trainees. Each trainer is capable of delivering approximately 40 weeks of training per year.

42.67 Each trainer is therefore effectively capable of delivering 320 (8 x 40) 'trainee weeks' per year.

42.68 New craft staff require approximately 14 weeks of formal training, graduate and TSTs require 7 weeks and for upskill training requires up to 18 weeks (reflecting the higher technical skills and knowledge training required).

42.69 Using these average number of training weeks per skillset allows us to derive the overall formal training requirements based on the additional highest case numbers from the Ofgem Reference Case as follows:

New skillset to recruit and train	Ofgem Reference Case	Training requirement
Overhead	200	2,800 weeks
Fitting	345	4,830 weeks
Jointing	135	1,890 weeks
Additional 20 craft staff per annum during RIIO-ED1 over and above the number in DPCR5	160	2,240 weeks
Graduate / TST	90	630 weeks
Technician/ Planning / Project Mgt (upskilled from existing)	*180*	*3,240 weeks*
Total additional training weeks required over RIIO-ED1 period		**15,630 weeks**
Trainer requirements - total weeks / 8 years / 320 trainee weeks per trainer per annum (rounded down for efficiency).		**6**

42.70 This analysis results in the requirement for 6 additional trainers over the average number employed in DPCR5 to meet the requirements for the Ofgem Reference Case.

42.71 We will continue to monitor our trainer resources against the demand in the knowledge that we may require these additional 6 trainers should LCT works increase beyond the WPD 'Best view' scenario.

42.72 WPD has a successful track record of recruiting trainers from within its existing skills base and will deliver the additional trainer resources required for this scenario in sufficient time to meet the required output.

Facilities

42.73 WPD currently operate two principle training centres based at Taunton in Somerset and Tipton in the West Midlands. These principal sites are supplemented by additional satellite training facilities located within our service territory.

Taunton training centre

42.74 The facilities at Taunton cover an area of approximately 3.8 hectares and are owned and maintained by Western Power Distribution. The facilities include:

- 14 class rooms;
- jointing workshops;
- metering and small wiring workshops;
- fitting workshops;
- an outdoor operational network for 33kV, 11kV and LV operations training;
- an indoor overhead line training facility;
- an outdoor overhead line training field.

Tipton training centre

42.75 The facilities at Tipton cover an area of approximately 4.6 hectares and are owned and maintained by Western Power Distribution. The facilities include:

- 16 class rooms;
- jointing workshops;
- metering and small wiring workshops;
- fitting workshops;
- a 33kV, 11kV and LV operations training network;
- an overhead line training field.

42.76 Both the Taunton and the Tipton facilities include a fully operational electricity distribution network allowing for full operations training up to and including 33kV for technicians and other operational staff.

42.77 Both training centres are therefore able to deliver all of the skills training of jointing, fitting and overhead line works together with operational training utilising directly employed trainers.

Other remote training facilities

42.78 There are a number of small satellite training facilities which are used to maximise the efficiency of training delivery by allowing locally based training of skills. These facilities are parts of existing operational sites, therefore making efficient use of available accommodation. These facilities include:

- **Dunkeswell** training facility in East Devon - the 3.4 hectare facility at Dunkeswell operates as a satellite to our main Taunton site and was acquired to deliver the additional overhead line skills training requirements for DPCR5 which is now complete. This facility will become the location for any additional RIIO-ED1 overhead line training requirements.
- **Cwmbran** in South Wales - use is made of the WPD Central Plant Unit for the training of fitting skills, and a local primary substation and adjoining field is used for overhead line training.
- **St Mellons**, Cardiff - WPD owns a 1 hectare field which allows us to effectively deliver 33kV and 11kV 'heavy construction' overhead line training.
- **Norton**, Worcester - a primary substation is used for the delivery of EHV plant and fitting courses.
- **Alfreton** - land adjoining a new WPD office has been allocated to small scale overhead line training / assessment activity.

42.79 These facilities allow us to minimise the travel time for staff. This is of particular benefit for short duration courses and refresher training. For these short duration courses; travel to the main Taunton or Tipton sites becomes significant in relation to the course duration and it is more efficient to move the trainer rather than the trainees where possible.

Development options for training facilities

42.80 The current facilities utilisation rate at Taunton means that to meet the additional training requirements of the Ofgem Reference Case scenario would necessitate the development of further workshop and classroom facilities.

42.81 In anticipation of this we have recently taken the opportunity to purchase a small adjacent site allowing simple expansion of our existing facilities to create 3 new workshops, a new EHV fitting training facility and associated class room space.

42.82 In addition, planning permission had already been sought and obtained for the construction of extra facilities within the existing site boundary if required. This planning permission was secured in 2011 against the possibility of not obtaining the adjacent site.

42.83 Whilst the training requirements under either scenario do not suggest we will need to progress this option to construction, we will seek to retain the planning permission as a contingency to allow us to respond quickly to any increased requirements for competent skilled staff training.

42.84 The newly acquired workshops can serve as either fitting or jointing facilities and would allow the appointment and accommodation of three new jointing or fitting trainers. This creates capacity to train a minimum of 540 new jointing or fitting craftsmen over the RIIO-ED1 period in Taunton.

42.85 At Tipton training centre; in order to facilitate the introduction of new HV jointing techniques into both WPD West Midlands and WPD East Midlands and to address the additional demand for ongoing jointing refresher training in these locations (to ensure consistency across the business) two jointing trainer posts were created and recently filled.

42.86 Minor building alteration work at Tipton has converted recently vacated space into training workshops for the two new trainers.

42.87 Provision has also been made in the plans to allow for the construction of two further workshops and classroom space if required during RIIO-ED1 (this provision was low cost enabling works – more costly fit out works will only be undertaken if necessary).

42.88 As with the proposed workshops at Taunton, both the new workshops and the enabling works for additional availability at Tipton were undertaken on the basis of allowing either jointing or fitting workshops to be created.

42.89 This provides the potential for a further two new workshops in Tipton adding capacity to train a further 360 craft staff if required.

42.90 Overhead line skills training is covered by the Dunkeswell facility. This site has the capacity for the training of up to 360 additional overhead line staff in RIIO-ED1.

42.91 Should demand become higher than currently envisaged we are still able to expand our facilities by the creation of a third overhead line training area, similar to those already at Dunkeswell. This would have the capacity for a further 180 overhead line staff and accommodation of one further overhead line trainer.

Summary

42.92 Based on the WPD 'Best view' scenario there will be no requirement to recruit and train additional staff over and above those who we are planning to recruit in order to replace retiring staff or staff who have left through natural wastage.

42.93 Whilst the number forecast to retire in RIIO-ED1 has increased by 160 over DPCR5 the additional training requirements will be absorbed as part of our efficiency improvements.

42.94 Should the LCT take up increase towards the Ofgem Reference Case levels then we will need to recruit and train up to 770 additional staff and upskill a further 180 staff.

42.95 We have already made provision to allow the quick adaptation of existing facility space to create a further 5 workshops and classrooms.

42.96 The additional workshop and classroom space allows us to train an additional 900 fitting or jointing staff over current levels. Our Dunkeswell facility allows us to train 360 additional linesman with the option to train a further 180.

42.97 We have a proven record of being able to recruit and 'train the trainer' and the creation of a further 6 trainers will be a straightforward process.

42.98 Our track record of dealing with routine staff replacement is proven. We have maintained a significant apprentice programme throughout the DPCR3, DPCR4 and DPCR5 timeframes.

42.99 Our existing apprenticeship, skills trainee, graduate and technical staff trainee programmes have ensured that the business has maintained the right numbers and mix of staff to deliver our programmes of work successfully.

42.100 In addition we have demonstrated our ability to manage any specific step change in workload with the addition of 265 staff required to deliver the ESQCR programmes of work commencing in DPCR5.

42.101 Our current planning and early action will ensure that we continue to match our recruitment and skills training to deliver the skilled staff required to meet the business need whether that be the WPD 'Best view' scenario or the Ofgem Reference Case.

Operational training expenditure (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
DPCR5 Annual Average	4.6	4.9	4.4	6.4	20.3
RIIO-ED1 Annual Average	6.0	6.0	4.4	5.9	22.2
RIIO-ED1 Total (8 years)	**47.8**	**47.7**	**35.3**	**46.8**	**177.5**

43 Traffic Management Act

43.1 The New Roads and Street Works Act 1991 (NRSWA) and the Traffic Management Act 2004 require utilities to notify Local Authorities and Highways Authorities of work that will be carried out on public highways.

43.2 There are three systems in operation: Notices, Permits and Lane Rental.

Notices, Permits and Lane Rental

43.3 Notices describe the work location, when the work will take place and how long it will take. They are the main method for notification and do not require any payment. Unless the Highway Authority objects, the work can go ahead as notified.

43.4 Permits are similar to Notices, with the main differences being that the Highway Authority will grant permission or refuse permission based upon assessment of the submitted permit request. In addition the Highway Authority can levy charges. The Department for Transport (DfT) is actively encouraging Highway Authorities to implement Permit schemes, specifically for strategic traffic routes.

43.5 Lane Rental is a scheme where Highway Authorities charge a daily fee for access to work in the highway. These can only be implemented once an Highway Authority has operated a Permit scheme for at least two years. Consequently only a limited number of authorities have currently either implemented or are seeking to implement a Lane Rental scheme. However, over the RIIO-ED1 period it is envisaged that more authorities will implement them and that there could be a significant impact on costs.

Applicable legislation

43.6 NRSWA gave powers to Highway Authorities to ensure that works are co-ordinated in the highway and the use of Notices has been the default process since the introduction of the legislation in 1991.

43.7 Notices are served via an Electronic Transfer of Notifications (EToN) protocol that allows two-way communication between Works Promoters (such as WPD) and Highway Authorities. The processes and information requirements are detailed in the Code of Practice for the Co-ordination of Street Works and Works for Road Purposes.

43.8 The introduction of the Traffic Management Act (TMA) in 2004 gave additional powers to Highway Authorities allowing them the option of implementing Permit schemes.

43.9 The Code of Practice for Permits sets out the framework that schemes should fit into, and all schemes must comply with EToN requirements to enable the two way submission and approval process to take place. Each Highway Authority is able to design a Permit scheme that suits their individual requirements, which leads to different administrative requirements for each authority. Examples of different scheme elements are:

- The streets covered by the scheme (all streets, or just selected streets);
- The type of work included (all works, or just certain types of work);
- The requirements for immediate works (such as fault works);
- Additional information required (e.g. plans);
- Conditions that must be complied with when undertaking works;
- Levels of permit fees to be charged (subject to a cap set by the DfT).

43.10 When authorities seek to implement a Permit scheme there is usually a consultation process with key stakeholders, allowing opportunity for utilities to respond and providing the trigger for review of those street works processes that the authority will need to change.

43.11 The Secretary of State for Transport is responsible for approving each Permit scheme at present, but there is a possibility that this power of approval may be devolved to local government after 2015.

43.12 The Permit scheme is enacted through a Statutory Instrument which gives the scheme a legal basis, as well as dis-applying certain elements of NRSWA that would no longer be relevant. It is important to note that even for an 'all-streets' Permit scheme, there is still a requirement to serve certain notices and elements of NRSWA legislation e.g. Section 74 charges for unreasonably prolonged occupation of the highway.

43.13 As well as having to pay a fee for a Permit, any failures to comply with the requirements of the Permit scheme can lead to a fixed penalty fine or ultimately prosecution.

Legislation in Wales

43.14 Street works legislation in Wales is a devolved power and not governed by the DfT.

43.15 The primary legislation (Traffic Management Act 2004) to allow Permit Schemes does exist in Wales, but the approval of individual schemes sits with the Welsh Government and not the DfT.

43.16 The Welsh Assembly is currently developing its own Street Works Strategy. It states that without robust evidence to prove the need for and success of Permit schemes the Welsh Assembly would not support their implementation in Wales. However if this evidence was provided to the satisfaction of the Welsh Assembly then Permit schemes may get implemented in Wales. This is different from England where the DfT is actively encouraging Permit schemes.

43.17 Due to this approach it is unlikely that a Permit Scheme would be approved in Wales before 2018, and this would only be with specific authorities. A change in Assembly policy in Wales may bring this date forward and our estimate is based on the current understanding of the Welsh view through the Welsh Highway Authorities and Utilities Committee.

Department for Transport directive

43.18 The Government believes that roadworks affect economic growth.

43.19 Part of the DfT's support of the Government objectives to drive economic growth is the effective management of the road networks. The DfT is actively encouraging Highway Authorities in England to implement Permit Schemes, and wrote to all Highway Authority Chief Executives in 2012 to highlight this objective.

43.20 Further guidance ('Traffic Management Act 2004 (part 3 permit schemes) Additional Advice Note – for developing and operating future Permit Schemes') was published by the DfT in January 2013. It focused on the essential issues that need to be considered when developing a Permit scheme. These were:

- how the Permit scheme will improve overall transport network management;
- how the Highway Authority will operate the scheme focusing on works on strategically significant streets;
- the scheme design should demonstrate improved co-ordination between all works promoters;
- that the fees and costs are proportionate to the value added by issuing the permit.

Scope of Permit scheme charges

43.21 The DfT has clarified in the January 2013 advice note that any new Permit schemes should be focused on strategic routes including traffic sensitive streets and streets that fall into reinstatement categories 0,1,and 2 (as defined in Section 1.3 of the Statutory Reinstatement of Highways 2010).

43.22 This does not preclude a Highway Authority from introducing a Permit scheme for all streets, but under these circumstances fees would most probably only be applicable to the traffic sensitive and strategic routes.

43.23 The legislation will still allow for permit fees to be charged on all streets and some Highway Authorities have indicated they want to implement a full scheme.

Highway Authority positions on Permit schemes

43.24 Some Highway Authorities have political, shared service and geographical alliances with each other and this may influence the timing and scope of Permit schemes. This could lead to the implementation of a scheme used by another Highway Authority (a Common Scheme), the development of a scheme in conjunction with another Highway Authority (a Joint Scheme) or implementation of an individual scheme. There is also the possibility of a 'domino effect' where, one-by-one, authorities view permits to be the future of managing works on the highway.

43.25 As Permit schemes apply to all works carried out in the highway, including the Highway Authority own works, the decision to implement a scheme is one for the elected members of the Local Authority.

43.26 Similarly a change in Government or Government policy will be another influencing factor on the scope and spread of Permit schemes.

43.27 The positions of the local authorities within WPD licence areas is summarised below and a more detailed breakdown by authority is available at the end of this chapter.

Highway Authority positions on implementation of Permit schemes (at 31 May 2013)				
	West Midlands	**East Midlands**	**South Wales**	**South West**
Permit schemes in operation	0	4	0	0
Permit schemes post consultation, not yet approved	0	2	0	0
Permit schemes at consultation	1	1	0	0
Permit schemes being prepared for consultation	1	3	0	0
Permit scheme to be developed in the future	11	4	0	1
No plans announced	2	6	19	9

Permit scheme costs

43.28 Assumptions have been made on both the likelihood and timescales of Permit scheme implementations, based on 2015 being a key date for possible devolution of approval. Consideration has also been given to the schemes in the pipeline that may influence other Highway Authorities to follow suit once schemes are approved and implemented.

43.29 Due to the DfT stated focus on traffic sensitive and strategic routes, it has been assumed that any further schemes would only charge for Permits on these routes. Where a Highway Authority has already stated that they are aiming for an 'all streets' Permit scheme then this is the assumption used.

43.30 The following values have been used for the cost of individual permits.

Assumed permit fee charges		
Type of Works Notice	**Permit fee for traffic sensitive road**	**Permit fee for non traffic sensitive road**
Major (>10 days)	£345	£225
Major (4-10 days)	£235	£150
Major (<3 days)	£170	£120
Standard	£130	£75
Minor	£65	£45
Immediate (faults)	£60	£40
Permit Variations	£45	£35

43.31 The overall costs of permit fees have been calculated by considering the annual volume of Notices that apply to traffic sensitive routes and 20% of the non-traffic sensitive (corresponding to those with specific reinstatement requirements). The annual costs during RIIO-ED1 are shown below:

Forecast annual Permit fee costs for RIIO-ED1	
License Area	**Annual £m**
West Midlands	0.37
East Midlands	0.45
South Wales	0.12*
South West	0.14

* South Wales costs would not be incurred until half way through RIIO-ED1, once the Welsh Assembly had determined the strategy.

Variations

43.32 Alterations to planned works are inevitable and therefore costs will be incurred to vary the terms of the Permits. It has been assumed that 10% of all Permits will incur a variation fee. This leads to the following costs for variation fees.

Forecast annual permit fee variation costs	
Licence Area	**Annual £m**
West Midlands	0.02
East Midlands	0.02
South Wales	0.01
South West	0.02

Permit condition costs

43.33 Highway Authorities may specify certain conditions, such as night time working, when approving a Permit. The majority of conditions are in line with how WPD would expect to undertake works, i.e. safely, promptly, considering the customer/public. WPD already undertakes works out of hours, or at weekends to satisfy the Highway Authorities' transport network management duties.

43.34 There are no specific identifiable additional costs for compliance with Permit conditions.

Lane Rental costs

43.35 NRSWA as amended by the Transport Act 2000 and the Traffic Management Act 2004 contains provision for Highway Authorities to operate schemes that involve charging Works Promoters for the time their works occupy the highway. These charges, normally levied on a daily basis, are known as Lane Rental charges.

43.36 In order to operate a Lane Rental scheme the Highway Authority must have operated a Permit Scheme for 2 years before applying. It is unlikely that all Permit Scheme operators will seek to implement full Lane Rental Schemes applicable to all roads. It is more likely that Highway Authority will apply Lane Rental to traffic sensitive routes only.

43.37 There is currently one Lane Rental scheme in operation in England, operated by Transport for London. In addition, Kent County Council is eligible to operate a scheme and has submitted a proposal to the DfT. These are both outside WPD's geographical area. The only Highway Authority within the WPD boundary currently eligible to operate a Lane Rental scheme is Northamptonshire County Council, but it has stated it does not want to operate a Lane Rental scheme at this time.

43.38 At the point of developing this Business Plan no Highway Authorities in any of the WPD licence areas have indicated they are planning to operate Lane Rental in the near future. But, it is conceivable that during RIIO-ED1, many Lane Rental schemes could be in operation, leading to high costs for works in the highway.

43.39 Potential costs have been estimated for Lane Rental on traffic sensitive routes only by considering the annual number of Notices, the average duration of works and daily rate chargeable. This has been calculated for different notice types of work - Major, Standard, Minor and Immediate - since the average duration of works varies for each type. The calculation assumes that all authorities introduce Lane Rentals and results are shown for each licence area in the following tables.

