Environment Report 2016/17
Detailed Commentary Associated with the Annexes

Overview

This file contains the commentary associated with Annexes 1 to 7 to the Environment and Innovation 2016/17 report. In the context of the regulatory reporting process, the purpose of this commentary is to provide to the regulator, Ofgem, information supporting the data that we submit in the Environment and Innovation Reporting Pack (i.e. Annexes 1 to 7).

Annexes 1 to 7 and this associated commentary are an edited copy[1] of our annual submission to the regulator. The structure and content of this document reflect their specific purpose, and as a result are not suited for the reader looking for some general information. For that reader, we recommend the Environment Report.

Date of publication: October 2017

Associated documents:

- Environment Report2016/17, Northern Powergrid, October 2017
- Annexes to the Environment report 2016/17, Northern Powergrid, October 2017
- Cost benefit analysis Tables, October 2017
- Regulatory Instructions and Guidance (RIGs) for RIIO-ED1,Ofgem, March 2016, available from: www.ofgem.gov.uk/publications-and-updates/direction-make-modifications-regulatory-instructions-and-guidance-rigs-riio-ed1

Content

[1] The edits consist in formatting changes to ease navigation and redaction of content that we agreed with the regulator were inappropriate for publication.

E1 – Visual Amenity

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.
We have updated Table E1, where the workload refers to the undergrounding of overhead lines within or around the borders of national parks/areas of outstanding natural beauty. We are reporting 9.16km of overhead line removed in Northeast and 3.85km in Yorkshire. We use specific work programmes to record costs and volumes of undergrounding work in our regions' Designated Areas. This allows us to separate the costs and activities of visual amenity from other undergrounding work. We have examined the circumstances of individual schemes to determine the correct voltage of the job and the relative amounts of overhead line removed and cable installed. Other assets involved with the work, such as the count of overhead services and poles removed and underground services installed have been noted in the asset register listing included in Table CV20. All the work undertaken is on either LV or HV overhead circuits. On examination of the schemes undertaken in 2016/17, we are able to confirm that all costs recorded arose from work carried out within the Designated area.

Explanation of the increase or decrease in the total length of OHL inside designated areas for reasons other than those recorded in worksheet E1. For example, due to the expansion of an existing, or creation of a new, Designated Area.
There have been no new Designated areas created or extended over the year or, to our knowledge, any change in the geographical size of any individual area.

E2 – Environmental Reporting

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.
Table E2 provides volumetric performance statistics on the treatment of oil leakage and gas emissions alongside investments made in mitigating the effects of oil, SF6 leakage and noise pollution. *Cost and Volumes categories* • The fact that we have a relatively low level of absolute expenditure reported in E2 should be seen in the context of the overall investment made and benefits achieved in asset replacement (where the replacement of fluid-filled cables are reported), in flooding and in asbestos mitigation projects. • The work reported in Table E2 has a specific environmental investment driver, and in 2016/17 we have undertaken schemes addressing noisy equipment, with work in both HV and EHV substations (see section on noise mitigation below) and on mitigating oil pollution, through remedial work on transformer bunds and also in the installation and installation/replenishment of spills kits

at our major substation sites.

- This year we have also included costs on three Yorkshire overhead line schemes where we have been faced with significant excess costs associated with treatment of land contaminated by the impact of our apparatus (Woodhouse Masts). Costs totalling £150k have been applied to the Contaminated Land category in Table E2 relating to these Woodhouse Mast Schemes.
    - Harrison Lane-Slaithwaite 33kV
    - Sowerby Bridge-Todmorden 33kV
    - Silsden-Haworth 33kV
- The requirement arises during the recovery of these steel masts, whilst undertaking the work in our EHV Overhead Line portfolio, it was discovered that they were coated in lead paint, which contaminated the soil underneath the offending apparatus and resulted in some loss of livestock. The additional costs in dealing with the land contamination relating to three projects: removing the contaminated soil, reinstatement and damages etc. have been applied to the contaminated land category in Table E2.

Volumetric Measures
Table E2 also includes a number of categories, against which we record Northern Powergrid's environmental performance.

- We recorded 10 incidents requiring reporting to the Environment Agency (none of the incidents resulted in civil Sanction); 4 in the Northeast and 6 in Yorkshire in 2016/17. These all relate to fluid filled cables. All incidents were appropriately addressed in consultation with the Environment Agency.
- On SF6 leakage, Table E2 records SF6 emitted as a proportion of the total gas bank. We have updated the amount of our overall gas bank with the net asset additions in each licence. We have also applied the amount of gas emissions, which we record on our source systems, and the table calculates a gas emitted ratio of 0.1% in Northeast and 0.5% in Yorkshire in 2016/17. Unfortunately, we have not been able to baseline the SF6 gas bank for the start of this year as we had hoped to do, since manufacturers have been unable to provide us with information on the weight of gas present in their equipment that we have deployed on our network. Our Asset Management team are now approaching colleagues in other DNOs to establish a database of commonly used switchgear types, to which agreed gas weights can be applied, in an attempt to make sure that we all use consistent values throughout the industry.
- On the fluid used statistics, in the reduced sub-table that is now used in RIIO, we record circuit kilometres, oil fluid litres and the amounts of oil top ups and recoveries. In order to calculate the fluid totals, we calculate the average value for litre per km for each cable core and voltage, taking account of a range of variables, including cable type, cable manufacturers' specifications and different types of site works. We have taken the circuit lengths of oil-filled

cable at each voltage, using data taken from the asset register.

- We have also reported the audited values for net fluid used for top ups and fluid recovered that are recorded on our source systems. When these are entered on to Table E2, the result is that our ratios of fluid tops ups to the total in service is 1.3% for Northeast and 1.7% for Yorkshire in 2016/17.

DNOs must provide some analysis of any emerging trends in the environmental data and any areas of trade-off in performance.

The overall number of environmental events (those reportable to the Environment Agency and those that fall outside this category) has reduced since 2012 from 97 in the 2012/13 regulatory year (Northeast and Yorkshire) to a flatline 64 in both the 2014/15 and 2015/16 regulatory years, reducing further in the 2016/17 regulatory year to 53. Changing weather patterns play a large role in this trend as the number of direct lightning strikes on equipment causing environmental events has dropped in the same time period.

Fluid loss continues an overall downward trend and gas loss continues to be stable.

Where reported in the Regulatory Year under report, DNOs must provide discussion of the nature of any complaints relating to Noise Pollution and the nature of associated measures undertaken to resolve them.

We have completed the row in Table E2 relating to noise complaints and have provided the number of calls relating to noise complaints on our calls systems. Of those calls, there are a number that result in formal complaints that lead to remedial action in terms of mitigation schemes that are reported in Table E2. We completed seven schemes in 2016/17; three in Northeast and four in Yorkshire.