West Midlands – Estimated annual Lane Rental charges for all work on traffic sensitive routes					
Parameter	**Major**	**Standard**	**Minor**	**Immediate**	**Total**
Volume of notices (number per annum)	75	402	100	423	
Average duration of works (days)	35.3	6.7	2.3	6.4	
Daily Permit Fee (£)	2,500	2,500	2,500	2,500	
Total Annual Cost (£m)	6.6	6.7	0.6	6.8	20.7

East Midlands – Estimated annual Lane Rental charges for all work on traffic sensitive routes					
Parameter	**Major**	**Standard**	**Minor**	**Immediate**	**Total**
Volume of notices (number per annum)	70	458	196	527	
Average duration of works (days)	35.3	6.7	2.3	6.4	
Daily Permit Fee (£)	2,500	2,500	2,500	2,500	
Total Annual Cost (£m)	6.2	7.7	1.1	8.4	23.4

South Wales – Estimated annual Lane Rental charges for all work on traffic sensitive routes					
Parameter	**Major**	**Standard**	**Minor**	**Immediate**	**Total**
Volume of notices (number per annum)	13	136	63	78	
Average duration of works (days)	9.3	6.5	2.4	5.9	
Daily Permit Fee (£)	2,500	2,500	2,500	2,500	
Total Annual Cost (£m)	0.3	2.2	0.4	1.2	4.1

South West – Estimated annual Lane Rental charges for all work on traffic sensitive routes					
Parameter	**Major**	**Standard**	**Minor**	**Immediate**	**Total**
Volume of notices (number per annum)	12	175	177	165	
Average duration of works (days)	7.6	6.5	1.4	6.9	
Daily Permit Fee (£)	2,500	2,500	2,500	2,500	
Total Annual Cost (£m)	0.2	2.8	0.6	2.8	6.4

Lane Rental reopener

43.40 There is significant uncertainty about the number of Lane Rental schemes that will ultimately be adopted and how they will be implemented. The potential costs of Lane Rental are so high that if a Highway Authority indicated they would operate such a scheme across all their roads a review of WPD's work delivery model would be required. It is therefore important that a price control reopener is available to amend allowances should Lane Rental schemes be introduced.

Sample inspection of work costs

43.41 Highway Authorities carry out sample inspections of road works to ensure that the processes for traffic management are adequate and the quality of reinstatement meets the required standard. There are three main categories of inspection:

- Category A – signing, lighting & guarding;
- Category B – reinstatement within 6 months of completion;
- Category C – reinstatement 3 months before the end of guarantee period (usually 2 years from completion).

43.42 Cost forecasts are based upon 30% of works being inspected at a fixed unit cost of inspection of £50. This gives the following annual costs of inspection.

Forecast annual inspection fee costs for RIIO-ED1	
Licence Area	**Annual £m**
West Midlands	0.20
East Midlands	0.21
South Wales	0.06
South West	0.09

Additional cost considerations

Systems and Processes

43.43 WPD's internal works management system (CROWN) has been updated during 2013 to allow better management of street works Permits. It is not anticipated that significant costs will be incurred for further system changes.

Resources

43.44 The changes made to the IT systems already support the introduction of further permit schemes without the need to increase resources to administer the schemes, based on current work volumes.

Congestion charging

43.45 No Local Authorities in the WPD licence areas have indicated that they plan to introduce a Congestion Charging scheme. No costs have therefore been included for congestion charging.

Legislative change – safety code

43.46 There is a proposed change to the Code of Practice for Safety at Street Works for England. The consultation draft issued in 2010 has been altered to ensure that it doesn't have an unnecessary burden of cost to comply. The final document has not been approved and has not

been circulated outside of the Chairs of the working group and the DfT. It is anticipated that there will not be any increase in sample inspection fee costs, but there is uncertainty about whether there are any other additional costs until the document is published. The safety code is currently also being reviewed by the Welsh Assembly and the DfT is awaiting the outcome of this before proceeding with implementation in England.

Legislative change – contributions to making good long term damage

43.47 Section 78 of NRSWA (Contributions to costs of making good long term damage) is currently an un-enacted piece of legislation. This legislation allows Highway Authorities to levy a fee for the 'scarring' of the highway to cover future costs of repair and resurfacing. There is currently no indication from Government that this will be implemented, but there is lobbying from some Highway Authorities and it is being discussed at street works co-ordination meetings.

43.48 The enactment of this legislation could lead to significant cost implications, but currently there is no clear understanding of the form these regulations would take or the suggested value of contribution and timescale for implementation.

43.49 The potential for the introduction of these costs needs to be factored into any price control re-opener for Traffic Management Act costs.

Individual Highway Authority positions on Permits

43.50 The following tables show the position on the introduction of Permits for each of the Highway Authorities within the boundaries of each licence area.

43.51 The current known status of each authority is given. However from indicating an intention to introduce a Permit scheme to actual implementation can take approximately 12 months. The assessment provides information on geographical coverage and potential impact on costs using the categories below.

WPD licence areas coverage categories:

- Complete – the WPD licence area is the only DNO operating in the Highway Authority area;
- Majority – the WPD licence area operates in the majority of the Highway Authority area, but another DNO also operates in a minimal area;
- Partial – the WPD licence area is a significant presence but shares the area with another DNO;
- Minimal – the WPD licence area operates in a small area of the Highway Authority (less than average of 50 initial notices a year).

Status categories:

- Implemented – a Permit scheme is already in operation;
- Consultation – a Permit scheme is either at consultation or post consultation awaiting Secretary of State approval;
- Preparation – a Permit scheme is being prepared for consultation
- Planned – a Permit scheme is planned for the future
- No plan – the local authority has not stated it has a plan

43.52 There is a joint Permit scheme under-development across the Midlands called the West and Shires Permit Scheme (WASPS) where a number of local authorities could operate under the same scheme.

West Midlands

Permit system status for Highway Authorities in the West Midlands			
Highway Authority	**Coverage**	**Status as at May 2013**	**Status**
Birmingham City Council	Complete	Preparing strategic routes scheme. Planned implementation 2014	Preparation
Borough of Telford & Wrekin Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Cheshire East Council	Minimal	May be part of WASPs – subject to cabinet approval	Planned
Dudley Metropolitan Borough Council	Complete	May be part of WASPs – subject to cabinet approval	Planned
Gloucestershire County Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Herefordshire County Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Oxfordshire County Council	Partial	No plans announced	No Plan
Sandwell Metropolitan Borough Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Shropshire County Council	Majority	Preparing All Streets scheme as a common scheme WASPS April 2014	Consultation
South Gloucestershire County Council	Partial	No plans announced	No Plan
Staffordshire County Council	Majority	May be part of WASPs – subject to cabinet approval	Planned
Stoke-on-Trent City Council	Complete	May be part of WASPs – subject to cabinet approval	Planned
Walsall Metropolitan Borough Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Wolverhampton City Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned
Worcestershire County Council	Complete	Will introduce permit scheme but no timescale or detail announced	Planned

East Midlands

Permit system status for Highway Authorities in the East Midlands			
Highway Authority	**Coverage**	**Status as at May 2013**	**Status**
Bedfordshire Borough Council	Minimal	All Streets Scheme implemented Nov 2012	Implemented
Buckinghamshire County Council	Partial	Consultation on strategic routes scheme ended Jan 2013, Planned implementation Autumn 2013	Post Consultation
Cambridgeshire County Council	Minimal	No plans announced	No Plan
Central Bedfordshire	Minimal	No plans announced	No Plan
Coventry City Council	Complete	May be part of WASPs – subject to cabinet approval	Planned
Derby City Council	Complete	Awaiting Secretary of State approval on strategic routes scheme. Planned implementation Autumn 2013	Post Consultation
Derbyshire County Council	Majority	Preparing strategic all streets scheme (may change). Planned implementation Autumn 2013	Preparation
Doncaster Metropolitan Borough Council	Minimal	Strategic routes scheme implemented June 2012.	Implemented
Leicester City Council	Complete	Preparing All Streets scheme. Planned implementation 2014	Preparation
Leicestershire County Council	Complete	No plans announced	No Plan
Lincolnshire County Council	Complete	No plans announced	No Plan
Milton Keynes Council	Complete	Strategic scheme out for consultation. Planned implementation 2014	Consultation
Northamptonshire County Council	Complete	Strategic routes scheme implemented Jan 2011	Implemented
Nottingham City Council	Complete	Preparing All Streets scheme. Planned implementation 2014	Preparation
Peterborough City Council	Minimal	No plans announced	No Plan
Rutland County Council	Complete	No plans announced	No Plan
Sheffield City Council	Minimal	Strategic routes scheme implemented June 2012.	Implemented
Solihull Metropolitan Borough Council	Partial	Will introduce permit scheme but no timescale or detail announced	Planned
Staffordshire County Council	Partial	May be part of WASPs – subject to cabinet approval	Planned
Warwickshire County Council	Partial	May be part of WASPs – subject to cabinet approval	Planned

South Wales

Permit system status for Highway Authorities in South Wales			
Highway Authority	**Coverage**	**Status as at May 2013**	**Status**
Blaenau Gwent	Complete	No plans announced	No Plan
Bridgend	Complete	No plans announced	No Plan
Caerphilly	Complete	No plans announced	No Plan
Cardiff	Complete	No plans announced	No Plan
Carmarthenshire	Complete	No plans announced	No Plan
Ceridigion	Complete	No plans announced	No Plan
Denbighshire	Minimal	No plans announced	No Plan
Gwynedd	Minimal	No plans announced	No Plan
Merthyr Tydfil	Complete	No plans announced	No Plan
Monmouthshire	Complete	No plans announced	No Plan
Neath Port Talbot	Complete	No plans announced	No Plan
Newport	Complete	No plans announced	No Plan
Pembrokeshire	Complete	No plans announced	No Plan
Powys	Partial	No plans announced	No Plan
Rhondda Cynon Taf	Complete	No plans announced	No Plan
Swansea	Complete	No plans announced	No Plan
Torfaen	Complete	No plans announced	No Plan
Vale of Glamorgan	Complete	No plans announced	No Plan
Wrexham	Minimal	No plans announced	No Plan

South West

Permit system status for Highway Authorities in the South West			
Highway Authority	**Coverage**	**Status as at May 2013**	**Status**
Bath & North East Somerset	Complete	No plans announced	No Plan
Bristol City	Complete	Mayor has announced desire for Permit Scheme, no further detail at this point	Planned
Cornwall County Council	Complete	No plans announced	No Plan
Devon County Council	Complete	No plans announced	No Plan
Dorset County Council	Partial	No plans announced	No Plan
North Somerset	Complete	No plans announced	No Plan
Plymouth City Council	Complete	No plans announced	No Plan
Somerset County Council	Complete	No plans announced	No Plan
South Gloucestershire County Council	Partial	No plans announced	No Plan
Torbay	Complete	No plans announced	No Plan

Business support costs

44 Introduction

44.1 Business support costs include a number of corporate activities that are provided by central functions for all licence areas.

44.2 WPD operates a low overhead business and there are no plans to change this philosophy. Generally, where increased requirements arise, these will be absorbed within the existing resources, accommodated through process improvements and efficiencies.

44.3 The following table summarises the corporate activity business support costs that are forecast for RIIO-ED1.

Corporate activities expenditure RIIO-ED1 (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
HR and non-operational training	6.1	6.2	3.6	5.0	20.9
Finance and regulation	62.9	57.9	35.7	57.9	214.4
CEO and corporate communication	18.0	19.0	8.0	12.9	57.9
RIIO-ED1 Total (8 years)	**87.0**	**83.1**	**47.3**	**75.8**	**293.2**

44.4 The following sections provide more details about each category of costs.

45 Human resources and non-operational training

45.1 The expenditure on human resources covers all the costs associated with the human resources function including development of HR policy and procedures, employee relations, payroll management, costs of recruiting non-operational staff and communicating to staff through letters and staff magazines.

45.2 The costs for non-operational training include the preparation and provision of non-engineering training courses and IT and telecoms training. The majority of training provided in WPD focusses on operational requirements and therefore expenditure in this area is low.

45.3 There are no anticipated increased requirements for either human resources and non-operational training. Efficiencies will be introduced into processing of payroll once current paper systems are replaced with electronic timesheets for staff involved in delivering direct activities (i.e. those that are directly involved with inspecting, maintaining, repairing, installing and replacing network assets).

45.4 Expenditure forecasts are broadly in line with current levels. The generic 1% per annum efficiencies that have been applied across expenditure forecasts will be partly achieved in Human Resources costs through the move to electronic timesheets.

Human resources and non-operational training expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	1.4	1.2	0.6	0.8	3.9
RIIO-ED1 Annual Average	0.8	0.8	0.4	0.6	2.6
RIIO-ED1 Total (8 years)	**6.1**	**6.2**	**3.6**	**5.0**	**20.9**

46 Finance & regulation

46.1 Finance and Regulation expenditure covers a wide range of activities that are grouped into five main categories:

- Finance;
- Insurance;
- Network Regulation;
- Procurement;
- Fines and penalties.

46.2 Finance activities include statutory and regulatory accounting. Whilst statutory accounting is not expected to change, the scale of regulatory reporting has grown with each price control as a consequence of the evolving maturity of the regulators understanding of DNOs. Increasingly sophisticated and detailed reporting templates are being introduced and require additional information to be extracted from DNO systems, translated into the required regulatory format and entered into predefined templates. WPD has implemented data analysis software (Hyperion) to make the extraction of data and population of templates less resource intensive, more consistent and faster. This means that as the burden of regulatory reporting increases, the impact on resource requirements is minimised, with more time dedicated to checking and validating rather than data handling.

46.3 Insurance includes the costs of insuring against events and the claims against DNOs for any damage that may have been caused during routine work activities. WPD works hard to ensure that customers are not inconvenienced and deals with genuine complaints and claims quickly. This avoids the need for protracted negotiations and the additional costs involved.

46.4 Regulatory obligations change with each price control, but once they are set they remain broadly unchanged. The role of the regulatory function is to ensure there is compliance with requirements and that obligations are met. Work is also carried out on the development of price control mechanisms through industry working groups to gain a better understanding of performance and establish new mechanisms for future price controls. The introduction of an eight year price control will mean that there should be more stability for a longer period of time.

46.5 There are no expected major changes to the requirements for procurement. WPD will continue to integrate contracts, incorporating requirements from the two Midlands DNOs into South West and South Wales contracts, to gain better efficiencies of scale. New contracts will need to be established for smart grid devices, but the impact of this will be minimal.

46.6 Cost forecasts remain broadly in line with current expenditure.

Finance and regulation expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	7.4	6.7	4.4	7.0	25.5
RIIO-ED1 Annual Average	7.9	7.2	4.5	7.2	26.8
RIIO-ED1 Total (8 years)	**62.9**	**57.9**	**35.7**	**57.9**	**214.4**

47 CEO, group directors and corporate communication

47.1 The expenditure classed under CEO include the cost of directors, board meeting costs, corporate communications, community awareness, legal services and company secretarial. There are no anticipated changes to CEO, director, legal and secretarial costs during the RIIO-ED1 period.

47.2 WPD supports numerous community initiatives, working with schools, children's sport teams, and community groups, providing information and sponsorship. Every year all customers receive a copy of the Power for Life publication, a four page A4 document, containing information about the company and promoting the existence of Guaranteed Standards of Service. This is supplemented by a TV advertising campaign that runs for a month on ITV and S4C, at various times of the day, to increase the awareness of who WPD are and what we do. We propose to continue with these initiatives to support local communities and make customers more aware of WPD. The costs of these activities are forecast to remain broadly in line with current expenditure.

47.3 There will be an additional £0.5m spent each year on raising the awareness of services available for vulnerable customers and provision of those services.

CEO, group directors and corporate communication expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	2.0	2.2	1.3	2.2	7.7
RIIO-ED1 Annual Average	2.3	2.4	1.0	1.6	7.2
RIIO-ED1 Total (8 years)	**18.0**	**19.0**	**8.0**	**12.9**	**57.9**

Vehicles, IT, property and tools

48 Introduction

48.1 The following four categories of expenditure have been historically classed as non-operational capex:

- Purchase of vehicles;
- Purchase of IT systems;
- Purchase and refurbishment of properties;
- Purchase of small tools, equipment, plant and machinery.

48.2 This section covers these costs, but also considers the costs that are classed as closely associated indirect costs for vehicles and business support costs for IT and property.

48.3 The following table summarises the costs for non-operational capital expenditure. It also shows the related costs for closely associated indirect costs or business support costs.

Vehicles, IT, property and tools expenditure RIIO-ED1 (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**WPD Total**
Vehicles closely associated indirects	34.1	26.2	17.2	29.9	107.5
Vehicles capital	30.3	23.3	15.2	26.3	95.2
IT&T business support costs	78.9	78.9	39.8	65.4	263.0
IT&T capital	33.9	33.9	17.1	27.8	112.6
Property business support costs	33.6	44.6	16.2	28.0	122.3
Property capital	3.4	3.3	2.3	5.4	14.3
Tools and equipment capital	22.9	22.9	12.6	19.0	77.4
RIIO-ED1 Total (8 years)	**237.1**	**233.1**	**120.4**	**201.8**	**792.3**

48.4 The following sections provide more details about each category of costs.

49 Vehicles & transport

49.1 WPD requires a fleet of vehicles and mobile plant to access and maintain the electricity distribution network. Historically in the West Midlands and East Midlands vehicles have been leased, but in South Wales and South West vehicles have been purchased. Vehicles in the Midlands will be progressively replaced with purchased items as the leases expire.

49.2 Fleet management is undertaken by a dedicated in-house WPD team, consisting of a Transport Manager and regional controllers for day to day fleet management. Vehicle specification and purchasing is undertaken by a technical specialist. Compliance and administration is covered by a small section based at two sites.

49.3 Regulatory cost reporting treats leased vehicles as closely associated indirects, whereas purchased vehicles are treated as non-operational capital. In recognition of the potential impact on cost benchmarking, Ofgem is analysing all the costs together and therefore for ease of reference all vehicle costs are included within this section.

Closely associated indirect vehicle costs

49.4 Closely associated indirect vehicle costs cover the activities of managing, operating and maintaining the commercial vehicle fleet and mobile plant (including generators). This includes lease costs, maintenance and repair, and fuel costs.

49.5 These costs are related to the amount of activity being carried out on the network. Expenditure forecasts have been rolled forward in proportion to the changes in the work programme with the application of the following cost reductions.

49.6 Cost benefit analysis demonstrates that it is better to purchase vehicles than lease them. Reductions have been applied to cost forecasts for the West Midlands and East Midlands to take account of the move from leased vehicles to purchased vehicles. These changes will be progressive and will apply when existing vehicles reach the end of their lease periods.

49.7 Reductions have also been incorporated for cost savings resulting from better fuel economy. When vehicles reach the end of their useful lives they will be replaced with modern vehicle that have more fuel efficient engines. In addition, having already trialled electric commercial vehicles for some time, we have placed orders for the new Renault Kangoo electric vans. Whilst the vehicles will be purchased outright, the battery units will be leased. This will reduce the overall operating costs of these vehicles, particularly as the battery upgrade costs can be significant

49.8 The maintenance and repair activity is completed by our own directly staffed workshops in the South West and by outsourced workshops in the other WPD areas. To ensure that our operating model remains the most cost effective, we have recently commenced a pilot project to compare costs between in house and out sourced facilities by opening a WPD operated workshop in Gloucester. Cost benefit analysis shows that having internal, flexible maintenance facilities provides a lower overall cost for vehicle maintenance. Facilities will be developed over the RIIO-ED1 period for more in-house maintenance

Vehicles closely associated indirect expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	9.6	8.9	3.9	6.1	28.6
RIIO-ED1 Annual Average	4.3	3.3	2.2	3.7	13.4
RIIO-ED1 Total (8 years)	**34.1**	**26.2**	**17.2**	**29.9**	**107.5**

Non-operational capital vehicle costs

49.9 The purchase of new vehicles, plant and generators is treated as a capital cost, but as these items do not form part of the network they are classed as being non-operational.

49.10 Vehicles are replaced based on an economic life where the age, condition and amount of use in service is considered against the cost of operating the vehicle. Vehicle replacement also provides the following benefits:

- cost reduction as vehicles with high running costs are replaced with more economic vehicles;
- reduced emissions as engine performance and body design improve;
- improved vehicle reliability;
- greater employee safety from vehicle improvements.

49.11 The options for financing new vehicles are either outright purchase or lease agreements. As mentioned above, vehicles in the East and West Midlands were leased, and as leases expire, replacements will be directly purchased. Our forecasts reflect this transition.

49.12 To ensure that our business approach to new and replacement vehicles remains the most cost effective, we undertake comparisons of purchase and lease costs, and our current analysis shows that outright purchase has a lower overall cost.

Example of monthly vehicle lease/purchase comparison			
Vehicle Type	**Lease cost**	**Purchase**	**% reduction**
Ford Transit 350	£334.93	£200.31	40%
Ford Connect 220	£237.24	£114.72	52%
Defender 110 MEWP	£942.43	£404.92	57%

49.13 Additionally, benefits associated with purchase of vehicles include being able to determine the vehicle life and avoiding punitive excess mileage and condition charges on vehicles that travel great distances.

49.14 As work programmes grow more vehicles are required to enable the work to be carried out. The forecast therefore reflects the changes to the work programme, as well as the migration from leasing.

Additional generation

49.15 Proposed changes to the Guaranteed Standard EGS2 mean that there will be a greater requirement for us to make use of mobile generation to be able to restore supplies in less than 12 hours.

49.16 WPD has been working with generator suppliers to develop new ways of connecting generators to the network. This has led to the availability of larger distribution accessories that can be connected to generators to provide temporary supplies to more customers in a greater number of fault and location specific circumstances.

49.17 Additional mobile generators and accessories will be purchased.

Vehicles non-operational capital expenditure

Vehicles non-operational capital expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	4.4	3.9	1.2	2.1	11.7
RIIO-ED1 Annual Average	3.8	2.9	1.9	3.3	11.9
RIIO-ED1 Total (8 years)	**30.3**	**23.3**	**15.2**	**26.3**	**95.2**

50 IT & telecoms (IT&T)

Introduction

50.1 WPD's Information Resources (IR) team is responsible for the purchase, development, installation and maintenance of non-operational computer and telecommunications systems and applications. This includes all the operating and maintenance costs of the IT infrastructure (servers, data & telephony networks, PC's and printers) including management and applications software costs. It excludes the IT and communications systems that are used to control the network and collect data from operational sites, which are classified as operational IT&T.

50.2 The IR team aims to deliver a simple 'no frills', highly resilient and available IT&T function, based on a flat and lean structure, without any reliance on contractors or outsourcing.

50.3 The IR team is an integral part of the business and not an arms-length service provider. IR shares WPD's goals and delivers IT&T services that are responsive, innovative, reliable and flexible in meeting business requirements.

50.4 The IR team's core principles are:

- **Business led** – IT services should be led by business need. By keeping core IT&T skills in-house enables the IT&T management team to develop close working relationships with the WPD management team and ensure that IT services are properly aligned with WPD business priorities.

- **Self help** –training existing business staff to provide first line support to their colleagues. This has removed the need for a help desk. (It is estimated that this approach saves £2.6m per annum when compared to previous arrangements in place for the two Midlands DNOs prior to acquisition by WPD).

- **Reliability** – achieved by using Tier 1 suppliers - such as IBM, Oracle, Dell, and Microsoft. The performance afforded by adopting proven technologies reduces the risks (and hidden costs) arising from obscure, over-hyped solutions with poor supply chains and inadequate support.

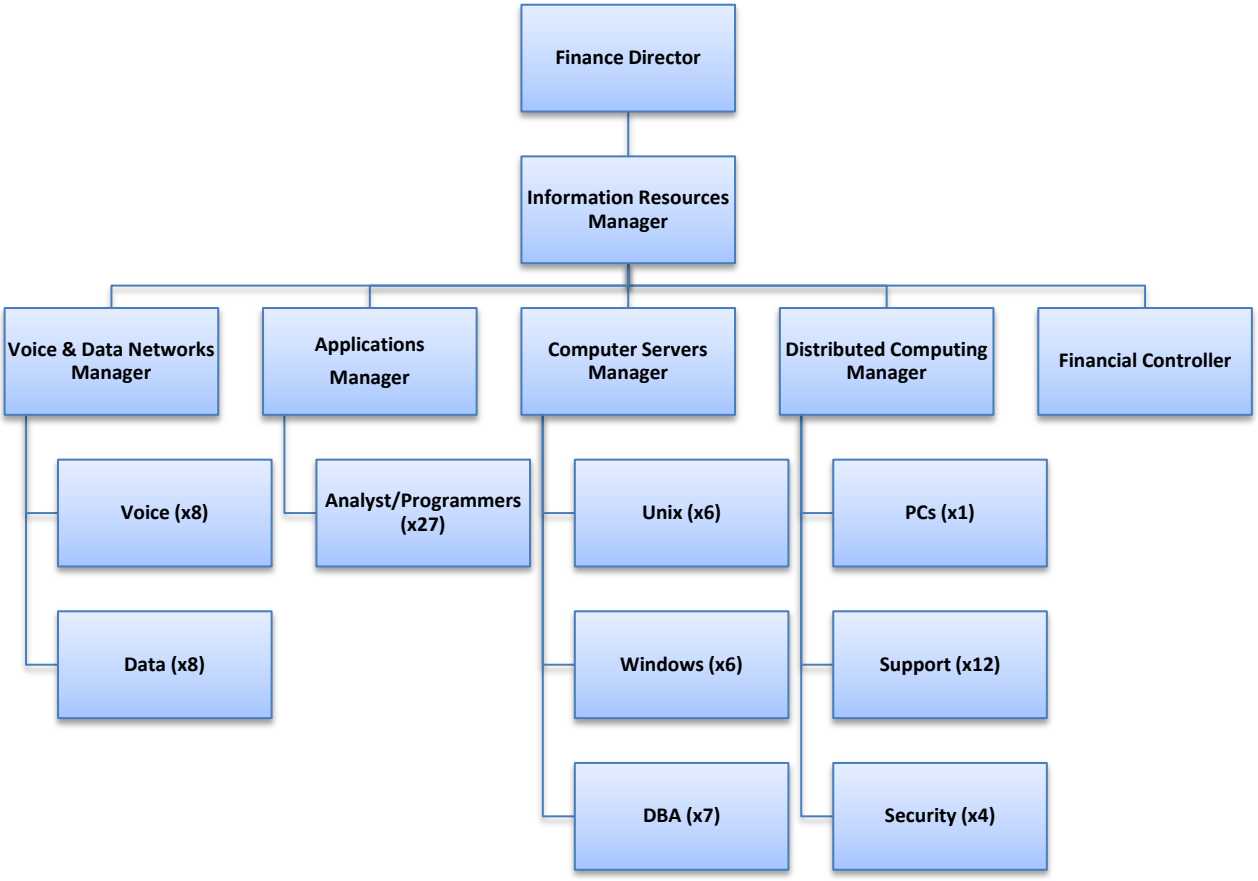
- **Standardisation** – using standard approaches across all hardware and software platforms minimises support costs by limiting the spread of skills needed by internal and external support staff. (It is estimated that this approach saves £1.3m per annum by having fewer support staff).

- **Minimising overheads** – achieved by flattening organisational structures, removing internal service level agreement processes and absorbing the roles of IT strategy, problem and change management, disaster recovery, business account management, project office and security oversight into the management team roles. (It is estimated that this approach saves £0.5m per annum by having fewer project managers and admin staff for these functions)

- **Resilience to Cyber security threats** – WPD has a policy of no direct access to the internet from WPD desk top and laptop computers. The benefits of this innovative policy are significant mitigation of the cyber security risk. (It is estimated that this approach saves at least £450k per annum by avoiding the costs of licences for security software and specialist staff). Furthermore, this policy leads to productivity benefits from the reduction in 'cyberloafing' -non-productive time associated with employees using the internet for personal reasons during working hours.

Organisation

50.5 The IR team headcount is currently 84. It is headed by five functional managers who are responsible for the delivery of all IT&T services to the company who report to the IR Manager who in turn reports to the Finance Director.



50.6 The scale of WPD's IT&T systems has grown significantly since 1999 with 3 major step changes each of which has demonstrated our ability to be both efficient and innovative.

- October 1999 - sale of SWEB supply business to London Electricity to create Western Power Distribution as a stand-alone DNO;
- April 2001 – integration of Infralec (Hyder);
- October 2011 – integration of Central Networks.

WHEN	HEADCOUNT	NOTES	
Oct 1999	45	1 licence	Following sale of SWEB supply business to London Electricity to create Western Power Distribution as a stand-alone DNO
Apr 2001	55	2 licences	+10 following Infralec (Hyder) Integration
Oct 2011	81	4 licences	+26 following Central Networks (Midlands) Integration
Apr 2013	84	4 licences	+3 due to sustained increase in workload since Central Networks (Midlands) Integration

50.7 After the supply business separation in 1999, WPD's strategy was to create a simple, cost effective, efficient and free-standing distribution business. Part of this was the successful creation of a brand new IT&T section.

50.8 The Infralec merger and acquisition activity in 2001 saw a two-thirds increase in business activity but only a marginal increase in staff numbers and IT&T costs. There was no change to the underlying strategy of how IT&T should be run within WPD. The strategy remained the same being based on the principles of keeping IT simple, standard, supported and under the direct control of the business.

50.9 The Central Networks merger and acquisition activity in 2011 exposed us to an example of an alternative way of running IT and reinforced our conviction that adopting the WPD approach is both more effective and less expensive.

50.10 Central Networks was a distribution business consisting of the two licences in East Midlands and West Midlands with the same business purpose as WPD. However, the business and IT were operated far less efficiently than WPD.

50.11 With respect to IT&T all of the IT services required by Central Networks had been outsourced firstly to the parent company E.ON and then on again to T-Systems and Hewlett Packard (HP). The only IT function that remained directly under Central Networks control was the Applications team consisting of some 73 people. The total costs for running IT&T (including Temporary Service Agreements with E.ON and CN IT staff) became the responsibility of WPD on completion of the sale.

50.12 By adopting the WPD approach, a saving of at least £19m per annum was made compared to the way Central Networks ran their IT&T.

50.13 These results have been examined through external benchmarking:

- The 2009 Mouchel Consulting cross DNO benchmark study concluded that "WPD operates a particularly lean IT operation to achieve low unit cost". This was substantiated with WPD ranking first in the majority of measures;

- The 2012 Deloittes' benchmark study concluded that WPD's South West & South Wales DNOs were efficient against the DNO benchmark in 2009/10. Acquiring two less efficient DNOs could have led to weaker productivity. Instead, the KPIs for the post-merger company show that productivity improved further compared to WPD in 2009/10. Most importantly the increase in IT&T costs for WPD from its efficient cost base of South Wales and South West to the larger group is less than would be expected given the availabilities of economies of scale. More details can be found in the Supplementary Annex (SA-08) Business Efficiency.

The task

50.14 Non-operational business activities (together with user numbers, locations and service levels) determine non-operational IT&T activity and costs.

50.15 The non-operational business activities undertaken by the WPD IR team are responsible for delivering outputs that are integral to the overall performance of the business, these include inter alia:

Business activities supported by the WPD IR team		
Corporate Services	**Network Services**	**Logistics**
Accounts Payable Accounts Receivable Data Transfer Network DUoS Billing End User Reporting Finance and Regulation General Ledger Human Resources Legal Management Reporting Meter Point Administration Payroll & Pensions Taxation Treasury	Contact Centres Control Centres Load Analysis Network Asset Management Network Geographical System Mapping Network Policy, Design and Engineering Pole & Site Risk Inspections Stores Barcoding Street Works Time Sheet Recording Vegetation Management	Inventory Management Procurement Property Purchase Management Transport Warehouse Management

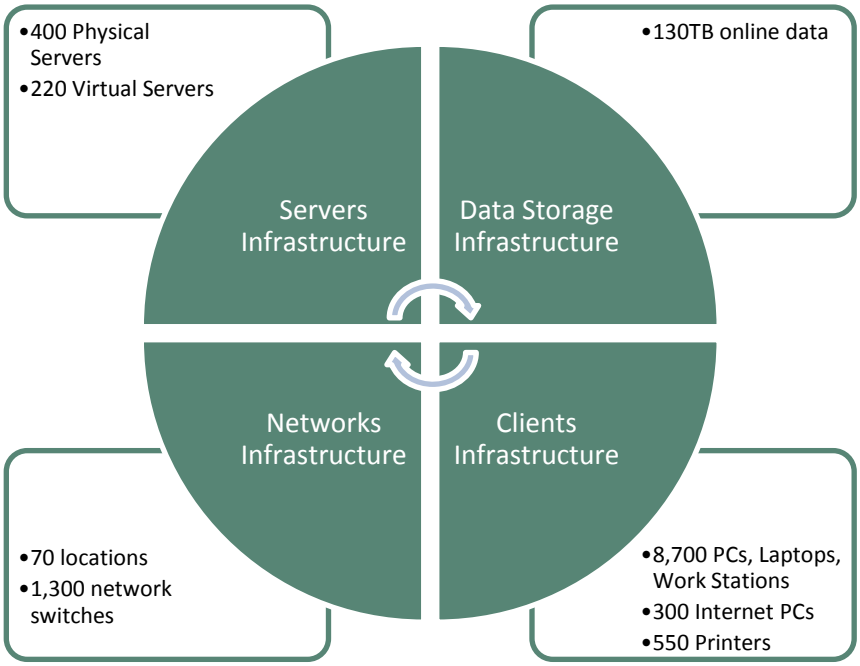
50.16 In support of these business activities IT&T can be separated into two main components:

- Software applications;
- Infrastructure.

50.17 Software applications provide the benefits to the business of reduced clerical staff costs, efficient business processes, better management control, greater productivity, compliance with regulations and improved customer service.

50.18 Software applications are supported by an underlying infrastructure that must be maintained, kept reliable and remain compatible with the software applications in order for the business to realise the benefits.

50.19 The scale of the IT&T required to support WPD's non-operational business is shown below:



50.20 This set of requirements could be supported in a variety of ways with any combination of contractors, outsourcing, in-sourcing, off-shoring, near-shoring and managed service arrangements.

50.21 WPD has chosen to keep direct control and retain a small core in house IT&T team. We do not outsource our service provision and we do not engage IT contractors. This enables WPD to ensure that IT&T support for its business requirements are satisfied as cost effectively, timely and efficiently as possible.

50.22 The choices WPD has made with respective to the efficient and cost effective delivery of Business Support costs and Purchasing of IT&T are described below.

IT&T business support costs

Activity overview

50.23 All daily maintenance and support activities are managed by WPD's IR team directly.

50.24 The IT&T activities ensure that on a daily basis the IT&T that the business relies on is available, reliable and performing as expected.

IT&T activities

50.25 Distributed Computing is responsible for delivery of the client computing infrastructure. This includes the support and services required for desktops, laptops, workstations, mobile devices, printers and the corporate desktop software portfolio. This includes:

- software purchasing, licensing, installation and maintenance;
- hardware purchasing, asset management, installation and maintenance;
- IT problem fixing and support;
- local IT support liaison ("virtual help desk");
- hardware and software technology refresh program;
- user security administration for Windows, mainframe, email, remote access, internet, corporate data share user accounts, starters, leavers and movers requests, password reset requests;
- information security awareness;
- infrastructure change management;
- mobile phones administration;
- disaster recovery testing and contingency planning.

50.26 Computer Services is responsible for the delivery of server computing infrastructure. This includes all server processors, data storage, sub systems and systems infrastructure software such as operating systems, job scheduling, database management systems, electronic mail and firewalls. This includes:

- software purchasing, licensing, installation and maintenance;
- hardware purchasing, asset management, installation and maintenance;
- operating system administration for Windows, Unix and Linux infrastructure;
- database administration for Oracle and SQL Server infrastructure;
- system administration for email infrastructure;
- backup and recovery, system monitoring, alerting, batch scheduling & capacity planning;
- firewall security management and control;
- infrastructure change management;
- hardware and software technology refresh program;
- disaster recovery testing and contingency planning;
- security and controls of Plymouth data centre (including air conditioning, Uninterruptable Power Supply (UPS) protection and intruder, fire, water alarms).

50.27 Communications Services is responsible for delivery of the voice and data network infrastructure and associated Control Rooms and Contact Centre systems. This includes:

- service management of voice and data network connectivity to the wide area network;
- system administration of the Local Area Network;
- system administration of the telephony system;
- system administration of voice mail system;
- system administration of voice recording system;
- system administration of control room telephony system;
- internet and non-internet communications infrastructure security;

- hardware and software technology refresh program;
- infrastructure change management;
- security and controls of out-based IT/Comms equipment rooms (including air conditioning, uninterruptable power supply protection and intruder, fire, water alarms);
- disaster recovery testing and contingency planning;
- third party management for WAN connectivity that connects WPD sites with voice and data networks, telephony, network equipment, mobile phones (service reviews, contracts, upgrades, outages, support).

50.28 Applications are responsible for delivery of the development, implementation, integration, support and enhancement of the application portfolio including the key business systems for corporate, distribution and smart metering. This includes:

- project life cycle management (estimating, planning and control);
- systems analysis (requirements, data);
- systems design (data design, software);
- systems development (programming);
- interfaces design and controls;
- data migration;
- system testing;
- system implementation;
- support and maintenance;
- applications change management;
- code management and version control;
- 3rd party developed systems integration;
- disaster recovery testing and contingency planning.