Noise complaints are considered objectively, by performing site surveys and measuring sound levels across the audible spectrum at various points in the area the complaint was raised. A noise complaint is justified if specified noise levels, especially in the 100Hz range, are exceeded. We examine each case in detail: this involves personal attendance at the site, taking EMF readings and an assessment of the best means of dealing with the nuisance.

A variety of mitigation solutions are possible: acoustic doors, acoustic roof panels, acoustic louvres, anti-vibration pads – but we have faced situations where poor ventilation or restricted space between substation doors and the electrical equipment inside does not allow us to install the acoustic solution (indeed these sometimes might pose a safety risk as a climbing aid). In those circumstances we are left with resiting the equipment (for pole mounted transformers) or full replacements, where we also have to consider synergies with other requirements for asbestos or opportunities for reinforcement or indeed planned asset replacement at the site. Any work at primary sites is, by the very nature of the assets being treated; a much more specialised, complicated and expensive exercise and as such, noise complaints involving primary sites can take time to resolve.

For the reporting year, we are reporting seven completed schemes and in brief,

the circumstances are as follows:

In Northeast:

- **Sheriff Hutton** is a primary substation between York and Malton. An acoustic wall was erected in front of the two 66kV transformers almost 20 years ago to address a justified complaint from the previous resident of a nearby farm. A recent installation of a large scale solar farm on land adjoining the substation led to a new noise complaint in summer 2015. A scheme to apply brick effect GRP sheets was put in place; however, following consultation with the customer, we developed a cheaper solution by cladding the walls in cedar, which were also more congruent with the surroundings and more than exceeded the expectations of the customers..

- In early 2016, a noise complaint has been upheld in relation to the sound levels emitted by the transformers at **Rowlands Gill West** outdoor distribution substation. As a result of the acoustic measurements taken at the site, we installed an acoustic cabinet over the plant installed in the substation. This is a new acoustic version of a standard GRP enclosure, specified in consultation with our contractors, which has a standard footprint and is compliant with our security standards..

- In June 2016, we received a complaint from a customer in Alnwick, Northumberland, which arose due to the noise being emitted from the transformer at **Blakelaw** distribution substation. We had the substation acoustically lined with acoustic fireproof foam, at minimum cost.

In Yorkshire

- When the work required to mitigation of the noise problem takes place in a primary substation, there can be heavy costs involved. The first case in Yorkshire provides an example of this, involving the resolution of a justified complaint received in July 2014 from customers within close proximity of **Whitehall Rd primary** substation in Leeds city centre. Involving very significant civils costs, the mitigation work was put out to tender and required the building of acoustic enclosures for the transformers at this somewhat restricted location.

- Again at a primary substation, a justified noise complaint was received in Spring 2015 proven to be due to the transformers at **Bolton Road** Primary Substation in Silsden near Keighley in West Yorkshire. The work has involved the fitting of acoustic shrouds to the transformers at the site. We will continue to monitor the situation, but we decided not to carry out more extensive works involving acoustic screens due to the design constraints imposed by the electrical layout, topology of the site and the potential for visual intrusion.

- In June 2015, we received a justified complaint regarding the noise emanating from the transformers at an outdoor compound at **Pickering** substation in Hull close to customers' houses. The switchgear and LV board at the site were located indoors in a large aged building and were themselves in poor condition. There were also load issues in localities where one of the feeders had high customer numbers. This combination of

issues meant that it was decided to establish a new low noise 800kVA UDE in the area at the front of the site to be contained within GRP housing. Additionally, new cables to the new equipment had to be installed in the public footpath (the existing LV and HV cables were in one of the adjacent gardens). At the end of the work all existing equipment will be disconnected and removed with the building demolished. We have taken the opportunity to pursue the sale of the excess land at the site.

- The fourth site to be completed in Yorkshire was a scheme to replace the indoor transformer at **Kershaw Crescent** substation in Luddendenfoot near Halifax. The original circumstances were that the site contained an indoor brick built premises with a flat ashfelt roof, located away from the roadside on a grassed area between two-storey social housing blocks. In August 2015 a noise complaint was received. An attempt to attenuate the noise levels of the transformer, which included the installation of anti-vibration pads, doors lined with fire retardant sound proofing material was made. The doors were changed for steel security soundproofed doors and an old wooden backed street lighting cabinet that faced onto the complainant's flat was bricked up. Whilst these measures successfully reduced the noise levels to within recommended limits the customer was still not content and in the event we determined to change the transformer for a new modern quieter 500kVA version. Due to the nature and location of the substation building, specialist lifting equipment was required to extricate the old unit and put the new one into position.

Where reported in the Regulatory Year under report, DNOs must provide details of any Non-Undergrounding Visual Amenity Schemes undertaken.
There are no such schemes to report during the reporting year.

Any Undergrounding for Visual Amenity should be identified including details of the activity location, including whether it falls within a Designated Area.
No work has been undertaken other than in work specifically under the Visual Amenity programme.

Where reported in the Regulatory Year under report, DNOs must provide discussion of details of any reportable incidents or prosecutions associated with any of the activities reported in the worksheet.
We recorded 10 incidents requiring reporting to the Environment Agency (none of the incidents resulted in enforcement actions or penalties); four in the Northeast and six in Yorkshire in 2016/17. Nine of the incidents related to fluid filled cables and one was associated with an attempted theft at a primary substation. All incidents were appropriately addressed in consultation with the Environment Agency.

Where reported in the Regulatory Year under report, DNOs must provide discussion of details of any Environmental Management System (EMS) certified under ISO or other recognised accreditation scheme.
We are certified to ISO14001:2004 and have been subject to one surveillance audit and one full recertification audit during the regulatory year under report.

Only two minor non-conformances were identified and continued certification was approved.

DNOs must provide a brief description of any permitting, licencing, registrations and permissions, etc related to the activities reported in this worksheet that you have purchased or obtained during the Regulatory Year.

We have three bespoke permits and one standard oil only permit. We are a registered upper tier waste carrier, broker and dealer.

DNOs must include a description of any SF6 and Oil Pollution Mitigation Schemes undertaken in the Regulatory Year including the cost and benefit implications and how these were assessed.

We have no work with the driver of reducing SF6 emissions but have undertaken a number of schemes with the driver of preventing oil pollution and oil leakage, which result from three separate programmes of work.

- Firstly we have a programme engaged in the treatment of transformer oil bunds at major substations. Our strategy is not to install full bund replacements until all existing bunds have been subjected to appropriate remedial works to remedy defects as there will be a greater benefit per £ value realised and indeed earlier benefit in terms of reduced oil leakage and environmental clean-up at our sites. We have therefore concentrated on bund refurbishment, which includes for the replacement / repair of bund pumps.