Cost drivers

50.29 WPD needs a set of core systems to support its (non-operational) business. These systems determine the level of fixed costs required for:

- applications support and maintenance;
- server support;
- database support;
- computer operations;
- network support;
- IT support;
- security administration;
- hardware maintenance;
- software licensing;
- data storage;
- disaster recovery;
- data centre;
- problem management;
- change management;
- cyber security.

50.30 The geographical nature of WPD's business and the operational requirements drive the number of locations (e.g. offices) requiring connectivity that, together with the required reliability and performance determine the level of variable costs for:

- voice and data network circuit (distance, bandwidth and resilience);
- communications/server rooms and support facilities (e.g. UPS, air conditioning, alarms);
- voice/data infrastructure (number of switches/ISDXs);
- local office server infrastructure (number of servers).

50.31 In addition, the user base mix/size determines the level of variable costs for;

- PCs/laptops;
- printers;
- fixed phones/mobile phones;
- voice/data usage costs;
- software licensing costs;
- support calls.

Expenditure forecast

50.32 The forecast has been built up by taking 2012/13 figures as a base and adjusting forecast operating costs with anticipated innovations, known contract changes and new regulatory requirements including:

- removal of mainframe managed services costs due to implementation of a new business system (E5) in 2013 for general ledger, accounts payable, accounts receivable, inventory management and project costing;
- growth in applications support and associated hardware that will be deployed to field staff e.g. electronic timesheets, substation inspections and work orders on tablet type devices;
- increased applications licences and support costs due to regulatory changes requiring new software systems or enhancements e.g. Street Wworks, Meter Point Registration System, geographical mapping of the network, Data Transfer Network for meter data exchange, asset management;
- increased use of management reporting and business intelligence tools (e.g. Webfocus & Hyperion);
- increased use of internet and portal based systems to interact with suppliers and customers e.g. new connections, supply chain management, procurement to pay, stakeholder engagement;
- greater use of image and video as part of normal business processes necessitating the need for new systems to facilitate increasing data storage volumes, management and back up;
- additional and improved ways of providing secure remote access to WPD systems e.g. from home, hotels, mobile;
- changes in software licensing models to match improvements in hardware performance;
- increased use of SMS texting to customers and staff to improve communications;
- Increased use of mobile mail – currently restricted to senior managers but could be pushed further down reporting lines as the need for mobile mail increases;
- New security systems to mitigate risks from cyber threats e.g. intrusion detection, vulnerability analysis, penetration testing;
- Expiry of PPL corporate discount for Oracle licences – the purchase agreement ending in 2017 will increase Oracle support costs;
- Replacement of unsupported technologies (e.g. conversion of ISDX telephony to internet protocol telephony) will incur increased hardware and software maintenance costs;
- Additional communication circuits and bandwidth between WPD offices to improve resilience and availability of voice and data network infrastructure;
- Increased use of internet services requiring improved connectivity and bandwidth.

50.33 Previous forecasts have been shown to have been accurate.

50.34 All revenue spend will be controlled in line with WPD's financial controls & policies.

IT&T business support costs

IT&T business support cost (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	11.2	10.7	5.2	8.2	35.3
RIIO-ED1 Annual Average	9.9	9.9	5.0	8.2	32.9
RIIO-ED1 Total (8 years)	**78.9**	**78.9**	**39.8**	**65.4**	**263.0**

Capital purchase of IT & telecoms

Activity overview

50.35 Non-operational capital expenditure maintains the IT&T asset base to meet existing and future business requirements.

50.36 This activity has two main cost drivers: the refresh of IT&T assets and changing business requirements.

Technology refresh of IT&T assets

50.37 Assets such as PCs, printers, servers, switches and software are replaced/upgraded at periodic intervals in order to:

- take advantage of improvements in hardware performance and reliability;
- reduce 'out of warranty' maintenance costs;
- reduce support & training costs by using common technologies across assset bases;
- experience less diverse faults;
- reduce the risk of any new software being incompatible with existing infrastructure.

50.38 Technology refresh delivers immediate benefits through better performance and reliability.

50.39 Technology refresh also enables the business to take advantage of innovation in IT and to apply it within the distribution business. This is because a modern infrastructure reduces the likelihood that any new software will be incompatible (e.g. today's new software will not be certified to run on the old Windows NT platforms). Secondly, WPD can rapidly adopt new technology in the field (e.g. iPads) without having to re-engineer the IT infrastructure that supports it.

50.40 The technology refresh plan is approved annually and is compiled after reviewing the various IT and communications asset bases in order to assess:

- performance, reliability and life expectancy;
- resources required to undertake the technology refresh;
- hardware, software and operating system compatibilities;
- higher storage capacities that may be required, (business operations may require additional storage that in turn will drive a need for faster processors, more memory, higher motherboard speed, faster network capability. Existing technology may be unable to meet the demands);
- servers need to be upgraded together so that they can work seamlessly;
- the likelihood of an increase in maintenance charges from vendors as warranties expire, components become more difficult to source and fault incidence increases;
- the possibility of skipping a generation of technology (e.g. Windows 2003 to Windows 2008) thereby reducing training and driving more value from original investment;
- whether third party software will reach the end of its life. If this occurs vendors are no longer able to maintain code. (e.g. WPD is replacing its general ledger in 2013 – the existing general ledger has been in service for 20 years but will no longer be supported by the original vendor).

50.41 Technology refresh plans are required due to long lead, migration, testing and implementation times needed to ensure that the impact to the business during the change process is minimised.

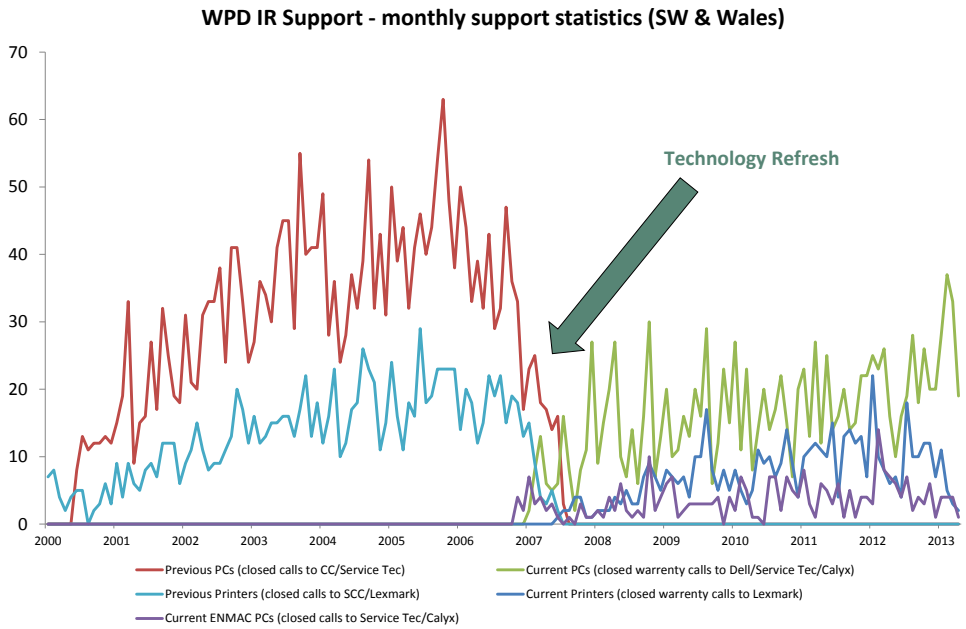
50.42 Assets of similar types (e.g. PCs, servers) are grouped together and refreshed en bloc in order to secure the same technology level across the asset base and obtain favourable bulk

purchase prices. Servers can attract a discount of 15-20% for ad hoc purchases, but we have obtained discounts of up to 60% when purchasing in bulk.

50.43 The table below illustrates some of the PC technology refresh discounts we have recently obtained.

Description	Unit Costs (£)	% Discount given
Dell Optiplex 990 Small Form Factor	480.00	54%
Dell Optiplex 990 Mini Tower	485.00	53%
Dell Latitude 6520 Laptop	838.00	49%
19" TFT	107.00	46%
20" TFT	182.00	47%
24" TFT	315.00	46%
Keyboards (for Laptop Use)	7.00	42%
Wired Mouse (Same as Desktop) (Spares)	3.00	54%
Laptop PSU (Extras)	20.00	54%
Laptop PSU Lead 2m 240v (Extras)	4.50	24%
USB Floppy Disk Kit (Desktop & Laptop)	18.00	14%

50.44 The chart below shows the effect on fault call volumes following the PC technology refresh in 2007.



Changing business requirements

50.45 Evolving markets, changing regulations and business innovation drive longer term work that can involve major changes to existing systems and/or the implementation of new systems. e.g. the acquisition of Central Networks, competition in connections, smart metering, green deal, contact centre performance (HVCT), WPD asset management system (CROWN), field mapping laptops and internet based interfaces (ICP new connections, vegetation management systems).

50.46 Software development projects are normally undertaken in-house although third party companies are involved with the development work if appropriate.

50.47 All such projects are business, not technology, led. Innovation comes from the business driven by the need to improve business efficiency and customer service. IR ensures that the supporting infrastructure required for such projects is available through regular upgrades and periodic technology refreshes.

Drivers of change

Applications software

50.48 The business will continue to innovate and drive the need for non-operational system changes most likely in the areas of:

- field data capture technologies removing the double handling of information;
- field access to corporate office based applications;
- use of internet technology to improve business-to-business processes;
- Contact centre computer telephony integration to improve customer service;
- business intelligence reporting software.

50.49 External influences that will drive functional application changes include:

- smart grids;
- smart metering;
- stakeholder engagement;
- environmental needs;
- regulatory compliance;
- standards of service.

50.50 The implementation of in-house developed systems will only be considered when off the shelf solutions are not available to meet business needs or where there are significant cost efficiencies to doing so. (For example, the HVCT system was built for 10% of the cost quoted by a third-party developer). However, such applications are always developed on supported platforms (e.g. Oracle).

50.51 WPD uses a high number of 3rd party applications. These suppliers will continue to enhance their software in line with industry trends (e.g. Web enabled browsers, Linux Operating Systems). Support for these 3rd party applications, in terms of bug fixing and enhancements, will continue to be provided by the 3rd party vendor.

50.52 Support for the integration of 3rd party systems into WPD's systems and subsequent upgrades/patches is provided by IR subject to ensuring the necessary integration skills are in place.

Computer servers

50.53 The current server asset base is standardised on HP and IBM hardware. This is typically on a 3 to 4 year technology refresh cycle.

50.54 Server hardware will continue to be cheaper, faster and more reliable over time. We will also continue to reduce the number of servers by running more than one application on each server (i.e. using virtual servers), but will do so in a way that does not compromise the resilience of the IT network.

50.55 The three, preferred, operating system environments will continue to be IBM's AIX, Red Hat Linux and Windows Server with the latter two using common Intel hardware to reduce operational costs and reduce the risk of having to translate applications from one operating system to another.

50.56 Storage Area Networks (SANs) are the preferred medium for data storage to optimise performance. A SAN provides large volume data storage that can be shared between multiple application servers through a high capacity fibre network. Various forms of RAID (disk redundancy) are used to provide protection from data loss whilst regular snapshots provide point in time recovery points for critical systems. The SANs are copied to the remote disaster

recovery (DR) site to reduce recovery times. The DR site is already equipped with servers to receive the data.

50.57 Server virtualisation reduces the number of physical servers by allowing applications to share the hardware. The benefit of this is clear however whilst software licences are linked to physical server processor sockets/cores, the deployment of software whether on physical or virtual environments continues to be a complex subject, with vendors pursuing conflicting strategies. Staying on top of licensing models and proving compliance will reinforce the need to keep things simple.

Distributed computing (PCs and printers)

50.58 The current asset base is standardised on Dell and Lexmark hardware. This is typically on a 3 to 4 year technology refresh cycle.

50.59 Client devices are becoming increasingly more commoditised and standard across Tier 1 manufacturers. This in turn makes devices both cheaper and more powerful

50.60 WPD PC clients will still predominately be desktop machines ('Thick Client'), because these suit the applications that are used in the business. However we plan to use more laptop/hand held devices with the introduction of more mobile working throughout the company.

50.61 There will continue to be a requirement for dedicated workgroup printers at each site, but there will be an increase in multi-functional printers to improve on the printer cost per page.

50.62 Improvements will be made in centralised system management of all client devices. Smart technologies and systems will be sought to ease the cost of supporting an enterprise size, national, multi-site organisation.

Data network

50.63 The current data network asset base is standardised on Cisco and Juniper hardware. This is typically on a 4 to 5 year technology refresh cycle.

50.64 The demand for an increasingly resilient, reliable, high bandwidth, low latency network will continue in order to meet business needs for highly available services with increasing amounts of data traffic - driven by smart metering, smart grids, mapping data, scanned images, graphics, pictures and video.

50.65 Wide Area Network (WAN) provision will continue to be provided predominantly by a mix of BT & WPD Telecoms provided circuits. With the acquisition of Central Networks in 2011 the WAN in the Midlands was connected using BT's 21CN network on a 3 year contract. Several South West and South Wales WAN circuits were reinforced to improve resilience and bandwidth requirements. WPD's aim is that WPD Telecoms will develop their network within the Midlands and then migrate circuits away from BT.

50.66 Remote access to corporate systems from WPD laptops has been very successful providing not only greater flexibility for staff but also customer service benefits through the use of home workers for the contact centre. Further improvements will be implemented through the introduction of proven technologies to enable access from home computers to compatible corporate systems e.g. email.

50.67 Changes arising from BT's national network conversion will be closely monitored, however, WPD's strategy is to utilise WPD telecoms network wherever possible.

Telephony network

50.68 The voice network is standardised on Siemens and will continue to be so during the RIIO-ED1 period. This is typically on a 5 year technology refresh cycle.

50.69 The Telephony network in the South Wales and the South West is based on a mature ISDX platform that will be transferred on to an IPT (combined voice and data) platform at the start of ED1. No new ISDX systems were available when we acquired Central Networks in 2011 and so we installed Siemens IPT throughout the West Midlands and East midlands as part of the transition.

50.70 Mobile phones are provided for key business staff and key business functions. Broadly speaking the service providers are Vodafone for South West and South Wales and O2 for the Midlands staff. In addition, key business staff have MTPAS (Mobile Telephone Privilege Access Scheme) enabled mobile phones for Civil Contingencies.

50.71 Smart phones are increasingly popular, with a trend for companies allowing employees to "Bring Your Own Device". Whilst looking to improve WPD mobile mail connectivity, corporately connected smart phones provision will be restricted to approved operating systems and senior staff for cost and security reasons.

Expenditure forecast

50.72 The forecast has been built up by:

- reviewing the base load historical spend, allowing for the recent acquisition of West Midlands and East Midlands and assuming a similar base load will be required for the RIIO-ED1 period;
- identifying the technology refresh cycles of the major IT/Telecoms components assuming refresh costs will remain broadly in line;
- including business driven initiatives to improve functionality and effectiveness.

50.73 Operational IT capital costs covering ENMAC/SCADA, private mobile radio, smart grids and smart metering have not been included. The costs for these are covered by the section on Operational IT&T.

50.74 Technology refresh estimates are provided on the basis that the cost of replacements will be broadly constant although we do expect better performance from the replacement devices.

IT&T Capital expenditure

IT&T non-operational capital expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	2.8	2.6	1.9	3.1	10.4
RIIO-ED1 Annual Average	4.2	4.2	2.1	3.5	14.1
RIIO-ED1 Total (8 years)	**33.9**	**33.9**	**17.1**	**27.8**	**112.6**

50.75 The well proven track record on the delivery of IT/Comms services that IR has established over previous price review periods will be sustained as we move ahead through RIIO-ED1 by the plan as described above.

Conclusion

50.76 Non-operational IT&T costs are driven by the software applications and infrastructure needed to support the business activities and user base across multiple geographic locations to the required service levels

50.77 WPD's approach of having direct control over IT and its track record demonstrates clear evidence of cost efficiency savings over other approaches of at least £19m per annum.

50.78 The replacement of similar technology types at regular technology refresh intervals ensures that IT&T remains reliable, compatible and through bulk purchasing discounts is cost efficient.

50.79 The investment made by WPD in non-operational IT&T has resulted in WPD maintaining its benchmark performance in terms of customer service, innovation and business efficiency.

51 Property

The property portfolio

51.1 The WPD operational area covers 55,500 km^2, about a quarter of the UK mainland. Operational excellence is achieved by having local teams that can attend to faults quickly and provide a local community based service.

51.2 Offices and depots are required for the 2,500 office-based and 3,600 field staff who serve the 7.8 million customers across the operational area.

51.3 Corporate activities are centralised in a few locations, but there are 59 properties throughout the region for local teams.

51.4 Local depots and reporting centres have office space, an area for parking company vehicles, and a storage area for higher turnover materials.

51.5 We also have two large central stores, from which materials are delivered either to local depots or directly to site.

51.6 Most of the property we occupy is owned by a property company within the group, and the network companies pay a commercial rent to the property company. Property management is run by three people based in Bristol. Specialist work is outsourced to consultants as required.

Environmental policies

51.7 We place a heavy emphasis on minimising our environmental impact, and use the Building Research Establishment Environmental Assessment Method (BREEAM) standards. All new offices and depots have to be BREEAM "excellent", and major refurbishments BREEAM "very good".

Property business support costs

51.8 During the RIIO-ED1 period, the operating costs are expected to remain in line with current levels of expenditure and will cover -the following costs:

- rent;
- security;
- routine maintenance;
- admin;
- cleaning.

Property business support costs expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	4.8	5.6	2.1	3.4	15.8
RIIO-ED1 Annual Average	4.2	5.6	2.0	3.5	15.3
RIIO-ED1 Total (8 years)	**33.6**	**44.6**	**16.2**	**28.0**	**122.3**

Property non-operational capital expenditure

51.9 We have no plans to buy new properties, but intend to spend almost £2m a year on improvements and refurbishments during the RIIO-ED1 period. This will include the selective installation of low energy lighting, improvements to heating and cooling systems and improved insulation to reduce energy consumption.

Property non-operational capital expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.9	1.2	1.0	1.1	4.3
RIIO-ED1 Annual Average	0.4	0.4	0.3	0.7	1.8
RIIO-ED1 Total (8 years)	**3.4**	**3.3**	**2.3**	**5.4**	**14.3**

52 Small tools, equipment, plant and machinery

52.1 Craft and engineering staff require tools to work on the network assets. These include hand tools for precision work such as electrical fitting and cable jointing, lifting and tensioning tackle for overhead line work, test equipment for commissioning assets and fault location, workshop machinery to enable fitters to refurbish components and plant such as drum trailers and winches used in the erection of overhead conductors.

52.2 Equipment is replaced as items become worn or broken. In addition new staff are provided with the equipment that they require to carry out their duties. Since the rate of usage of equipment and number of new additional staff are related to the volume of work being carried out on the network, the costs have been rolled forward in proportion to the changes in the work programme.

Tools non-operational capital expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	2.8	3.3	1.7	2.0	9.8
RIIO-ED1 Annual Average	2.9	2.9	1.6	2.4	9.7
RIIO-ED1 Total (8 years)	**22.9**	**22.9**	**12.6**	**19.0**	**77.4**

Non price control costs

53 Non price control costs

53.1 Non price control costs are incurred by carrying out distribution network related activities that operate outside the regulatory price control including the activities where the costs are recharged to third parties. They include:

- excluded services:
  - ES2: Diversion works under an obligation;
  - ES3: Works required by alteration to premises;
  - ES4: Top-up, standby and enhanced system security;
  - ES5: Revenue protection services;
  - ES6: Metering services (other than legacy meter equipment provision);
  - ES7: Miscellaneous.
- legacy metering;
- out of area networks;
- de minimis;
- other (consented) activities.

ES2: Diversions

53.2 Every year there are a number of enquiries for network assets to be moved as a consequence of third party activities. For example, the creation of a new access road onto an existing business estate will remove existing footpaths, lowering ground to road level and reducing depth of cables. This would require the exiting cables to be installed deeper and ducted to provide mechanical protection from the weight of traffic traveling over them. In these circumstances the cost of carrying the work are recovered from the customers and are excluded from price control assessments.

53.3 The majority of these enquiries will be small in scale, with the exception of a very significant and prestigious infrastructure development (High Speed 2 (HS2)) that will impact the East Midlands and West Midlands.

53.4 The forecast for diversions (excluding HS2) are shown in the table below:

Diversions expenditure (excluding HS2) (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	5.6	8.2	2.3	3.6	19.7
RIIO-ED1 Annual Average	8.1	12.0	2.7	4.2	27.0
RIIO-ED1 Total (8 years)	**64.7**	**96.1**	**21.6**	**34.0**	**216.4**

High Speed 2

53.5 In January 2012 the Secretary of State for Transport announced the decision to go ahead with the development of a high speed rail network between London, Birmingham, Leeds and Manchester stating that HS2 is the largest transport infrastructure investment in the UK for a generation.

53.6 HS2 will be built in two phases with the first stage, the link between London and Birmingham, being planned for completion by 2026. The construction of the line will go through the WPD area passing through large parts of Warwickshire, into the North Eastern parts of Birmingham and extending into Staffordshire and consequently there will be the requirement to divert existing overhead line and cables to enable the new railway to be built.

53.7 Detailed analysis of the proposed route has identified that there will be 317 diversion schemes in the RIIO-ED1 period in both the West Midlands and East Midlands. This includes the diversion of overhead lines, underground cables and also some re-siting of substations and plant. Work is due to start in 2017 with completion estimated by 2023.

53.8 There remains uncertainty that HS2 will actually proceed and a change of Government could reverse the decision made in January 2012. For our Business Plan we have assumed that HS2 does proceed. The following information is provided to identify the potential scale of the diversions work should HS2 go ahead.

HS2 project volumes and costs				
	West Midlands		East Midlands	
Voltage	Number of Diversions	Cost (£m)	Number of Diversions	Cost (£m)
132kV	11	24.7	5	6.1
EHV	12	2.3	9	2.0
HV. LV & Communication Circuits	213	23.7	67	6.8
Total	**236**	**50.7**	**81**	**14.9**

ES3: Service alterations

53.9 Every year there are a number of enquiries for network assets to be moved to accommodate an alteration to existing premises. For example, an extension to a property may require the diversion of the existing overhead service. In these circumstances the cost of carrying the work are recovered from the customers and are excluded from price control assessments.

53.10 RIIO-ED1 forecasts are in line with the levels of current (2012/13) expenditure.

Service alteration expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	3.0	2.4	0.7	1.4	7.5
RIIO-ED1 Annual Average	1.7	1.2	0.6	1.3	4.8
RIIO-ED1 Total (8 years)	**13.5**	**9.7**	**4.9**	**10.2**	**38.3**

ES4: Top-up, stand-by and enhanced systems security

53.11 Top up and standby excluded service income was introduced at the start of privatisation when there was no regulatory distinction between supply business and distribution business revenues within a REC (Regional Electricity Company).

53.12 A customer with their own generation capability required back-up from a REC if their electricity demand exceeded their generation output.

53.13 Whilst a REC was rewarded through the supply tariff if a customer required back-up, there was no reward for a REC if a customer took zero volumes. However, the REC still had to cover the cost of its distribution network assets so the excluded top up and standby service income was created to overcome this issue.

53.14 In subsequent years supply and distribution businesses were separated but top up and standby income continued to be classified as excluded service income by distribution businesses (DNOs).

53.15 In our view it is no longer necessary to have a top up and standby classification because the cost and the volume of the distribution assets relating to top up and standby customers are

included in the RAV; a DNO is rewarded through the price control allowed revenues calculation for RAV and associated operating costs.

53.16 Therefore, for the Business Plan we assume £nil revenues for top up and standby.

ES5: Revenue protection

53.17 Revenue protection services relate to the investigation and prevention of electricity meter interference and other forms of illegal abstraction of electricity.

53.18 This is a service provided to third party suppliers, at their request, with costs recharged to them. Suppliers can make alternate arrangements alternate arrangements for the provision. In South Wales and South West the provision of these services were associated with WPD's domestic metering businesses which were transferred to SSE and EDF respectively. In the West Midlands and East Midlands they remained part of the network operator.

53.19 It is forecast that volumes of activity will remain constant during the RIIO-ED1 period, remaining at 2012/13 levels.

Revenue protection expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.9	0.8	0.0	0.0	1.7
RIIO-ED1 Annual Average	0.7	0.6	0.0	0.0	1.3
RIIO-ED1 Total (8 years)	**5.7**	**4.5**	**0.0**	**0.0**	**10.2**

ES6: Metering services (other than legacy meter equipment provision)

53.20 WPD provides metering services through WPD South West to EDF where meters are purchased and provided primarily to EDF customers under rental agreements. It is anticipated that this service will continue into the RIIO-ED1 period until the roll out of the smart metering programme is completed around 2020. Therefore, we have assumed that the service will wind down to £nil from 2020/21.

Metering services expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	-	-	-	0.7	0.7
RIIO-ED1 Annual Average	-	-	-	0.2	0.2
RIIO-ED1 Total (8 years)	**-**	**-**	**-**	**1.4**	**1.4**

ES7: Miscellaneous

53.21 WPD does not provide any miscellaneous services

Legacy metering

53.22 Legacy metering activities relate to the provision of meters installed before 31 March 2007. Suppliers pay rentals agreements for the provision of these meters, with small costs of approximately £0.1m across the RIIO-ED1 period being incurred for the administration of the service.

53.23 This activity will continue to be carried out until the roll out of the smart metering programme is completed in 2020, at which point the legacy meters will have been replaced.

Legacy metering income (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	3.0	4.5	1.5	3.4	12.4
RIIO-ED1 Annual Average	0.8	1.3	0.5	1.0	3.6
RIIO-ED1 Total (8 years)	**6.5**	**10.5**	**3.9**	**8.5**	**29.4**

De minimis

53.24 The services included under this heading are:

- property rentals;
- training;
- transport;
- private networks;
- multi-utility (gas/water).

53.25 Actual costs for 2012/13 are shown in the table below. It is expected that volumes of activity will remain constant during the RIIO-ED1 period and so costs will remain at 2012/13 levels.

De-minimis activities - 2012/13 actual gross direct costs (£m)					
	West Midlands	**East Midlands**	**South Wales**	**South West**	**Total**
Transport	-	-	-	0.2	**0.2**
Property	-	-	-	0.5	**0.5**
Training	-	-	-	0.3	**0.3**
Private Networks	0.3	0.4	1.1	1.5	**3.3**
Multi-Utility	0.3	0.8	0.5	0.0	**1.6**
Other	0.4	0.2	0.1	0.2	**0.9**

Out of area networks

53.26 WPD does not provide any service under this heading

Other consented activities

53.27 WPD does not provide any service under this heading

Non activity based costs

54 Non activity based costs

Pass through costs

54.1 Pass through cost in DPCR5 included business rates, transmission exit point charges and Ofgem licence fees. We have assumed in the determining allowed revenues that these items will continue to be treated as pass through costs in RIIO-ED1.

Business rates

54.2 Details about business rates are provided in the Supplementary Annex (SA-07) Financing the Plan. The table below summarises the costs.

Business rates expenditure (£m)					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	28.1	35.6	16.3	19.1	99.1
RIIO-ED1 Annual Average	34.5	45.3	18.1	18.3	114.3
RIIO-ED1 Total (8 years)	**276.0**	**362.7**	**144.8**	**146.4**	**929.9**

Transmission exit point charges

54.3 See chapter for Transmission Exit Point charges in this document

Ofgem licence fees

54.4 Licence fees are assumed to continue at the same level as in 2012/13.

Ofgem licence fee **(£m)**					
	West Midlands	East Midlands	South Wales	South West	WPD Total
DPCR5 Annual Average	0.9	1.1	0.5	0.7	3.3
RIIO-ED1 Annual Average	1.2	1.3	0.5	0.8	3.8
RIIO-ED1 Total (8 years)	**9.7**	**10.3**	**4.3**	**6.1**	**30.4**

Smart meter costs

54.5 See chapter for smart meters in the Supplementary Annex (SA-03) Innovation.

Bad debts

54.6 The level of bad debts is difficult to forecast but is typically low in relative terms; we assume £nil in our forecasts.

Sale of scrap

54.7 Scrap is created when poor condition assets are removed from the network or where the construction on new assets leads to short offcuts that cannot be used elsewhere. The disposal of scrap is carried out primarily for environmental reasons where materials such as copper conductor can be recovered and reused. Scrap is sold where materials that have a high commodity value allowing some of the original expenditure to be recovered.

54.8 The current Ofgem RAV policy on the sale of scrap is to fully deduct the income received from RAV on the basis that such assets were probably initially added to RAV, so on sale should be treated as a disposal and therefore deducted from RAV.

54.9 We note that the level of income on sale of scrap is considerably higher in WPD than for other DNOs.

54.10 We have assumed £nil for income from sales of scrap as it is difficult to forecast and we consider that any income should be a reward to a DNO on environmental grounds.

Special considerations

55 Cost allocation methodology

Indirect costs allocation to non-price control activities

55.1 The main activities of WPD are to build, operate, maintain and repair the electricity distribution network. The most significant other business of WPD is the connection of new customers. There are also activities such as diversions of equipment that are treated as excluded services and classed as non price control costs.

55.2 WPD's organisation is set-up on a geographical team structure basis. This means that a team has responsibility for all the main activities, connections and non price control work.

55.3 Direct costs relate to physically working on the network assets. Each team member carrying out direct work completes a timesheet so that the reason for the costs can be separately identified. This also applies to the cost of materials and the cost of using external contractors. Costs can therefore be attributed to the relevant part of WPD.

55.4 Indirect costs represent the cost of engineering management, operations and planning, corporate activities (such as HR, and finance) and non-operational capital for offices and IT systems. As such, these costs are not identified by individual job and therefore a cost allocation methodology is used to allocate indirect costs between business areas.

Allocation methodology

55.5 In general indirect costs are allocated pro rata to the direct costs of main activities, connections and non price control.

55.6 There are two areas of adjustments made before allocation to ensure the costs are reflective of the activities carried out:

- certain indirect costs, which only relate to the main activities, are excluded from the allocation methodology;
- an uplift is applied to connection costs for additional planning work.

Exclusions

55.7 Closely associated indirect costs, business support costs and non-operational capital, are assessed by activity to determine whether the connections business and non price control activities should receive a share of these costs.

55.8 Some categories of costs are excluded from the allocation process (e.g. wayleaves) because there is no association with connections or non price control activities. In certain cases an indirect cost activity is only partially related and thus a portion of that activity's costs is excluded from this process. The exclusions are shown in table below.

Indirect cost allocation - exclusions	
Cost Type	**% excluded**
Wayleaves costs and associated administration costs	100%
IT&T	Partial
Workforce renewal	100%
Insurance premiums, claims and legal fees relating to the network	100%
PR costs including awareness campaign (TV & Leaflets)	100%
ENA membership	100%
EATL fees	100%
Ordnance Survey fees	100%
Fault management and dispatch	100%
Call Centre	Partial

55.9 All exclusions are allocated in full to the main business.

55.10 After exclusions, indirects are allocated pro rata to the direct cost of the main activities, connections and other non price control activities with the exception of Network Design and Engineering.

Uplift for connections design and other non-price control work

55.11 An uplift percentage is applied to connection projects for design work as this is more cost reflective of work done to provide quotations, taking account of the additional planning carried out where customers do not accept connection offers and direct work does not proceed.

Allocation of shared indirect costs between WPD DNOs

55.12 Corporate activities such as finance and IT and other activities, including the control centre and contact centre, are operated as a shared activity in WPD, as this is deemed by management to be the most cost effective way of working.

55.13 Following the acquisition of Central Networks in April 2011 a new operating structure for the Midlands was initiated in the summer of 2011, which followed the WPD working model. The process of assimilation of the Midlands workforce into the new operating structure was partly completed by December 2011 and fully completed by April 2012.

55.14 The year ending March 2012 represented a year of transition so that the cost base did not represent a "normal" year. Whilst costs stabilised to some extent from December 2011, there was still some uncertainty and so shared costs were allocated 50:50 between WW and WEM for just the four months December 2011 to March 2012.

55.15 Commencing April 2012 and to 2022/23 in the BPDT shared costs are allocated:

- 30% East Midlands;
- 30% West Midlands;
- 15% South Wales;
- 25% South West.

55.16 The basis of this allocation is the identification of the key cost drivers which drive shared costs as follows:

Basis for cost allocation of shared indirect costs					
	East Midlands	**West Midlands**	**South Wales**	**South West**	**Total**
MEAV (Modern Equivalent Asset Value)	34%	30%	15%	21%	100%
RAV - per final DPCR5 proposals April 2010	32%	33%	14%	21%	100%
Number of DNOs	25%	25%	25%	25%	100%
WPD Number of distribution managers	28%	28%	16%	28%	100%
Indicative simple average	30%	29%	17%	24%	100%

55.17 These key cost drivers are essentially scale variables with the first two drivers listed (MEAV and RAV) representing a descriptive view of what drive costs, whereas the Number of DNOs and the Number of Distribution Managers (DMS), who cover geographical areas, represent a more deterministic view. For example, the number of DNOs determines how many accounts and RRPs to be produced, whilst the number of DMs is a good indicator of operational workload in the four DNOs.

55.18 The allocation is to an extent judgemental so in our opinion it is appropriate to round the allocation percentage to the nearest five percentage points.

56 Regional adjustments

56.1 WPD distributes electricity to a wide range of different areas including:

- the dense urban sprawl of Birmingham and the West Midlands conurbation;
- large cities including Bristol, Cardiff, Nottingham, Derby, Leicester, Stoke;
- mining towns in the East Midlands;
- sparsely populated rural areas in Lincolnshire, Cornwall and South Wales.

56.2 Travel times can vary significantly, due to availability or absence of direct routes and the effect of traffic congestion.

56.3 Each location has its unique challenges and on balance the mix of issues does not necessitate any specific locational or regional adjustments.

57 Real price effects

57.1 WPD has engaged First Economics to assess real price effects (i.e. above inflation costs) and the findings are shown in the table below:

Real price effects (%)						
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19 to 2022/23**
Labour – general	(0.6)	0.2	0.7	0.5	0.2	0.9
Labour – specialist	0.7	1.5	2.0	1.8	1.5	2.1
Materials – general/civils	0.7	1.7	1.3	1.0	0.8	1.1
Materials – electrical	0.2	2.2	1.8	1.5	1.3	1.6
Plant and equipment	0.2	1.2	0.8	0.5	0.3	0.6
IT	(2.1)	(2.1)	(2.5)	(2.8)	(3.0)	(2.7)
Property rentals	(0.6)	0.2	0.7	0.5	0.2	0.9

57.2 The forecast has been derived from a number of data sources including the Office for National Statistics and the Office for Budget Responsibility.

57.3 The forecasts costs for specific activities in the Business Plan have not included the effects of these above inflation costs. Their impact is accounted separately and offset, in part, by efficiency savings.

57.4 The First Economics report can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Supporting-Expenditure-information/First-Economics-RPE-forecast.aspx

58 Efficiency assumptions

58.1 We have sought to identify the scope for year on year efficiency improvements. We have considered efficiency improvements into three component parts:

- efficiency catch up, which relates to the opportunity for an inefficient DNO to improve its efficiency to a level consistent with the most efficient DNO;
- merger efficiencies, which relate to the cost saving delivered as a consequence of merger and acquisition activity;
- frontier efficiency shift, which relates to the on-going efficiency improvements that can be delivered by a DNO already operating at the efficiency frontier.

58.2 WPD has been identified as one of the most efficient DNOs. Therefore there is negligible scope associated with catch up efficiency.

58.3 The synergy and efficiency savings that have been delivered following WPD's acquisition of the West and East Midlands DNOs have been identified in this Business Plan. Therefore, there is no further scope for additional merger efficiencies.

58.4 However, our review of available information indicates that there is scope for year on year improvements available to WPD as a frontier performing DNO. Our Business Plan assumes that efficiency savings of 1% per year will be achieved for controllable cost elements of labour, materials and contractor costs.

Business efficiency improvement (%)								
	2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**
Labour	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Materials	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Contractors	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

58.5 This 1% per year efficiency saving does not relate to any specific initiatives. However, the generic initiatives that we seek to exploit include:

- improvements to business processes;
- improvements to operational working practices;
- new innovative techniques developed as part of LCNF projects;
- learning from other DNOs, utilities and large asset based organisations;
- reductions in the cost of procured goods and services;
- continued use of in-house resource to undertake core activities; and
- design of the right engineering solutions to network problems (i.e. no 'gold plating').