- Secondly, we install and replenish oil spills kits at substations, where there is a heightened risk of or requirement to deal with oil leakage. The kits provide a temporary measure until the leaks can be resolved or the plant replaced and contain all the equipment required for site staff to use should an oil leak occur.

- The third workstream here is one that was driven by Environment Agency Pollution Prevention Guidelines, PPG 21. Our Northeast and Yorkshire sites have detailed drainage plans which are available in the event of an incident such as an oil spill or fire.

Whilst we seek to protect and prevent interference as our top priority, it is recognised that the management of incidents is an inevitable outcome and therefore pollution containment measures are essential in reducing environmental, financial and reputational damage to Northern Powergrid. To ensure effective remediation we have a 24 hour environmental response support contract in place to attend for any and all environmental incidents as required.

E3 –BCF

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.
Data entry is in the form of base measurement and conversion factors. Such factors are the factors published by DEFRA in place on 31 March of the regulatory period being reported. Where multiple conversion factors were required to calculate BCF within a particular category (e.g. due to use of both diesel and petrol vehicles), a weighted average of these factors has been entered. Variations in volume of each fuel type between NPgY and NPgN will result in different weighted average conversion factors for similar categories. E.g. In NPgY a lower quantity of petrol was used for business transport and a larger quantity of diesel was used. Therefore the resultant overall weighted average conversion factor for this category for NPgY will be different to that of NPgN. All Contractor figures are actual returns. No estimates have been made.

BCF reporting boundary and apportionment factor DNOs that are part of a larger corporate group must provide a brief introduction outlining the structure of the group, detailing which organisations are considered within the reporting boundary for the purpose of BCF reporting. Any apportionment of emissions across a corporate group to the DNO business units must be explained and, where the method for apportionment differs from the method proposed in the worksheet guidance, justified.
All figures relate to the activities of the regulated business. All data is collected in a form where it is attributed to one of the licensed distribution businesses. Corporate categories are allocated on a 50:50 basis. Business travel by bus, taxi and ferry has not been included as it believed not to be material. Refrigerant gas loss from air conditioning units has not been included. The amount is not believed to be material. Energy use at substations has been estimated. The company is audited on an annual basis to ensure compliance with the ISO 14064-1:2006 standard. This tests the management, reporting and verification of our greenhouse gas inventory.

BCF process The reporting methodology for BCF must be compliant with the principles of the Greenhouse Gas Protocol.[2] Accounting approaches, inventory boundary and calculation methodology must be applied consistently over time. Where any processes are improved with time, DNOs should provide an explanation and assessment of the potential impact of the changes.
• To maintain consistency and comparability, the figures for 2015_16 have been re-stated with the conversion factors published by DEFRA in place on 31 March of the regulatory period. For clarity, the previous submission had utilised two separate conversion factors – those in place on 31 March 2015 and those issued in June 2016. This has resulted in changes to some of the

[2] Greenhouse gas protocol

conversion factors in both NPgY and NPgN which has had a minor incremental effect on the overall company BCF.

- We have also taken the opportunity to amend one inaccuracy from the 2015_16 submission – which was outlined during the response to RRP return 2015_16 supplementary question 4 (ENV4 – NpgY Business carbon footprint):

    - The NPgY SF6 figure was inaccurately stated - data was incorrectly transferred between tables and missed the QA check given a minor variation – the value submitted was 83.64 and it should have been 84.49. This has now been corrected.

All variations (less than 1%) and resulting change in BCF (CO2Te) are outlined in the following tables.

NPgY 2015_16 re-stated				
Buildings Energy Usage		Conversion Factor Variance	Volume Variance	CO2Te Variance
	Buildings - Electricity	0.0000170	-	57.09
	Buildings - Other Fuels	0.0000002	-	0.05
	Substation Electricity	0.0000128	-	173.37
	Total			**230.51**
Operational Transport				
	Road	-0.0000068	-	-6.84
	Total			**-6.84**
Business Transport				
	Road	-0.0000003	-	-1.28
	Rail	-0.0000011	-	-0.63
	Air	0.0000021	-	1.64
	Total			**-0.27**
Fugitive Emissions				
	SF6	-	0.85	19.38
	Total			**19.38**
Losses				
	Losses	0.0000172	-	21,951.94
	Total BCf Variance Excl Losses			**242.78**
	Total BCf Variance Incl Losses			**22,194.72**

NPgN 2015_16 re-stated				
Buildings Energy Usage		Conversion Factor Variance	Volume Variance	CO2Te Variance
	Buildings - Electricity	0.0000159	-	47.56
	Buildings - Other Fuels	0.0000002	-	0.13
	Substation Electricity	0.0000128	-	104.86
	Total			**152.54**
Operational Transport				
	Road	- 0.0000068	-	- 7.39
	Total			**- 7.39**
Business Transport				
	Road	- 0.0000003	-	- 1.29
	Rail	- 0.0000010	-	- 0.44
	Air	0.0000029	-	1.91
	Total			**0.18**
Losses				
	Losses	0.0000186	-	14,753.29
	Total BCf Variance Excl Losses			**145.33**
	Total BCf Variance Incl Losses			**14,898.62**

Commentary required for each category of BCF

For **each** category of BCF in the worksheet (ie Business Energy Usage, Operation Transport etc) DNOs must, where applicable, provide a description of the following information, ideally at the same level of granularity as the Defra conversion factors:

- the methodology used to calculate the values, outlining and explaining any specific assumptions or deviations from the Greenhouse Gas Protocol
- the data source and collection process
- the source of the emission conversion factor (this shall be Defra unless there is a compelling case for using another conversion factor. Justification should be included for any deviation from Defra factors.)
- the Scope of the emissions ie, Scope 1, 2 or 3
- whether the emissions have been measured or estimated and, if estimated the assumptions used and a description of the degree of estimation
- any decisions to exclude any sources of emissions, including any fugitive emissions which have not been calculated or estimated
- any tools used in the calculation
- where multiple conversion factors are required to calculate BCF (eg, due to use of both diesel and petrol vehicles), DNOs should describe their methodology in commentary
- where multiple units are required for calculation of volumes in a given BCF category (eg, a mixture of mileage and fuel volume for transport), DNOs should describe their methodology in commentary, including the relevant physical units, eg miles.

DNOs may provide any other relevant information here on BCF, such as commentary on the change in BCF, and should ensure the baseline year for

reference in any description of targets or changes in BCF is the Regulatory Year 2014-15. DNOs should make clear any differences in the commentary that relate to DNO and contractor emissions.

Building energy usage

- Data from electricity and gas bills relating to all the licensee's non-operational properties is collated by the facilities department. For non-half-hourly metered bills, the amount included is that billed in the quarter even if based on an estimated reading. A small number of buildings that are owned by a landlord are excluded. For gas the conversion factor for gross calorific value has been used.
- Own use at substations has been estimated for 2016/17. The figures have been built bottom up from the various components (heating, lighting, etc.), although the contribution of each component is an engineering judgement rather than a direct or sample measurement.

Operational Transport

- The main source of fuel reported here is used by the company's fleet, and data is collected from company fuel card use. Figures are collated for petrol, diesel, and LPG (when used).
- We also report volume of fuel stored onsite to fill the forklifts and logistics HGV vehicles.
- Other usage of fuel includes that used by contractors for their fleet and generators. Data on contractors' usage is compiled from returns sent in response to a request. See comments under Contractors.

Business Transport

- Business transport - road

Data is collected from business miles claimed by staff monthly on their expense claim forms. The data is split between diesel and petrol according to the information provided on the claim forms. Corporate staff mileage is split 50:50 between licensees (to reflect the fact that such travel is undertaken on behalf of both licensees equally).

- Business transport – rail and air

Staff wishing to make a business journey by train or air must complete a "Request for Travel" form. Data from these forms is transferred to a spreadsheet where the mileage for each journey is calculated and then collated according to rail, domestic flights, short-haul international, and long-haul international. As mentioned above, figures relating to corporate staff are attributed 50:50 between licensees.

Fugitive Emissions

These figures are the same as those used in Table E2 and are the SF6 emissions from the network.

Fuel combustion

This is the fuel used for generators by our contractors.

Losses

- This data stream uses the figures derived under the Balancing and Settlement Code arrangements and reported regularly to Ofgem.
- The volume of energy is converted in tonnes of carbon dioxide using the "Electricity – generation" (scope 2) factor provided by DEFRA.

Contractors
When reporting BCF emissions due to contractors in the second half of the worksheet please:

- Explain, and justify, the exclusion of any contractors and any thresholds used for exclusion.
- Provide an indication of what proportion of contractors have been excluded. This figure could be calculated based on contract value.

Please provide a description of contractors' certified schemes for BCF where a breakdown of the calculation for their submitted values is not provided in the worksheet.

If a DNO's accredited contractor is unable to provide a breakdown of the calculation and has entered a dummy volume unit of '1' in the worksheet please provide details of the applicable accredited certification scheme which applies to the reported values.

Contractor figures are derived from actual returns provided by the contractor. Contractors use for generation has increased significantly which is reflected in the much higher contractor operational fleet and combustion figures than in previous years.

Building energy usage
Natural gas, Diesel and other fuels are all categorised as fuel combustion and must be converted to tCO2e on either a Gross Calorific Value (Gross CV) or Net Calorific Value (Net CV) basis. The chosen approach should be explained, including whether it has been adapted over time.

Substation Electricity must be captured under Buildings Energy Usage. Please explain the basis on which energy supplied has been assessed.

Own use at substations has been estimated for 2016/17. The figures have been built bottom up from the various components (heating, lighting, etc.), although the contribution of each component is an engineering judgement rather than a direct or sample measurement.

E4 – Losses Snapshot

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.

E4 includes:

- Activities where the costs incurred principally relate to managing Distribution Losses.
  - In practice at this time this will be restricted to actions to deal with Relevant Theft of Electricity as we have no other investments solely to reduce losses.
- Activities where some of the costs incurred relate to managing Distribution Losses (but where losses are not the principal reason for the expenditure) excepting activities that may help to manage losses but where Distribution Losses are not associated with the DNO's decision to undertake the activity and where any losses benefits are purely coincidental:
  - At present this is restricted to 300mm^2 cable at LV and 11kV

- Our losses strategy also includes distribution transformers and primary transformers, however Ofgem regarded these initiatives as producing coincidental loss reductions at the RIIO-ED1 review and they are therefore excluded from the E4 returns.

Costs
Total costs are taken from the overall unit cost for cable replacement times the cable lengths installed.
The differential between the 300mm^2 cable and 185mm^2 cable is known and together with the lengths of each type and the overall unit cost can be used to calculate a unit cost specific to each type.
This calculation is done for NPgN and NPgY and for 11kV cable and LV cable, giving four cost lines in total.
Incremental costs associated with the losses initiative are taken from the CBA cost per meter and the volumes of 300mm^2 cable.

Volumes
Total cable volumes and 300mm^2 cable volumes are taken from work undertaken for the RRP asset additions submission. An assumption has been made that 20% of the 300mm^2 would have been this size in any case.

Losses benefits
Losses benefits (MWh) associated with the losses initiative are taken from the CBA losses benefit per meter and the volumes of 300mm^2 cable.

CBAs
The CBAs are based on the submitted RIIO-ED1 CBAs reviewed in line with the financial data (WACC) from the ED1-RIIO settlement and actual cable lengths involved.
By entering the actual cable lengths in the actual year of installation in the Ofgem CBA and altering the output table on the option calculation sheet to 8 years this can be made to calculate a RIIO-ED1 benefit and a 45-year benefit.

Programme/Project Title
Please provide a brief summary and rationale for each of the activities in column C which you have reported against.

The benefits of low loss design have usually been in the form of oversizing conductors (relative to existing utilisation levels), which can have the added benefit of improving network performance (i.e. voltage drop, current carrying capacity and earth loop impedance).

LV cable oversizing
At low voltage (230/400V), the use of 300mm^2 aluminium cables has been adopted as standard cable size for all mains other than spurs carrying less than 120A per phase in line with our RIIO-ED1 business plan submissions.

11kV cable oversizing
At 11kV the use of 185mm^2 aluminium has been adopted as a standard network feeder size, with 300mm^2 aluminium used for the first leg from the primary substation and highly loaded feeders. Going forward, and in line with our RIIO-ED1 business plan submissions we will implement the policy of installing a minimum cable size of 300mm^2 at 11kV where practical (e.g. if bending radii and termination arrangements allow).The use of 95mm^2 is only recommended in special circumstances, as it becomes uneconomical in terms of lifetime losses at greater than 100A peak loading.

Primary driver of activity
If, in column E, you have selected 'Other' as the primary driver of the activity, please provide further explanation.

Cables are replaced or installed as part of activities such as asset replacement, reinforement, connections, visual amenity and faults volumes. These are the primary drivers.

Baseline Scenario
Please provide a brief description of the 'Baseline Scenario' inputted in column K for each activity.