Appendices

59 Appendix A1 – Transform model

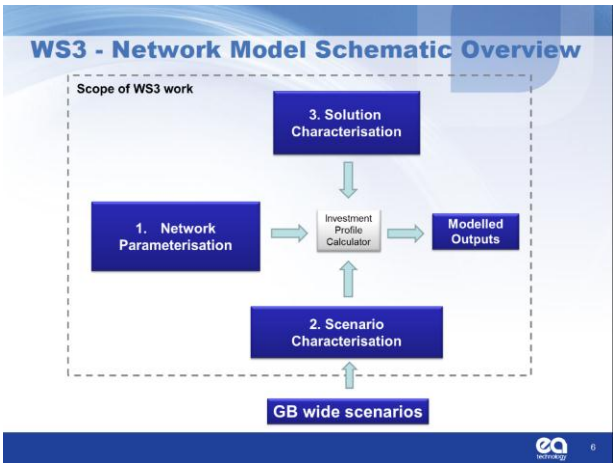
59.1 The Smart Grids Forum (SGF) was established by Ofgem and DECC in early 2011. It brings together key opinion formers, experts and stakeholders involved in the development of smart grids with the aim of providing strategic input to help shape Ofgem's and DECC's thinking and provide leadership in smart grid policy and deployment.

59.2 The SGF has several 'Work Streams' which work on different smart grid issues. Work Stream 3 is led by the DNOs and works to assess the network impacts of LCTs. WPD is a member of the SGF and provides technical expertise for Work Stream projects.

59.3 Work Stream 3 engaged EA Technology to develop an industry model that uses representative networks to assess the impact of load growth forecasts and technology adoption scenarios to determine the mix of traditional and smart interventions required to provide adequate capacity headroom on LV, HV and EHV circuits. EA Technology brands this as the Transform model.

59.4 The main elements of the Transform model are:

- matrix of representative networks with pre-existing loads;
- load growth scenarios including clustering assumptions;
- potential solutions including traditional and smart interventions.
- investment calculation engine;
- modelled outputs/results.



59.5 There are two branches of the Transform model: the GB model and DNO licence model. The Transform GB model considers the whole of Great Britain's distribution networks, and includes additional functionality to generate load profiles (including the impact of supplier led time of use tariffs), represent non-distribution parts of the GB electricity industry, and perform cost-benefit analyses between different investment strategies. The Transform DNO model can be populated to represent an individual DNO licence area.

59.6 Further information about the model can be found in EA Technology's report 'Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks', published at http://www.ofgem.gov.uk/Networks/SGF/Publications/Pages/index.aspx.

Matrix of Representative Networks (Network Parameterisation)

59.7 The Transform model considers LV, HV and EHV networks. It uses a small number of generic 'feeders' to represent the wide variety of circuits that exist across Great Britain. To model a particular DNO licence area, each circuit in that licence area must be mapped to the most similar feeder in Transform. The connectivity between circuits at different voltages is also mapped to the connectivity between generic feeders.

59.8 Pre-existing residential and commercial loads connected to each generic feeder form the 'base load' of the modelled distribution network.

59.9 WPD used its asset management database and network management tools to map each of its licence areas into the Transform model.

Separation of EHV modelling

59.10 WPD operates detailed circuit specific models of its EHV system which extends as far as the HV busbars of primary substations. These models provide a more accurate forecast and have been used in place of the EHV components of the Transform model. To avoid double-counting, the EHV components of the Transform model were disabled by setting all EHV headrooms (see section on headroom below) to levels that will not be exceeded.

Load growth scenarios and clustering

59.11 The Transform model comes prepopulated with four LCT and distributed generation (DG) uptake scenarios that represent the four DECC carbon plan scenarios:

- scenario 1 - high abatement in low carbon heat
- scenario 2 - high abatement in transport
- scenario 3 - high electrification of heat and transport
- scenario 4 - credit purchase

59.12 These DECC scenarios are further described in the uncertainty section of this plan.

59.13 DECC's GB-wide LCT uptake forecasts were regionalised to DNO level by Element Energy for use in the Transform DNO model.

59.14 The Transform DNO model can also be populated with a DNO's own view of LCT and DG uptake. As its 'best view' WPD is adopting a scenario based on the Transform model, but also informed by stakeholder feedback and analysis undertaken by the Centre for Sustainable Energy (CSE). The 'best view' scenario is based on the following assumptions.

Growth of LV-connected PV generation

59.15 In each licence area this has been based upon the CSE's analysis for property types suitable for small scale PV, modified by the proportion of GB deployment to date within each licence area from Ofgem feed in tariff data.

Growth of electric vehicles

59.16 In each licence area this has been based upon CSE's analysis of social demographic customer types combined with WPD's view of likely uptake in RIIO-ED1. The mix of electric vehicle types and speed of charging is consistent with SGF Workstream 1 forecasts based on a low uptake of EVs. Charging types are a mixture of slow 3kW, fast 7kW and rapid 50kW.

Growth of domestic heat pumps

59.17 In each licence area this has been based upon CSE's analysis of property types suitable for heat pumps, combined with WPD's view of likely uptake in the RIIO-ED1 period. Significant uptake of domestic heat pumps is assumed to be limited to off-gas areas (at least during this period).

Growth of wind, biomass and large-scale PV generation

59.18 In each licence area this is forecast to be 1/14th of DECC's GB-wide 'High' case.

Customer engagement with Demand Side Response (DSR)

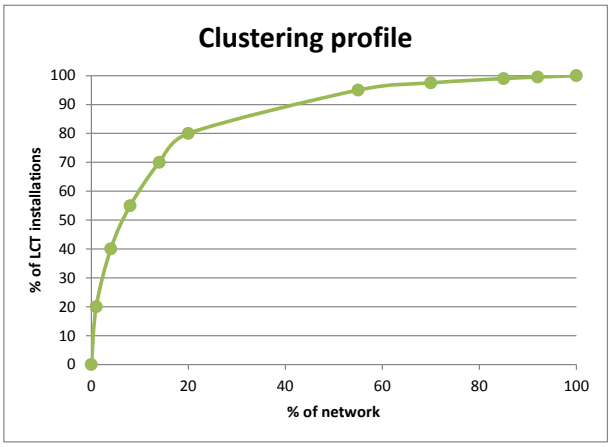
59.19 This is forecast to be in line with EA Technology's 'Low DSR' case included in the Transform model.

Clustering

59.20 The take-up of LCTs is driven by a variety of technical, social and economic factors. An example is that higher levels of solar irradiation in the south of England have driven early adoption of solar panels. Some factors apply to small geographic areas, for instance WPD believes that heat pumps will be more popular in areas without mains gas. This is because a heat pump is currently more economical to run than conventional electric heating, but less economical than gas-fired central heating.

59.21 The model uses clustering to represent the non-uniform network impact of LCT uptake. The same generic feeder with the same pre-existing loads is modelled ten times with different levels of LCT uptake. The illustration below shows high levels of clustering with 80% of all installations appearing on 20% of the network.

Percentage of Network	Percentage of low carbon technology installations
1%	20.0%
4%	40.0%
8%	55.0%
14%	70.0%
20%	80.0%
55%	95.0%
70%	97.5%
85%	99.0%
92%	99.5%
100%	100.0%



59.22 By default the model uses a clustering profile calculated from the uptake of the Feed in Tariff for small-scale generators. For its 'best view', WPD has calculated a clustering profile for each licence area based on the uptake of domestic heat pumps at distribution substation level, forecast using data from CSE.

Winter temperatures and heating load

59.23 A significant proportion of the load applied to the network in the Transform model is electric heating, both conventional (direct or storage) and heat pumps. The magnitude of this load is heavily dependent on winter ambient temperatures.

59.24 Two representative winter days are modelled in Transform. The 'Winter Peak' day is representative of the coldest two-week period of the year. The 'Winter Average' day is representative of the coldest six-month period of the year, excluding the two weeks of the 'Winter Peak'. The temperature at the time of peak demand (which typically occurs at around 6pm) for each representative day can be set in the range -5°C to 5°C. By default, the 'Winter Peak' temperature is set to -3°C and the 'Winter Average' temperature is set to 0°C.

59.25 For its 'best view', WPD has calculated more representative winter temperatures on a regional basis, using hourly temperature data from weather stations in all four licence areas from 2005 to 2013. Following this analysis, the 'Winter Peak' temperature was set to 1°C for the West Midlands and East Midlands licence areas, and 2°C for the South Wales and South West licence areas. This aligns with National Grid guidance for Average Cold Spell conditions for the 'North' and 'South' of GB. The 'Winter Average' temperature was calculated to be approximately 11°C for all licence areas, but was capped at 5°C due to the limited input range. This is unlikely to reduce the accuracy of modelling because most investment for thermal capacity is driven by peak rather than average load.

Solution characterisation

59.26 There is a range of solutions that could be applied to the networks to provide additional headroom. The Transform model characterises these as:

- conventional: representing those options that are currently widely used;
- smart: representing the new technological or commercial solutions being developed.

59.27 Some of the smart solutions require additional investment such as communications infrastructure to allow their use. The Transform model characterises this investment as 'Enablers'.

59.28 We have reviewed the solutions in the Transform model, the year they are forecast to become available, their costs and associated real price effects. We have accepted EA Technology's view on smart solutions and enablers, except for two solutions that we have disabled until 2024 as they are not likely to be implemented during the RIIO-ED1 period. These are 'DSR - DNO to residential' and 'Local smart EV charging infrastructure-Intelligent control devices'. We have used our own costs and views on real price effects for conventional solutions.

Calculation engine

Investment strategy

59.29 The model includes three investment strategy options:

- business as usual – only chooses from conventional solutions to solve network problems;
- smart Incremental – chooses from conventional and smart solutions to solve network problems and 'buys' enablers as they are required for smart solutions;
- top down – chooses from conventional and smart solutions to solve network problems and 'buys' all enablers ahead of need so that infrastructure is in place to support smart solutions.

59.30 WPD has adopted the 'Smart Incremental' strategy for its primary modelling, but also uses the BAU strategy for comparison purposes.

Tipping points

59.31 The Transform model includes 'tipping point' functionality to model changing costs and benefits as some technologies are standardised and benefit from economies of scale.

59.32 This functionality is not fully developed and is targeted at higher levels of deployment of LCTs than we are forecasting as part of our best view. As a result, WPD has left the tipping point functionality of the model disabled, which is the default as provided by EA Technology.

Headroom

59.33 The model uses headroom as the key measure in determining when investment should take place and how much additional capacity is released by an intervention. Headroom is used as a common base to allow comparison of different constraints, including:

- thermal constraints;
- voltage constraints;
- fault level constraints.

59.34 Generic feeders have pre-set starting levels of headroom, while solutions increase (or decrease) headroom by a pre-set percentage when they are applied.

59.35 We have reviewed the pre-set headroom of feeders and made some changes where appropriate to individual licence areas. We have also reviewed the headroom released by solutions and accepted the default settings provided by EA Technology.

Treatment of Transform model output

Real price effects

59.36 Different types of solutions in the Transform model have different real price effects or 'cost curves' setting how their price changes over time. Ofgem's guidance on the Transform model states that the model should be run with real price effects (RPEs) included, but that the RPEs associated with the conventional solutions cost curve (Type 1 – high aluminium, steel, or copper content) should then be stripped out of the model results. This allows the model to take price movements into account in the cost-benefit assessment of solutions, but present costs on a consistent price base.

Re-profiling of results

59.37 The Transform model uses a small number of generic circuits to represent the thousands of unique circuits in a licence area. Therefore when a particular generic circuit reaches a headroom limit, it purchases the appropriate solution as many times as there are real circuits represented by that generic circuit. This results in unrealistically sporadic investment.

59.38 It is WPD's belief that LCT related reinforcement will require more gradual investment as real circuits reach their headrooms. To reflect this in WPD's 'best view' the output of the model has been re-profiled to mirror the forecast ramped uptake of LCTs.

Scaling of results

59.39 It is WPD's view that it is appropriate to scale the resulting expenditure from the Transform model for the following reasons:

- there is significant uncertainty around the future uptake of LCTs, their clustering and hence the impact of LCTs upon distribution networks;
- clustering has a significant impact on the investment needed and whilst our forecasts are based on a detailed analysis of property types and demographic information, other factors such as subsidy or support mechanism designs may result in differing clustering patterns emerging;
- there will be some overlap with asset replacement of HV and LV assets which is difficult to forecast accurately;
- a scaling down of the forecast investment provides a strong incentive on WPD to further innovate and seek the lowest cost solution;
- it is appropriate to share the risk of these uncertainties between WPD and customers.

59.40 As a result, the output from the Transform model for LCT reinforcement in the RIIO-ED1 period has been scaled down by 30% to determine the expenditure requirement in our Business Plan.

60 Appendix A2 – Cost benefit analysis (CBA)

60.1 We have carried out a number of CBAs covering the major areas of expenditure.

60.2 CBAs have been compiled into logical groups in related subject areas. For each group we have established a hyperlink that will access a folder on the WPD website. The folder contains all the CBAs for that group in line with the tables below.

60.3 There is also an index of all the CBAs which can be access by using this link http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/CBA-Index.aspx

Reinforcement

60.4 25 CBAs were completed on a wide range of different types of reinforcement schemes across the four WPD licence areas to test the cost effectiveness of the various reinforcement solutions employed.

60.5 The 25 CBAs covered schemes at 11kV, 33kV 66kV and 132kV with various reinforcement drivers including fault levels, voltage and both 'n-1' and 'n-2' load driven reinforcements.

60.6 A number of generic CBAs were also undertaken to evaluate WPD's proposals to increasingly apply a wide range of smart solutions to address reinforcement needs.

60.7 These support WPD's proposed approach and demonstrate that business as usual (application of conventional reinforcement solutions) only is not a cost effective approach.

60.8 The Reinforcement CBAs are listed in the table below.

CBA Reference	Description	Licence Area
B001_WPD_CBA_ReinforcementSchemes	Feckenham South 66kV Voltage Reinforcement_LR50012	West Midlands
B002_WPD_CBA_ReinforcementSchemes	Ironbridge 33kV Switchgear Replacement_Fault Level_LR80005	West Midlands
B003_WPD_CBA_ReinforcementSchemes	Madeley 33_11kV Substation Reinforcement_LR80003	West Midlands
B004_WPD_CBA_ReinforcementSchemes	Oldbury GSP Reinforcement_LR7017	West Midlands
B005_WPD_CBA_ReinforcementSchemes	Penn 132kV switchgear Replacement_Fault Level_LR7020	West Midlands
B006_WPD_CBA_ReinforcementSchemes	Shrewsbury-Ironbridge 132kV Group Reinforcement_LR80012	West Midlands
B007_WPD_CBA_ReinforcementSchemes	Leicester 132-33kV Substation Reinforcement_LR10135	East Midlands
B008_WPD_CBA_ReinforcementSchemes	Lincoln 132-11kV Substation Reinforcement_LR10018	East Midlands
B009_WPD_CBA_ReinforcementSchemes	Milton Keynes East BSP Reinforcement_LR10060	East Midlands
B010_WPD_CBA_ReinforcementSchemes	Rugby Central 11kV Reinforcement_LR10056	East Midlands
B011_WPD_CBA_ReinforcementSchemes	Staythorpe 132kV Switchgear Replacement_Fault Level_LR10022	East Midlands
B012_WPD_CBA_ReinforcementSchemes	Wigston Magna 132-11kV Substation Reinforcement_LR10136	East Midlands
B013_WPD_CBA_ReinforcementSchemes	Cardiff East-Cardiff North BSP Group Reinforcement_LRSWal25	South Wales
B014_WPD_CBA_ReinforcementSchemes	Mid-Wales 66kV Voltage Reinforcement _LRSWal28	South Wales
B015_WPD_CBA_ReinforcementSchemes	Cardiff South 11kV Switchgear	South

	Replacement_Fault level_LRSWal30	Wales
B016_WPD_CBA_ReinforcementSchemes	East Yelland BSP Reinforcement_LRSWe02	South West
B017_WPD_CBA_ReinforcementSchemes	Exeter City BSP Reinforcement_LRSWe03	South West
B018_WPD_CBA_ReinforcementSchemes	Exeter Main 132kV switchgear Replacement_Fault Level_LRSWe14	South West
B019_WPD_CBA_ReinforcementSmart	Eastern Avenue_FL limiter application_Fault Levels	West Midlands
B020_WPD_CBA_ReinforcementSmart	Leicester_FL limiter application_Fault Levels	East Midlands
B021_WPD_CBA_ReinforcementSmart	132kV OHL Circuit Reinforcement_DLR Application	All 4 Regions
B022_WPD_CBA_ReinforcementTransform	HV Temporary Meshing	All 4 Regions
B023_WPD_CBA_ReinforcementTransform	RTTR Distribution Tx -Defer replacement for 6 years	All 4 Regions
B024_WPD_CBA_ReinforcementTransform	BAU vs Smart Incremental-ED1 only	All 4 Regions
B025_WPD_CBA_ReinforcementTransform	BAU vs Smart Incremental	All 4 Regions

60.9 The results of the reinforcement CBAs demonstrate that WPD has adopted a wide range of solutions across the various types of reinforcement schemes, and in each case adopted the optimum solution after considering the merits of the alternative options.

60.10 Sensitivity analysis has been carried out on the adopted solutions to consider the impact of a cost increase. The increment in costs considered ranges from 10% right up to 30%. An increase of up to 100% has been applied on some of the proposed smart solutions to reflect the higher cost risks that they pose.

60.11 The results of the sensitivity analyses also support WPD's proposed solutions.

60.12 The CBA for reinforcement can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Reinforcement.aspx

Asset replacement

60.13 WPD's proposed asset replacement has been underpinned by extensive cost benefit analyses and a cross section of 64 CBAs were originally included as part of our Business Plan submission. The submission included 16 asset replacement CBAs for each of our DNOs. The CBAs that have been selected for submission on the basis of:

- ensuring that the CBAs covered a broad cross section of asset types. CBAs associated with the 32 most significant asset types have been included;
- the degree of significance as determined by the forecast expenditure. The Asset Replacement activities associated with these CBAs account for more than 80% of the forecast Asset Replacement expenditure of each DNO for RIIO-ED1.

60.14 A further 13 CBAs for asset replacement have been provided in response to specific supplementary questions from Ofgem.

60.15 A short commentary is provided with each CBA explaining the selected investment option.

60.16 Sensitivity analyses have been prepared in all instances.

60.17 The Asset Replacement CBAs are listed below and can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Asset-Replacement.aspx

Reference	Asset Type	Licence Area
C001_WPD_CBA_AssetReplacement	LV Main (OHL) Conductor	West Midlands
C002_WPD_CBA_AssetReplacement	LV Main (OHL) Conductor	South West
C003_WPD_CBA_AssetReplacement	LV Service (OHL)	South Wales
C004_WPD_CBA_AssetReplacement	LV Service (OHL)	South West
C005_WPD_CBA_AssetReplacement	LV Poles	West Midlands
C006_WPD_CBA_AssetReplacement	LV Poles	East Midlands
C007_WPD_CBA_AssetReplacement	LV Poles	South Wales
C008_WPD_CBA_AssetReplacement	LV Poles	South West
C009_WPD_CBA_AssetReplacement	LV Main (UG)*	West Midlands
C010_WPD_CBA_AssetReplacement	LV Main (UG)*	South West
C011_WPD_CBA_AssetReplacement	LV Service (UG)	East Midlands
C012_WPD_CBA_AssetReplacement	LV SGR at Subs	West Midlands
C013_WPD_CBA_AssetReplacement	LV SGR at Subs	South Wales
C014_WPD_CBA_AssetReplacement	LV UGB & LV Pillars (OD not at Substation)	West Midlands
C015_WPD_CBA_AssetReplacement	LV UGB & LV Pillars (OD not at Substation)	East Midlands
C016_WPD_CBA_AssetReplacement	6.6/11kV OHL (Conventional Conductor)	West Midlands
C017_WPD_CBA_AssetReplacement	6.6/11kV OHL (Conventional Conductor)	South Wales
C018_WPD_CBA_AssetReplacement	6.6/11kV OHL (Conventional Conductor)	South West
C019_WPD_CBA_AssetReplacement	6.6/11kV Poles	West Midlands
C020_WPD_CBA_AssetReplacement	6.6/11kV Poles	East Midlands
C021_WPD_CBA_AssetReplacement	6.6/11kV Poles	South Wales
C022_WPD_CBA_AssetReplacement	6.6/11kV Poles	South West
C023_WPD_CBA_AssetReplacement	6.6/11kV UG Cable	East Midlands
C024_WPD_CBA_AssetReplacement	6.6/11kV UG Cable	South Wales
C025_WPD_CBA_AssetReplacement	6.6/11kV CB (GM) Primary	West Midlands
C026_WPD_CBA_AssetReplacement	6.6/11kV CB (GM) Primary	East Midlands
C027_WPD_CBA_AssetReplacement	6.6/11kV CB (GM) Primary	South West
C028_WPD_CBA_AssetReplacement	HV GM SWGR (secondary) *	West Midlands
C029_WPD_CBA_AssetReplacement	HV GM SWGR (secondary) *	East Midlands
C030_WPD_CBA_AssetReplacement	HV GM SWGR (secondary) *	South Wales
C031_WPD_CBA_AssetReplacement	HV GM SWGR (secondary)	South West
C032_WPD_CBA_AssetReplacement	6.6/11kV Switchgear - Other (PM)	East Midlands
C033_WPD_CBA_AssetReplacement	6.6/11kV Transformer (PM)	South Wales
C034_WPD_CBA_AssetReplacement	6.6/11kV Transformer (PM)	South West
C035_WPD_CBA_AssetReplacement	6.6/11kV Transformer (GM)	West Midlands

C036_WPD_CBA_AssetReplacement	6.6/11kV Transformer (GM)	East Midlands
C037_WPD_CBA_AssetReplacement	6.6/11kV Transformer (GM)	South Wales
C038_WPD_CBA_AssetReplacement	33kV OHL (Pole Line) Conductor	South Wales
C039_WPD_CBA_AssetReplacement	33kV OHL (Pole Line) Conductor	South West
C040_WPD_CBA_AssetReplacement	EHV Poles	West Midlands
C041_WPD_CBA_AssetReplacement	EHV Poles	South Wales
C042_WPD_CBA_AssetReplacement	EHV Poles	South West
C043_WPD_CBA_AssetReplacement	66kV OHL (Pole Line) Conductor	South Wales
C044_WPD_CBA_AssetReplacement	33kV UG Cable (Non Pressurised)	East Midlands
C045_WPD_CBA_AssetReplacement	33kV UG Cable (Non Pressurised)	South Wales
C046_WPD_CBA_AssetReplacement	33kV UG Cable (Oil)	South West
C047_WPD_CBA_AssetReplacement	33kV UG Cable (Gas)	South West
C048_WPD_CBA_AssetReplacement	33kV CB (Air Insulated Busbars)(ID) (GM)	East Midlands
C049_WPD_CBA_AssetReplacement	33kV CB (Air Insulated Busbars)(ID) (GM)	South Wales
C050_WPD_CBA_AssetReplacement	33kV CB (Air Insulated Busbars)(OD) (GM)	South West
C051_WPD_CBA_AssetReplacement	33kV Switchgear - Other	South West
C052_WPD_CBA_AssetReplacement	33kV Transformer (GM)	East Midlands
C053_WPD_CBA_AssetReplacement	33kV Transformer (GM)	South Wales
C054_WPD_CBA_AssetReplacement	33kV Transformer (GM)	South West
C055_WPD_CBA_AssetReplacement	132kV OHL (Tower Line) Conductor	West Midlands
C056_WPD_CBA_AssetReplacement	132kV OHL (Tower Line) Conductor	East Midlands
C057_WPD_CBA_AssetReplacement	132kV Fittings	East Midlands
C058_WPD_CBA_AssetReplacement	132kV UG Cable (Oil)	West Midlands
C059_WPD_CBA_AssetReplacement	132kV UG Cable (Gas)	West Midlands
C060_WPD_CBA_AssetReplacement	132kV CB (Air Insulated Busbars)(OD) (GM)	East Midlands
C061_WPD_CBA_AssetReplacement	132kV Switchgear - Other	West Midlands
C062_WPD_CBA_AssetReplacement	132kV Transformer	West Midlands
C063_WPD_CBA_AssetReplacement	132kV Transformer	East Midlands
C064_WPD_CBA_AssetReplacement	132kV Transformer	South Wales
WPD-RIIOED1-Ph1-131 CBA West Midlands	33kV Overhead Line Fittings	West Midlands
WPD-RIIOED1-Ph1-131 CBA East Midlands	33kV Overhead Line Fittings	East Midlands
WPD-RIIOED1-Ph1-131 CBA South Wales	33kV Overhead Line Fittings	South Wales
WPD-RIIOED1-Ph1-131 CBA South West	33kV Overhead Line Fittings	South West
WPD-RIIOED1-Ph1-132 CBA West Midlands	66kV Overhead Line Fittings	West Midlands
WPD-RIIOED1-Ph1-132 CBA South Wales	66kV Overhead Line Fittings	South Wales
WPD-RIIOED1-Ph1-134 CBA	33kV CB OD (Air Insulated Busbars)	West Midlands
WPD-RIIOED1-Ph1-135 CBA South Wales	33kV Switch (GM)	South Wales
WPD-RIIOED1-Ph1-135 CBA South West	33kV Switch (GM)	South West
WPD-RIIOED1-Ph1-136 CBA West Midlands	33kV Switchgear Other	West Midlands
WPD-RIIOED1-Ph1-136 CBA East Midlands	33kV Switchgear Other	East Midlands
WPD-RIIOED1-Ph1-139 CBA West Midlands	132kV Overhead Line Fittings	West Midlands
WPD-RIIOED1-Ph1-141 CBA	132kV CB OD (Air Insulated Busbars)	West Midlands

* Where the asset installed is a different asset type to the asset removed, CBAS have been prepared on the basis of an aggregation of asset types. For example, three types of LV underground cable are removed but only one type installed.

Diversions and Conversion of Wayleaves to Easements

60.18 In order to confirm the suitability of our overall approach to injurious affection claims, wayleave terminations and requests for diversions, CBAs have been completed on a range of typical schemes, each assessing the different solutions available.

CBA Reference	Description
A001_WPD_CBA_Diversions&Easements A002_ WPD_CBA_Diversions&Easements A003_ WPD_CBA_Diversions&Easements A004_ WPD_CBA_Diversions&Easements	132kV overhead line across a development site
A005_WPD_CBA_Diversions&Easements A006_WPD_CBA_Diversions&Easements A007_WPD_CBA_Diversions&Easements A008_WPD_CBA_Diversions&Easements	132kV overhead line across residential areas
A009_WPD_CBA_Diversions&Easements A010_WPD_CBA_Diversions&Easements	EHV overhead line across a development site
A011_WPD_CBA_Diversions&Easements A012_WPD_CBA_Diversions&Easements	EHV overhead line across residential areas
A013_WPD_CBA_Diversions&Easements A014_WPD_CBA_Diversions&Easements	HV overhead line diversion/injurious affection claim
A015_WPD_CBA_Diversions&Easements A016_WPD_CBA_Diversions&Easements	LV overhead line diversion/injurious affection claim

60.19 The adopted options vary between CBAs, confirming WPD's pragmatic approach where the chosen solution will be dependent upon the situation, considering customer requirements, likely costs and the long term impact.

60.20 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Diversion-and-Easements.aspx

Operational IT and Telecoms

60.21 CBA has been completed to assess the suitability of replacement cycles for Primary SCADA trunk communications equipment.

CBA Reference	Description
D001_WPD_CBA_OpsIT&T	Replacement intervals for Primary SCADA communications equipment

60.22 Following the CBA analysis, we have extended the time interval for replacement of Primary SCADA communications equipment from eight years to twelve years.

60.23 The CBA can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Operational-IT-T.aspx

BT 21st Century (BT 21CN)

60.24 CBAs were completed to assess options for replacing the protection communications circuits affected by the BT 21CN programme.

CBA Reference	Description
D002_WPD_CBA_BT21CN	Options for replacing BT circuits in WPD West Midlands
D003_WPD_CBA_BT21CN	Options for replacing BT circuits in WPD East Midlands

60.25 The CBAs demonstrate the appropriateness of our approach to replacing the circuits with predominantly a combination of microwave and UHF links, and utilising fibre optic circuits where microwave and UHF links are unsuitable.

60.26 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/BT21CN.aspx

Quality of Supply

60.27 WPD are proposing to invest in order to reduce number and duration of unplanned supply interruptions to customers. Cost Benefit Analyses has been undertaken in order to demonstrate that the proposed investment is positive.

60.28 The CBAwas undertaken in order to compare the quality of supply experienced by customers with and without investment during ED1 targeted at reducing the number and duration of unplanned supply interruptions to customers.

60.29 These CBAs demonstrate that the proposed investment is justified for all four DNOs as the Net Present Values (NPV) are positive with a study period of 16 years. Sensitivity analyses have revealed that the NPV of the proposed investment in South Wales is essentially zero with a study period of 10 years. However, the effectiveness of the proposed investment is at least 25 years.

60.30 The completed CBAs are identified in the table below and can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/QoS.aspx

CBA Reference	Description
E001_WPD_CBA_QOS	Reducing number and duration of unplanned supply interruptions to customers in West Midlands
E002_WPD_CBA_QOS	Reducing number and duration of unplanned supply interruptions to customers in East Midlands
E003_WPD_CBA_QOS	Reducing number and duration of unplanned supply interruptions to customers in South Wales
E004_WPD_CBA_QOS	Reducing number and duration of unplanned supply interruptions to customers in South West

Protecting equipment from flooding risk

60.31 CBAs were completed to assess flood protection options at a number of sites.

CBA Reference	Description
F001_WPD_CBA_Flood	Flood Defence Solutions at a 132/11kV Substation
F002_WPD_CBA_Flood	Flood Defence Solutions at a 132/33kV Substation
F003_WPD_CBA_Flood	Flood Defence Solutions at a 33/11kV Substation
F004_WPD_CBA_Flood	Flood Defence Solutions at a 33/11kV Substation

60.32 The CBAs demonstrated that our general policy of protecting substations by utilising specific protection methods to target assets at risk is the most cost effective solution.

60.33 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Flood-Defences.aspx

Environment

60.34 CBAs have been completed for a range on environmental investment areas:

CBA Reference	Description
G001_WPD_CBA_PFT	Use of PFT in cables - short cable length
G002_WPD_CBA_PFT	Use of PFT in cables - longer cable length
G003_WPD_CBA_LowLossTx	Installation of lower loss 11kV transformers
G004_WPD_CBA_LowLossCable	Installation of uprated cable to reduce losses
G005_WPD_CBA_LowLossPMT_Mar14	Upsizing pole mounted transformers West Midlands
G006_WPD_CBA_LowLossPMT_Mar14	Upsizing pole mounted transformers East Midlands
G007_WPD_CBA_LowLossPMT_Mar14	Upsizing pole mounted transformers South Wales
G008_WPD_CBA_LowLossPMT_Mar14	Upsizing pole mounted transformers South West
G009_WPD_CBA_LowLossHVCable_Mar14	Upsizing HV cable (185mm to 300mm) West Midlands
G010_WPD_CBA_LowLossHVCable_Mar14	Upsizing HV cable (185mm to 300mm) East Midlands
G011_WPD_CBA_LowLossHVCable_Mar14	Upsizing HV cable (185mm to 300mm) South Wales
G012_WPD_CBA_LowLossHVCable_Mar14	Upsizing HV cable (185mm to 300mm) South West
H001_WPD_CBA_OverSizeTx	Over-sizing of transformers in LCT hot spots
H002_WPD_CBA_OverSizeCable	Over-sizing of cable in LCT hot spots

60.35 The following conclusions can be drawn from the CBAs:

- the addition of PFT can be very cost effective mainly due to the reduced repair costs as a result of easier and quicker fault location;
- the losses saving from introducing lower loss transformer units does not outweigh the incremental cost of these units;
- as for transformers, the reduction in losses alone does not deliver benefits above the additional cost incurred for installing larger cables;
- targeted installation of higher rated assets in low carbon technology 'hot spots' is effective in avoiding future reinforcement costs.

60.36 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Environmental.aspx

Black Start

60.37 A CBA has been completed to show the cost effectiveness of establishing Black Start resilience of protection / tripping batteries by installing load disconnection schemes.

CBA Reference	Description
I001_WPD_CBA_BlackStart	Options for establishing Black Start resilience of protection/ tripping batteries

60.38 The CBA can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Black-Start.aspx

Inspections and maintenance

60.39 In order to demonstrate the overall cost effectiveness of WPD's approach to inspection and maintenance of network assets strategy, CBAs were completed to evaluate options for two recently revised programmes:

- expanding maintenance of Primary transformers to include oil regeneration;
- maintenance of distribution voltage ring main units – interval and content.

CBA Reference	Description
J001_WPD_CBA_I&M	Oil Regeneration of a 132kV Transformer
J002_WPD_CBA_I&M	Oil Regeneration of a 33kV Transformer
J003_WPD_CBA_I&M	Maintenance intervals for 11kV Ring Main Units
J004_WPD_CBA_I&M	Maintenance intervals for 11kV Ring Main Units
J005_WPD_CBA_I&M	Maintenance content for 11kV Ring Main Units
J006_WPD_CBA_I&M	Maintenance content for 11kV Ring Main Units

60.40 The results of these CBAs support our overall approach towards inspection and maintenance.

60.41 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/I-M.aspx

Tree Cutting

60.42 CBAs have been completed to evaluate the time interval for routine LV tree clearance.

CBA Reference	Description
K001_WPD_CBA_Trees	LV tree clearance intervals in WPD South West
K002_WPD_CBA_Trees	LV tree clearance intervals in WPD South Wales

60.43 WPD's current policy is to clear trees on a seven year cycle. There are currently additional costs associated with revisits to maintain clearance during this interval. The CBAs demonstrate that shortening the cycle to five years would remove the need for the more expensive revisits and is therefore more cost effective.

60.44 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Trees.aspx

Vehicles

60.45 CBAs have been completed to assess the following areas:

- operational vehicles: direct purchase or lease;
- operational vehicles: insourced or outsourced maintenance;
- insourced or outsourced fleet management.

CBA Reference	Description
L001_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD West Midlands: Purchase or Lease
L002_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD East Midlands: Purchase or Lease
L003_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD South Wales: Purchase or Lease
L004_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD South West: Purchase or Lease
L005_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD West Midlands: Insourced or Outsourced Maintenance
L006_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD East Midlands: Insourced or Outsourced Maintenance
L007_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD South Wales: Insourced or Outsourced Maintenance
L008_WPD_CBA_Vehicles	Non-Specialist Operational Vehicles in WPD South West: Insourced or Outsourced Maintenance
L009_WPD_CBA_Vehicles	Fleet management: Insource or Outsource

60.46 The results of these CBAs demonstrate the overall cost effectiveness of WPD's strategy towards management of operational vehicles:

- direct purchase of vehicles is cheaper than lease;
- insourced maintenance is cost effective for WPD West Midlands, WPD East Midlands and WPD South West. However, due to the availability of suitable contracts in this area only, outsourcing of maintenance is the preferred option for South Wales;
- insourced fleet management is preferable to outsourcing the same activity.

60.47 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Vehicles.aspx

Smart meters

60.48 CBAs were completed to assess options for purchase and use of Smart Meter data from the Data Communications Company (DCC).

CBA Reference	Description
M001_WPD_CBA_SmartMeters	Comparison of Smart Meter Data Options in WPD West Midlands
M002_WPD_CBA_SmartMeters	Comparison of Smart Meter Data Options in WPD East Midlands
M003_WPD_CBA_SmartMeters	Comparison of Smart Meter Data Options in WPD South Wales
M004_WPD_CBA_SmartMeters	Comparison of Smart Meter Data Options in WPD South West

60.49 Comparison of the options for purchase of different data quantities demonstrates that WPD's proposals for Smart Meter data provides the most appropriate balance of cost and benefits.

60.50 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Smart-Meters.aspx

Non-operational IT and Telecoms

60.51 In order to demonstrate the overall cost effectiveness of WPD's non-operational IT and telecoms strategy, CBAs were completed to evaluate options for a significant element of the IT and telecoms function, namely the routine replacement of PCs and printers.

CBA Reference	Description
N001_WPD_CBA_NonOpIT&T	Routine refresh of IT hardware in WPD West Midlands
N002_WPD_CBA_NonOpIT&T	Routine refresh of IT hardware in WPD East Midlands
N003_WPD_CBA_NonOpIT&T	Routine refresh of IT hardware in WPD South Wales
N004_WPD_CBA_NonOpIT&T	Routine refresh of IT hardware in WPD South West

60.52 WPD replace PCs and printers at four –year intervals. The CBAs for extending this interval demonstrate that any capital expenditure benefit would be more than outweighed by the additional operational support required to maintain levels of service.

60.53 The CBAs can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Non-Op-IT-T.aspx

Non-operational capital expenditure - property

60.54 Buro Happold are a leading international professional services firm that provides engineering consultancy, design, planning, project management and consulting services for all aspect of buildings, infrastructure and the environment. WPD engaged Buro Happold to evaluate WPD's property portfolio in order to assess investment requirements to ensure that the properties remain in good condition. In addition, Buro Happold specifically investigated the scope for replacing heating and cooling systems and lighting systems with low energy variants when the existing systems have reached the end of their useful lives.

60.55 Cost Benefit Analysis (CBA) has been undertaken in order to compare:

- The cost of replacing either the heating and cooling and lighting system or lighting system on a "like for like" basis;
- The cost of replacing either the heating and cooling and lighting system or lighting system with a low energy variant and the consequential energy savings.

60.56 These CBAs have demonstrated that it is not cost effective to replace either Heating and Cooling systems or lighting systems with low energy variants when the existing systems have reached the end of their useful lives. The Net Present Values of the CBAs are not positive during the lifetime of the systems.