The baseline scenario assumed each metre of cable actually installed as 300mm^2 was installed as 185mm^2.
Volumes were restricted to 300mm^2 cable which would otherwise have been 185mm^2. Any cable actually installed at a smaller size or that would have been the larger in any event was excluded.
On the CBA, only incremental costs were included so the baseline was a blank sheet.

Use of the RIIO-ED1 CBA Tool
DNOs should use the latest version of the RIIO-ED1 CBA Tool for each of the activities reported in column C. Where the RIIO-ED1 CBA Tool cannot be used to justify an activity, DNOs should explain why and provide evidence for how they have derived the equivalent figures for the worksheet. The most up-to-date CBA for each activity reported in the Regulatory Year under report must be submitted.

Ofgem's version 4 CBA from the RIIO-ED1 business plan submissions was used. This is understood to be Ofgem's current version.
All CBAs show that one year of investment has a a positive benefit over 45 years as shown in the table below.

	NPVs based on payback periods following one year investment (£m)			
	8 years	24 years	32 years	45 years
Overlaying LV cable with 300m^2 wf (NPgN)	-£0.003	£0.06	£0.15	£0.192
Overlaying LV cable with 300m^2 wf (NPgY)	-£0.002	£0.09	£0.23	£0.29
300m^2 for all 11kv network feeders (NPgN)	-£0.02	-£0.01	£0.00	£0.01
300m^2 for all 11kv network feeders (NPgY)	-£0.08	-£0.05	£0.02	£0.05

Changes to CBAs If, following an update to the CBA used to originally justify the activity in column C, the updated CBA shows: • a negative net benefit for an activity, but the DNO decides it is in the best interests of consumers to continue the activity, or • a substantively different NPV from that used to justify an activity that has already begun. the DNO should include an explanation of what has changed and why the DNO is continuing the activity. For example, where the carbon price used in the RIIO-ED1 CBA Tool has changed from that used to inform the decision such that the activity no longer has a positive NPV.
N/A

Cost benefit analysis additional information Please include a reference to the file name and location of any additional relevant evidence submitted to support the costs and benefits inputted into this worksheet. This should include the most recent CBA for each activity reported in column C in the Regulatory Year under report.
A summary of the CBA tables are included in this report.

E5 – Smart Metering

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.
Worksheet E5 records: 1 Pass-through Smart Meter Communication Licensee Costs and Smart Meter Information Technology Costs, plus Elective Communication Services costs that are outside of the price control, and 2 DNO's estimates of the benefits of smart metering for domestic and non-domestic customers using the categories set out in DECC's January 2014 Impact Assessment. **1. Pass-through Smart Meter Communication Licensee Costs and Smart Meter Information Technology Costs, plus Elective Communication Services that are outside of the price control** Smart Metering Communication Licensee Costs consist only of the monthly charges levied by the Data Communications Company (DCC). These are recorded against dedicated account codes in our financial recording systems allowing us to separate these costs from any other cost items. In 2015/16 our Smart Metering Information Technology Costs solely related to the costs of implementing our IT user gateway that will allow us to consume DCC services. In 2016/17 our Smart Metering Information Technology Costs cover both the costs of implementing our IT user gateway plus a number of additional items,

which have been included in the revised definition of Smart Meter Information Technology Costs as per V3.0 of the RIIO-ED1 regulatory instructions and guidance.

These additional items are:

- Marginal cost of improving the resilience and security of computer rooms.
- Planning and development of new and improved business processes that either on a stand-alone basis, or in conjunction with existing IT applications, will use smart metering data to deliver DNO benefits from smart metering.
- Costs associated with the provision of Registration Data Provider (RDP) service specifically associated with initial set up associated with DCC Live R1.2, plus costs associated with the ongoing provision of RDP service on an ongoing basis.

The implementation of our IT user gateway is being undertaken as a stand-alone capital project allowing us to record the costs of this activity separately from the costs and activities of other smart metering and non-smart metering activities.

Business process planning and RDP costs have been taken directly from invoice values, hence no estimation, allocation or apportionments have been undertaken except for splitting these costs equally between our two licences.

The marginal cost of improving the resilience and security of computer rooms covers only the marginal cost of improvements made to our Leeds based computer facilities housing our smart metering production system. This cost has been arrived at by allocating a proportion of the overall expenditure incurred in making significant security and environmental improvements to our Leeds data centre that hosts our smart metering production systems.

We have not incurred any Elective Communication Services costs. These costs are payable to the DCC in respect of Elective Communication Services, which include services to or from a Smart Metering System that relate solely to the Supply of Energy (or its use), and services that are provided by DCC pursuant to a Bilateral Agreement (rather than the DCC User Interface Services Schedule). The DCC did not enter into any Bilateral Agreements for 2016/17.

2. DNO's estimates of the benefits of smart metering for domestic and non-domestic customers using the categories set out in DECC's January 2014 Impact Assessment

Smart Metering Estimated Benefits for the 2016/17 regulatory year are nil because each of the seven benefit categories set out in DECC's Impact Assessment require smart metering data to be provided to us by the DCC as an essential input to the delivery of benefits.

No data has yet been made available by the DCC. The reason being that as at the end of the 2016/17 regulatory year, suppliers had not rolled-out to customers any smart meters that could link to DCC systems.

Actions to deliver benefits

Detail what activities have been undertaken in the relevant regulatory year to produce benefits of smart metering where efficient and maximise benefits overall to consumers. At a minimum this should include:

- A description of what the expenditure reported under Smart Meter Information Technology Costs is being used to procure and how it expects this to deliver benefits for consumers.
- A description of the benefits expected from the non-elective data procured as part of the Smart Meter Communication Licensee Costs. The DNO should set out how it has used this data.
- A description of the Elective Communication Services being procured, how it has used these services, and a description of the benefits the DNO expects to achieve.

The expenditure reported under Smart Meter Information Technology Costs is being used to implement our IT user gateway, provide our RDP service and support the development of business processes that will enable us to utilise smart metering data.

- The expenditure on our IT user gateway will allow us to receive smart meter alerts, execute service requests that send commands to smart meter devices, and execute service requests that instruct the DCC to undertake an activity. This IT user gateway system is as an essential enabler for the delivery of smart meter benefits for customers.

- Our expenditure on our RDP service supports the wider smart metering programme's security model by providing details to the DCC of each of our customer's registered suppliers.

- Our expenditure on business process planning activities is allowing us to revise our relevant customer-facing business processes such that they can utilise, and therefore derive benefit from, the smart metering data that will be received by us via our IT user gateway.

No non-elective data has been procured from the DCC because the absence of enrolled smart meters meant that DCC data services were not active during any part of the 2016/17 regulatory year.