60.57 The completed CBAs are identified in the table below and can be found at http://www.westernpower.co.uk/docs/About-us/Stakeholder-information/Our-future-business-plan/Cost-Benefit-Analysis/Non-Op-Property.aspx

CBA Reference	Description
P001_WPD_CBA_NonOpProperty	Replacement of Lighting Systems With Low Energy Variants
P002_WPD_CBA_NonOpProperty	Replacement of Heating and Cooling Systems With Low Energy Variants

61 Appendix A3 – Summary core cost tables including pensions

WPD Total

WPD Total - Core costs funded through DUoS including pensions											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-6.2	6.7	6.1	6.0	6.5	6.7	7.1	6.9	7.0	7.3	53.6
General Network Reinforcement	54.8	46.4	73.0	67.7	38.9	49.4	39.9	34.9	38.7	28.5	371.0
Reinforcement for Low Carbon Technologies	0.0	25.1	4.7	4.7	9.6	18.6	27.6	36.5	45.3	53.9	200.8
TOTAL - Reinforcement of the Network	**48.6**	**78.2**	**83.8**	**78.4**	**55.0**	**74.7**	**74.6**	**78.3**	**91.0**	**89.7**	**625.4**
Asset Replacement	197.8	209.2	210.9	211.6	209.4	210.2	209.2	208.5	207.9	206.2	1673.9
Diversions	26.2	39.9	54.4	52.8	38.0	38.3	29.2	33.7	34.1	39.0	319.5
Quality of Supply (reducing power cuts)	13.0	3.8	5.2	5.1	5.1	5.0	5.0	4.9	0.0	0.0	30.3
Improving service for remote ("worst served") customers	0.3	0.4	0.0	1.6	1.6	0.0	0.0	0.0	0.0	0.0	3.2
Real Time Control Systems and Telecommunications	14.4	12.3	19.4	11.6	24.4	12.9	6.6	8.8	3.7	10.8	98.2
Protecting equipment from flooding risk	4.2	1.9	5.1	4.0	2.3	0.4	0.7	1.3	0.5	0.7	15.0
Enhancing site security, ESQCR and other legal requirements	19.3	12.4	16.6	15.8	15.6	10.4	10.4	10.1	10.0	9.9	98.8
Reducing oil and gas leaks from equipment	4.9	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	13.6
Undergrounding in National Parks and AONBs	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.0
Other Network Investment	10.0	3.9	8.4	9.5	3.2	3.5	2.6	1.5	1.5	0.8	31.0
TOTAL - Non-Load Network Investment	**291.2**	**286.4**	**322.7**	**314.7**	**302.3**	**283.4**	**266.4**	**271.5**	**260.4**	**270.1**	**2291.5**
Inspection, maintenance and routine tree cutting	79.0	51.4	53.2	52.5	52.1	51.5	50.8	50.9	50.2	49.8	411.0
Tree clearance to improve network resilience to severe weather	3.8	7.6	7.8	7.7	7.7	7.7	7.4	7.4	7.4	7.4	60.5
Responding to and repairing faults	97.5	94.4	99.7	98.1	96.6	95.0	93.3	92.0	90.9	89.8	755.4
Other network operating costs	8.1	8.4	8.7	8.6	8.4	8.4	8.4	8.2	8.1	8.1	66.9
TOTAL - Network Operating Costs	**188.4**	**161.7**	**169.4**	**166.9**	**164.8**	**162.6**	**159.9**	**158.5**	**156.6**	**155.1**	**1293.8**
Engineering management	**148.5**	**132.4**	**136.2**	**135.4**	**133.5**	**132.3**	**131.3**	**131.0**	**130.0**	**129.1**	**1058.8**
Corporate activities	**77.9**	**39.8**	**41.6**	**41.3**	**40.5**	**39.9**	**39.4**	**39.2**	**38.6**	**38.2**	**318.7**
Workforce renewal	**21.1**	**23.2**	**22.5**	**23.0**	**23.4**	**23.3**	**23.3**	**23.3**	**23.3**	**23.3**	**185.4**
Vehicles, IT, Property & Engineering Equipment	**110.6**	**101.0**	**107.0**	**108.3**	**91.8**	**102.3**	**101.7**	**102.0**	**102.4**	**92.4**	**807.9**
TOTAL CORE COSTS	**886.3**	**822.7**	**883.2**	**868.0**	**811.3**	**818.5**	**796.6**	**803.8**	**802.3**	**797.9**	**6581.5**

West Midlands

West Midlands - Core costs funded through DUoS including pensions											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-2.2	2.3	2.1	2.1	2.3	2.4	2.4	2.4	2.4	2.5	18.6
General Network Reinforcement	26.7	16.7	19.7	20.3	17.5	18.6	18.0	12.4	13.1	13.9	133.5
Reinforcement for Low Carbon Technologies	0.0	7.0	1.3	1.3	2.7	5.2	7.7	10.1	12.6	15.0	55.7
TOTAL - Reinforcement of the Network	**24.5**	**26.0**	**23.1**	**23.7**	**22.5**	**26.2**	**28.1**	**24.9**	**28.1**	**31.4**	**207.8**
Asset Replacement	64.1	63.9	64.7	65.3	64.1	64.3	63.8	63.4	63.1	62.4	511.1
Diversions	9.6	11.0	9.7	9.0	8.7	9.4	9.7	14.2	13.5	13.5	87.7
Quality of Supply (reducing power cuts)	3.8	2.0	2.7	2.6	2.6	2.6	2.6	2.5	0.0	0.0	15.6
Improving service for remote ("worst served") customers	0.0	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	5.0	3.1	5.7	3.9	6.8	1.2	1.7	1.9	0.8	2.5	24.5
Protecting equipment from flooding risk	0.6	0.2	0.0	0.1	0.2	0.1	0.2	0.4	0.1	0.1	1.2
Enhancing site security, ESQCR and other legal requirements	5.2	3.1	3.3	3.2	3.2	3.2	3.1	3.1	3.0	3.0	25.1
Reducing oil and gas leaks from equipment	1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4.0
Undergrounding in National Parks and AONBs	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Other Network Investment	1.1	1.2	3.2	3.4	0.7	0.8	0.6	0.3	0.3	0.2	9.5
TOTAL - Non-Load Network Investment	**91.1**	**85.3**	**90.1**	**88.8**	**87.6**	**82.4**	**82.50**	**86.6**	**81.6**	**82.5**	**682.1**
Inspection, maintenance and routine tree cutting	27.0	14.5	15.0	14.8	14.7	14.5	14.4	14.4	14.2	14.1	116.1
Tree clearance to improve network resilience to severe weather	1.3	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	15.6
Responding to and repairing faults	30.0	27.5	29.1	28.6	28.2	27.7	27.2	26.8	26.4	26.1	220.1
Other network operating costs	**2.4**	2.5	2.6	2.6	2.5	2.5	2.5	2.4	2.4	2.4	19.9
TOTAL - Network Operating Costs	**60.7**	**46.5**	**48.7**	**48.0**	**47.4**	**46.7**	**46.0**	**45.5**	**44.9**	**44.5**	**371.7**
Engineering management	**48.7**	**39.6**	**40.8**	**40.5**	**39.9**	**39.5**	**39.40**	**39.2**	**38.9**	**38.7**	**316.9**
Corporate activities	**32.1**	**11.6**	**12.1**	**12.0**	**11.8**	**11.6**	**11.50**	**11.4**	**11.2**	**11.1**	**92.7**
Workforce renewal	**4.8**	**6.3**	**6.1**	**6.2**	**6.3**	**6.3**	**6.30**	**6.3**	**6.3**	**6.3**	**50.1**
Vehicles, IT, Property & Engineering Equipment	**35.5**	**30.0**	**32.4**	**31.7**	**25.4**	**28.3**	**31.0**	**32.7**	**31.7**	**27.1**	**240.3**
TOTAL CORE COSTS	**297.4**	**245.2**	**253.3**	**250.9**	**240.9**	**241.0**	**244.8**	**246.6**	**242.7**	**241.6**	**1961.7**

East Midlands

East Midlands - Core costs funded through DUoS including pensions											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-3.0	2.2	2.0	2.0	2.1	2.2	2.2	2.4	2.3	2.3	17.5
General Network Reinforcement	20.3	21.4	47.2	40.5	13.8	15.6	9.6	12.8	20.8	11.1	171.4
Reinforcement for Low Carbon Technologies	0.0	11.0	2.1	2.1	4.2	8.2	12.1	16.0	19.9	23.7	88.3
TOTAL - Reinforcement of the Network	**17.3**	**34.6**	**51.3**	**44.6**	**20.1**	**26.0**	**23.9**	**31.2**	**43.0**	**37.1**	**277.2**
Asset Replacement	54.8	53.6	54.1	53.9	53.6	53.5	53.2	53.8	53.6	53.4	429.1
Diversions	9.1	10.7	13.5	13.1	12.8	12.6	8.4	8.3	8.4	8.4	85.5
Quality of Supply (reducing power cuts)	3.8	1.1	1.5	1.5	1.5	1.4	1.4	1.4	0.0	0.0	8.7
Improving service for remote ("worst served") customers	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2
Real Time Control Systems and Telecommunications	5.8	3.2	6.0	4.0	6.9	1.3	1.9	2.0	0.8	2.6	25.5
Protecting equipment from flooding risk	1.5	0.6	1.3	1.7	0.9	0.1	0.2	0.4	0.2	0.2	5.0
Enhancing site security, ESQCR and other legal requirements	4.0	3.3	3.4	3.4	3.3	3.3	3.3	3.2	3.2	3.1	26.2
Reducing oil and gas leaks from equipment	1.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	4.8
Undergrounding in National Parks and AONBs	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8
Other Network Investment	7.8	2.0	4.9	5.3	1.4	1.5	1.1	0.6	0.6	0.3	15.7
TOTAL - Non-Load Network Investment	**88.9**	**75.2**	**85.4**	**83.7**	**81.2**	**74.4**	**70.2**	**70.4**	**67.5**	**68.7**	**601.5**
Inspection, maintenance and routine tree cutting	22.0	12.2	12.6	12.4	12.3	12.2	12.0	12.1	11.9	11.8	97.3
Tree clearance to improve network resilience to severe weather	0.7	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.7	14.0
Responding to and repairing faults	31.7	31.5	33.1	32.6	32.2	31.7	31.2	30.8	30.5	30.1	252.2
Other network operating costs	**2.8**	3.0	3.1	3.0	3.0	3.0	3.0	2.9	2.9	2.9	23.8
TOTAL - Network Operating Costs	**57.2**	**48.4**	**50.6**	**49.8**	**49.3**	**48.7**	**47.9**	**47.5**	**47.0**	**46.5**	**387.3**
Engineering management	**48.8**	**40.3**	**41.8**	**41.4**	**40.7**	**40.2**	**40.0**	**39.6**	**39.5**	**39.1**	**322.3**
Corporate activities	**27.5**	**11.1**	**11.7**	**11.6**	**11.3**	**11.1**	**11.0**	**10.9**	**10.8**	**10.6**	**89.0**
Workforce renewal	**5.1**	**6.3**	**6.1**	**6.2**	**6.3**	**6.3**	**6.3**	**6.3**	**6.3**	**6.3**	**50.1**
Vehicles, IT, Property & Engineering Equipment	**35.7**	**29.6**	**30.2**	**30.2**	**26.5**	**29.2**	**30.6**	**30.6**	**32.1**	**27.6**	**237.0**
TOTAL CORE COSTS	**280.5**	**245.5**	**277.1**	**267.5**	**235.4**	**235.9**	**229.9**	**236.5**	**246.2**	**235.9**	**1964.3**

South Wales

South Wales - Core costs funded through DUoS including pensions											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-0.3	1.1	1.0	0.9	1.1	1.0	1.3	1.1	1.1	1.3	8.8
General Network Reinforcement	3.8	3.9	2.6	2.7	3.0	7.6	6.1	5.5	2.2	1.5	31.2
Reinforcement for Low Carbon Technologies	0.0	1.4	0.3	0.3	0.5	1.0	1.5	2.1	2.6	3.0	11.3
TOTAL - Reinforcement of the Network	**3.5**	**6.4**	**3.9**	**3.9**	**4.6**	**9.6**	**8.9**	**8.7**	**5.9**	**5.8**	**51.3**
Asset Replacement	32.1	36.3	35.6	36.4	36.0	37.2	36.8	36.1	36.5	36.1	290.7
Diversions	3.1	8.4	17.6	17.3	8.9	8.8	3.6	3.6	3.7	3.8	67.3
Quality of Supply (reducing power cuts)	2.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	3.0
Improving service for remote ("worst served") customers	0.2	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	1.3	3.0	3.8	2.0	5.7	5.2	1.3	2.2	0.9	2.7	23.8
Protecting equipment from flooding risk	1.3	1.0	3.7	2.1	1.1	0.1	0.2	0.1	0.1	0.3	7.7
Enhancing site security, ESQCR and other legal requirements	3.4	1.4	1.5	1.4	1.4	1.3	1.4	1.3	1.3	1.3	10.9
Reducing oil and gas leaks from equipment	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Undergrounding in National Parks and AONBs	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.6
Other Network Investment	0.9	0.3	0.1	0.3	0.40	0.4	0.3	0.2	0.2	0.1	2.0
TOTAL - Non-Load Network Investment	**45.3**	**51.3**	**63.3**	**61.0**	**55.0**	**54.0**	**44.6**	**44.5**	**43.2**	**44.8**	**410.4**
Inspection, maintenance and routine tree cutting	13.2	10.3	10.7	10.6	10.5	10.4	10.2	10.2	10.1	10.0	82.7
Tree clearance to improve network resilience to severe weather	1.0	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	12.9
Responding to and repairing faults	12.5	12.6	13.4	13.2	12.9	12.7	12.4	12.2	12.1	12.0	100.9
Other network operating costs	**1.1**	1.1	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	9.0
TOTAL - Network Operating Costs	**27.8**	**25.7**	**27.0**	**26.6**	**26.1**	**25.8**	**25.3**	**25.1**	**24.9**	**24.7**	**205.5**
Engineering management	**21.5**	**21.3**	**22.0**	**22.0**	**21.5**	**21.5**	**21.1**	**21.1**	**20.9**	**20.6**	**170.7**
Corporate activities	**7.3**	**6.8**	**7.1**	**7.1**	**6.9**	**6.9**	**6.7**	**6.7**	**6.6**	**6.5**	**54.5**
Workforce renewal	**4.6**	**4.6**	**4.4**	**4.6**	**4.7**	**4.6**	**4.6**	**4.6**	**4.6**	**4.6**	**36.7**
Vehicles, IT, Property & Engineering Equipment	**15.5**	**15.5**	**15.8**	**17.0**	**15.0**	**17.7**	**15.5**	**14.8**	**14.2**	**13.9**	**123.9**
TOTAL CORE COSTS	**125.5**	**131.6**	**143.5**	**142.2**	**133.8**	**140.1**	**126.7**	**125.5**	**120.3**	**120.9**	**1053.0**

South West

South West - Core costs funded through DUoS including pensions											
Costs excluding RPEs & pensions, including efficiency (£m at 2012/13 prices)	**Average per year in DPCR5**	**Average per year in RIIO-ED1**	**Spend profile in RIIO ED1**								**Total RIIO-ED1**
			2015/16	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	
Customer Related Reinforcement	-0.7	1.1	1.0	1.0	1.0	1.1	1.2	1.0	1.2	1.2	8.7
General Network Reinforcement	4.0	4.4	3.5	4.2	4.6	7.6	6.2	4.2	2.6	2.0	34.9
Reinforcement for Low Carbon Technologies	0.0	5.7	1.1	1.1	2.2	4.2	6.3	8.3	10.2	12.2	45.5
TOTAL - Reinforcement of the Network	**3.3**	**11.1**	**5.6**	**6.3**	**7.8**	**12.9**	**13.7**	**13.5**	**14.0**	**15.4**	**89.1**
Asset Replacement	46.8	55.4	56.5	56.0	55.7	55.2	55.4	55.2	54.7	54.3	443.0
Diversions	4.4	9.9	13.6	13.4	7.6	7.5	7.5	7.6	8.5	13.3	79.0
Quality of Supply (reducing power cuts)	2.9	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	3.0
Improving service for remote ("worst served") customers	0.1	0.1	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	1.0
Real Time Control Systems and Telecommunications	2.3	3.1	3.9	1.7	5.0	5.2	1.7	2.7	1.2	3.0	24.4
Protecting equipment from flooding risk	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	1.1
Enhancing site security, ESQCR and other legal requirements	6.7	4.6	8.4	7.8	7.7	2.6	2.6	2.5	2.5	2.5	36.6
Reducing oil and gas leaks from equipment	1.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.4
Undergrounding in National Parks and AONBs	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	3.2
Other Network Investment	0.2	0.5	0.2	0.5	0.7	0.8	0.6	0.4	0.4	0.2	3.8
TOTAL - Non-Load Network Investment	**65.9**	**74.7**	**83.9**	**81.2**	**78.5**	**72.6**	**69.1**	**70.0**	**68.1**	**74.1**	**597.5**
Inspection, maintenance and routine tree cutting	16.8	14.4	14.9	14.7	14.6	14.4	14.2	14.2	14.0	13.9	114.9
Tree clearance to improve network resilience to severe weather	0.8	2.3	2.3	2.3	2.3	2.3	2.2	2.2	2.2	2.2	18.0
Responding to and repairing faults	23.3	22.8	24.1	23.7	23.3	22.9	22.5	22.2	21.9	21.6	182.2
Other network operating costs	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	14.2
TOTAL - Network Operating Costs	**42.7**	**41.2**	**43.1**	**42.5**	**42.0**	**41.4**	**40.7**	**40.4**	**39.8**	**39.4**	**329.3**
Engineering management	**29.5**	**31.1**	**31.6**	**31.5**	**31.4**	**31.1**	**30.8**	**31.1**	**30.7**	**30.7**	**248.9**
Corporate activities	**11.0**	**10.3**	**10.7**	**10.6**	**10.5**	**10.3**	**10.2**	**10.2**	**10.0**	**10.0**	**82.5**
Workforce renewal	**6.6**	**6.1**	**5.9**	**6.0**	**6.1**	**6.1**	**6.1**	**6.1**	**6.1**	**6.1**	**48.5**
Vehicles, IT, Property & Engineering Equipment	**23.9**	**25.8**	**28.6**	**29.4**	**24.9**	**27.1**	**24.6**	**23.9**	**24.4**	**23.8**	**206.7**
TOTAL CORE COSTS	**182.9**	**200.3**	**209.4**	**207.5**	**201.2**	**201.5**	**195.2**	**195.2**	**193.1**	**199.5**	**1602.5**