No Elective Communication Services have been procured from the DCC because DCC data services were not active during any part of the 2016/17 regulatory year.

Calculation of benefits

Explain how the benefits have been calculated, including all assumptions used and details of the counterfactual scenario against which the benefits are calculated.

Smart Metering Estimated Benefits for the 2016/17 regulatory year are nil.

This is because the RIGs require us to estimate "gross financial benefits delivered in the Regulatory Year from the use of smart metering data" against each of the seven benefit categories set out in DECC's January 2014 Impact Assessment.

Whilst Release 1.2 of DCC systems nominally went live in November 2016, as at 31 March 2017 suppliers had not installed any smart meters that could link to

DCC systems. As such no smart metering data was made available to us in 2016/17, which in turn precludes us from delivering benefits.

Use of the RIIO-ED1 CBA Tool
DNOs should use the latest version of the RIIO-ED1 CBA Tool for each solution reported in the worksheet in the Regulatory Year under report. Where the RIIO-ED1 CBA Tool cannot be used to justify a solution, DNOs should explain why and provide evidence for how they have derived the equivalent figures for the worksheet. The most up-to-date CBA for each activity reported in the Regulatory Year under report which are used to complete the worksheet must be submitted.

As at 31 March 2017 suppliers had not installed any smart meters capable of linking to DCC systems; hence no smart metering data was available from which to derive benefits. Therefore the RIIO-ED1 CBA Tool has not been used to calculate gross financial benefits delivered in the 2016/17 year.

Cost benefit analysis additional information
Please include a reference to the file name and location of any additional relevant evidence submitted to support the costs and benefits inputted into this worksheet. This should include the most recent CBA for each solution reported in the Regulatory Year under report.

N/A.

E6 – Innovative Solutions

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.

The Regulatory Instructions and Guidance published by Ofgem in April 2016 planned for a working group to be established to clarify instructions and guidance on:

• the definition of a unit for different solutions

• consistency in reporting of Innovative Solutions definitions

• consistency in reporting methods with regards to impacts.

Since the working group has not yet been formed, we have followed the guidance in the RIGs and made assumptions that are explained in the commentary below.

General
For each of the solutions please explain:

- In detail what the solution is, linking to external documents where necessary.
- How this is being used, and how it is delivering benefits.
- What the volume unit is and what you have counted as a single unit.
- How each of the impacts have been calculated, including what assumptions have been relied upon.

Increase Network Capacity / Optimise Utilisation

Underutilised Capacity Recovery – There is the potential to recover some of the underutilized capacity from half-hourly metered customers if these customers are confident that they have no future plans that might need it. This can release capacity for use by other connectees and also save the customer money through reduced capacity charges.

In 2016/17 we contacted a total of 170 customers including all EHV and HV

generators who underutilise capacity at levels <75%. 79 responses were received and an additional 18MW of export capacity in 2016/17 was recovered from 4 customers

This exercise continues as business as usual and we will report our success rates back via the DG-DNO Steering Group and Ofgem.

	Generation Customers		
	EHV	HV	*Total*
Customers Numbers	22	64	***86***
Potential capacity recovery (MW)	167	125	***292***
Customers Contacted	22	13	***35***
Recoverable potential from customers contacted (MW)	167	18	***186***
No. of customers responded	5	0	***70***
Recoverable potential from customers responding (MW)	20	0	***20***
Customers agreeing to capacity reduction	04	0	***18***
Total Capacity released (MW)	**0**	**0**	***18***

It is difficult to put a cash value on the capacity released due to this being dependent upon local network conditions, the demand for connections in the particular areas where the capacity is released and the avoided reinforcement costs delivered by this released capacity. However, if we were to apply a generic reinforcement cost of, say, £0.6m/MVA then the incremental value of 18 MVA could be as high as £11m.

Voltage Reduction – We have started to receive complaints of high voltage on our network as the amount of embedded generation increases and so we have commenced a programme of reducing the set point voltage at 11kV busbars of our primary substations. This is the first step in a revision to our voltage control policy which is being amended as a result of the learning from the CLNR project. The basic assessment involved determining whether the tapping range at the substation is adequate for the expected load flows and voltages on the network, whilst still leaving room for an OC6 voltage reduction. The assessment assumed that the reduction in statutory voltage limit on the LV network (from 225.6V to 216.2V) would provide the necessary voltage leg-room to lower the target voltage at the primary substation by 200V. Reducing the target 11kV voltage by 200V results in a voltage reduction of approximately 4.5V at the LV terminals of a distribution transformer. During 2016/17 we reduced the set point voltage at 85 primary substations. These actions are designed to create the voltage headroom to cater for the connection of PV without creating voltage complaints. It is estimated that these actions release sufficient voltage headroom to connect an additional 9MVA of distributed generation such as solar PV to the LV network fed from each primary substation; 765MVA across the 85 primary substations addressed in 2016/17.

Other - We consider the smart techniques that we currently deploy, such as the use of remote control switching, to now be a conventional technique and our innovative solutions for connecting customers in capacity constrained areas have been directed towards the new connections activity (see below) rather than general reinforcement activity where the requirement is still a very low level.

Improve asset life cycle management

Transformer insulating oil regeneration - Acidity and moisture are products of the degradation of the insulation systems and their presence will accelerate the further deterioration of the paper insulation. Treatment of the insulating oil to remove acidity and moisture will extend the transformer life significantly.

On-line regeneration of the oil has significant benefits over an oil change including;

- More effective removal of particles and sludge;
- Longer term improvement of the insulating oil;
- Negates the need to drain the transformer;
- Negates the need to pull a vacuum on the transformer;
- Significantly reduces the quantity of insulating oil that needs to be transported to site and reduces the associated safety risk and cost; and
- Overall reduction of Northern Powergrid's carbon footprint.

Life extension of the transformer will only be realised if all the components of the unit remain serviceable. Oil regeneration shall only be undertaken following an assessment of tapchanger serviceability and main tank integrity, and subject to satisfactory oil dissolved gas analysis results. The 2015 Asset Serviceability Review identified 47 transformers for refurbishment (which will include oil regeneration in the majority of cases) during RIIO ED1. The deployment started in 2016/17, with three units installed in Yorkshire and none in the Northeast.

Improve Network Performance

LV Technology Programme - We have implemented a pro-active approach to LV network intermittent faults by use of new technology that was previously developed under an ENW IFI project with Kelvatek. This centres on the concurrent deployment of 1,435 smart LV devices on the LV network (424 of them in 2016/17). The intention is to restore intermittent (Non Damage) faults within 3 minutes and thus enhance customer experience. Over time, this allows the proactive location and repair of persistently active intermittent faults before customers experience a longer, permanent unplanned interruption (Damage Fault). These devices improve customer service and reduce costs associated with service failures as well as reducing overtime payments due to the ability to programme fuse replacements in normal working time.

HV automation - We are currently rolling out Automatic Power Restoration System (APRS) across our High Voltage distribution network. This has been deployed across 41 primary substations in 2016/17,15 in the Northeast (running total 33) and 26 in Yorkshire (running total 42). It is designed to identify and isolate faulted sections of the network and then restore healthy sections of network within three minutes. This restores supplies to many customers automatically and also enables fault restoration/repair staff to be directed towards the faulted section of network more quickly, both of which enhance the customer experience.

Improve vegetation management

No innovative solutions deployed in 2016/17.

Improve Safety

Telematics in operational vehicles – We have installed telematics into operational vehicles with the key aims of improving driver and public safety but also with the additional aims of reducing fuel consumption and thereby reducing fuel costs and CO_2 emissions and also improving the dispatch of resources to faults to speed up supply restoration times. We believe vehicle telematics to be innovative because it will provide leading indicators regarding driver behaviour, an area where we have relied almost solely on lagging indicators in the past.

The installation of the first vehicles took place in November 2015 and by the end of March 2016, 690 vehicles had been installed. Between April 2016 and August 2016 (when the installation phase was completed) a further 110 vehicles had telematics installed bringing the total number of vehicles installed to 800 (this figure is subject to change because of minor fluctuations in the size of the fleet).

Fire retardant work wear – We continue to deploy new sets of fire retardant workwear in 2016/17.

Farm safety – We commenced a new method of engagement with the farm community on safety issues via the country shows in our region in 2015/16 and during 2016/17 we targeted our safety messages and delivery of safety literature via seven shows in the region (five in Yorkshire and two in the Northeast) .

Improve environmental impact

We deployed PFT leak detection techniques to successfully locate and repair seven EHV fluid filled cable circuits in 2016/17 (six in Yorkshire and none in the Northeast). The time saved to locate these leaks, compared with traditional dig and freeze technique, saved approximately 4,500 litres of cable fluid that would otherwise have been lost into the ground. Location using PFT is quite an expensive technique and, whilst it does not actually deliver any significant cost savings relative to the traditional technique, it does reduce the number of excavations required and so reduces the impact of the leak location and repair activity on the local environment in terms of street-works disruption. The increased speed of leak location and reduced fluid loss also enables us to restore full network security more quickly and reduces the risk of prosecution under environmental legislation. We currently have a prioritised programme for a fluid exchange programme to add PFT to all leaking 132kV and EHV fluid filled cables so that as soon as the leak rate reaches threshold values we able to achieve a very rapid location and repair due to the fact that the cable already contains the PFT and the location only needs a leak location survey.

Improve connection performance

Constrained generation connections - Four further offers (all in Yorkshire) have been accepted by customers in the 2016/17 period. Information has been shown in the tables as the network impact additional to the lower level connection and therefore additions or disposals have been shown as they are associated with the lower level connection; not the larger flexible connection. The costs are de minimis and therefore not shown. Gross costs avoided are estimated counter factual costs and assume that the full MVA would still have been installed in the absence of a flexible or constrained solution; in practice the connection might have gone ahead as an unconstrained connection at a lower value negating any costs avoided but reducing the amount of generation connected.

Use of the RIIO-ED1 CBA Tool DNOs should use the latest version of the RIIO-ED1 CBA Tool for each solution reported in the Regulatory Year under report. Where the RIIO-ED1 CBA Tool cannot be used to justify a solution, DNOs should explain why and provide evidence for how they have derived the equivalent figures for the worksheet. The most up-to-date CBA for each solution reported in the Regulatory Year under report which are used to complete the worksheet must be submitted.
It should be noted that none of the initiatives reported in this return were initially justified by using the Ofgem CBA table. The information in our own CBAs has therefore been transcribed into the Ofgem CBA as best as reasonably practicable. Any expenditure incurred in 2016, for benefits realised in 2017 and projected beyond 2017, has been shown as a 2017 expenditure. CBAs have been completed in this way for the following items: • LV technology programme (Bidoyngs) • HV automation (APRS) • Telematics in operational vehicles • Fire retardant workwear • Farm safety • Cable fluid leak location • Oil regeneration We have not completed CBAs for capacity recovery or constrained generation. For capacity recovery, the costs are quite low but the payback can be quite random. For constrained generation connections, the CBA really lies with the connectee who has to consider the risks of occasional constraints on future cash flows vs the reduction in connection costs that can be achieved through these arrangements.

Changes to CBAs If, following an update to the CBA used to originally justify the activity in column C, the updated CBA shows a negative net benefit for an activity, but the DNO decides it is in the best interests of consumers to continue the activity, the DNO should include an explanation of what has changed and why the DNO is continuing the activity.
N/A

Calculation of benefits Explain how the benefits have been calculated, including all assumptions used and details of the counterfactual scenario against which the benefits are calculated.
Increase Network Capacity / Optimise Utilisation ***Underutilised Capacity Recovery*** – Actual capacity released by those customers who agreed to reduce the capacity of their connection agreement. The £0.5m / MVA benefit calculation is a ballpark estimate of average incremental distribution costs from a paper published by KPMG. ***Voltage Reduction*** – The benefits for generators, as a result of lowering the target 11kV (or 20kV) voltage at the primary substation will vary depending upon the local network topology. We have undertaken a desktop study of 65

existing LV feeders to identify the potential increase in generation export capacity if the voltage at the distribution substation was lowered.

Lowering the LV bar at a 11,000/400V distribution substation by 4V (from 252V to 248V) the average export capability per household increases significantly but the starting and revised export capability varies significantly by network, as follows:

	No. of customers on feeder	Max kW generation per customer at 252V	Max kW generation per customer at 248V	Total kW permitted generation at 252V	Total kW permitted generation at 248V
Average	*46*	*0.88*	*4.40*	*26.00*	*129.80*
Max	*106*	*3.18*	*15.86*	*59.66*	*298.30*
Min	*14*	*0.07*	*0.34*	*6.09*	*29.58*

From the above studies, the average increase in permitted generation export is 3.5kW per customer. However, after accounting for voltage rise in the HV network it would be prudent to reduce the expected increase in capability to, say, 1.5kW per customer.

NPg has 654 primary substations and 3.96 million customers. With an average of 6,050 customers per primary substation, the average increase in LV generation capacity is estimated to be 9MW per primary substation.

For the 85 primary substations completed in 2016/17, the expected increase in generation capacity is therefore approximately 765MW.

Improve asset life cycle management

Transformer insulating oil regeneration – Oil regeneration is expected to increase the residual service life by 10 years if it is undertaken with around 10 years residual service life remaining – i.e. it increases residual service life from 10 years to 20 years.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
Oil regeneration	-1.44	-5.15	-10.73	-15.59

Improve asset life cycle management

LV Technology Programme **(Bidoyngs)** – Estimate of CI / CML savings on substations where the Bidoyngs have been located and successfully operated on an intermittent fault, calculated from the avoidance of an over three minute interruption. An estimate of avoided overtime due to a reduction in fuse replacements during overtime and a reduction in EGS2 payments due to better fault location information reducing restoration times on permanent faults.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
LV Technology Programme (Bidoyngs)	2.70	1.64	0.94	0.23

HV automation **(APRS)** - For CI, the benefits are taken directly from the number of customers whose supplies were restored within three minutes. For CML, the counterfactual is based on long-run historical fault data, which shows that remote switching from the control centre took, on average, five minutes.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
HV automation (APRS)	2.18	1.90	1.72	1.54

Improve Safety

Telematics in operational vehicles – Benefits are seen in the reduction of the number of harsh driving events and fuel use. The technology is also helping significantly in the investigation of vehicle accidents. The fuel saving in 2016/17 is estimated to be £125k split 60:40 between NPgY and NPgN.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
Telematics	0.49	0.62	0.71	0.80

Fire retardant work wear – Reduction in serious injuries calculated from a review of actual flashover incidents and a qualitative assessment of what injuries could have been sustained without the protection provided by the workwear.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
Fire retardant work wear	2.78	3.34	3.63	3.91

Farm safety – A noticeable reduction in incidents involving farm machinery coming into contact with our overhead lines multiplied by the number of injuries occurring historically.

	NPVs based on payback periods following one year investment (£m)			
	16 years	24 years	32 years	45 years
Farm safety	0.26	0.25	0.24	0.24

Improve environmental impact

Fluid filled leak location - In table E6 we have included the actual cost of PFT treatment on the six circuits to which it was applied in 2016/17 and have shown the avoided costs to be the same[#]. The oil leakage benefit is calculated from the average leak location timescale being reduced from 28 days to 3 days. This 25 day saving is multiplied by the average leak loss per day to give the fluid loss benefit. For the six circuits in 2016/17 the approximate saving in fluid loss due to the PFT method of location was 6 circuits * 30 litres per day * 25 days quicker location = 4,500 litres; 4,500 litres for the six cables in Yorkshire.

(# The PFT treatment costs presented in Table E6 are the total costs of fluid exchange and leak location survey on the seven circuits in 2016/17, which works out on average to be £67k per circuit – However, when one takes into account the fact that the PFT treatment by fluid exchange sets the cable up for all future leaks to be located without further PFT dosing.)

	NPVs based on payback periods following one year investment (£m)

	16 years	24 years	32 years	45 years
Fluid filled leak location	0.05	0.05	0.05	0.05

Improve connection performance

Constrained generation connections – The benefits are calculated from a simple comparison between the constrained and the unconstrained connection quotations.

Cost benefit analysis additional information
Please include a reference to the file name and location of any additional relevant evidence submitted to support the costs and benefits inputted into this worksheet. This should include the most recent CBA for each solution reported in the Regulatory Year under report.

A summary of the CBA tables are included in this report.

E7 – LCTs

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.

The methodology used to report the data has allowed allocating the LCTs to the relevant Northern Powergrid licence with a good level of accuracy.

We assumed that no heat pumps or DG (G83) were connected to the primary network.

LCT – Processes used to report data
(i) Please explain processes used to calculate or estimate the number and size of each type of LCT.
(ii) If any assumptions have been made in calculating or estimating either of these values, these must be noted and explained.

Heat pumps
The source of data for heat pump installation and capacity is e-serve in Ofgem, through the public reports.
By adopting this report, we have made the following adjustments:

- We have adopted e-serve's reporting year, which starts in May, rather than April.
- We have adopted a regional split based on administrative border rather than DNO licence borders

Electric vehicle chargers
The source for Electric Vehicle chargers data is the connection notifications that the installers send to Northern Powergrid. No assumptions or estimations were made on this data before reporting the values in the table.
DG (G83):
The source for DG (G83) data is Ofgem (e-serve). Customers who install small renewable generation are incentivised to declare it to Ofgem through the Feed-In-Tariff scheme. This results in a higher level of accuracy for this data source compared to that held by Northern Powergrid. We have made the following low-risk assumptions whilst using the data source:

- "Commissioned date" corresponds to the connection date of the LCT,

- "Installed capacity" corresponds to the size of the LCT installed, we use it to filter the G83 from non-G83

We have restated 2015/16 numbers in order to remain true to the database, which is updated every quarter, and after consultation with the team in Ofgem (e-serve) responsible for the report. This resulted in an approximate 10% increase of that particular category of LCT in that year (volume and capacity)

DG (non G83)
The source for DG (non G83) data is the connection request database held in Northern Powergrid.

LCT - Uptake
Please explain how the level of LCT uptake experienced compares to the forecast in your RIIO-ED1 Business Plan and the DECC low carbon scenarios. This must also include any expectation of changes in the trajectory for each LCT over the next Regulatory Year in comparison to actuals to date.

Our forecast of LCT uptake in our licence areas, over the RIIO-ED1 period was quantified in our submission back to Ofgem of Table CV103 in 2014.

The rate of LCT uptake is highly sensitive to government's stimuli and also depends on the market's ability to find profitable business models.
During the regulator year 2015-16, a reduction took place on FiT and RHI, and Renewable Obligation (RO) closed on new onshore wind operators. As a result, and in line with our expectations, the DG and heat pumps uptake in 2016-17 is lower than in the previous year. This is particularly true at the DG (G83) level.

Our expectation is that DG volumes will stabilise at similar volumes in the short term followed by a pick-up, as markets identify new business models; and that the deployment of EV chargers remains stable with commercial deployments largely of fast chargers.

Heat pumps
Our LCT growth projection for the 2015-23 period was based on a Low HP forecast scenario. In Yorkshire and the Northeast, the actuals are well below forecast (both in terms of number of installations and input electrical capacity).

Electric vehicle chargers
Our LCT growth projection was again based on Low EV forecast scenario.
The comparison between Actuals versus forecast shows that EV chargers are behind forecast, especially in Yorkshire. We do not expect the trend on slow chargers to pick up but rather for the market to gradually move towards fast chargers mainly.

Photovoltaic (G83 and non-G83)
Our LCT growth projection was based on the low DECC forecast for HV and EHV, and the medium DECC forecast for LV.
As last year, the actuals are well below forecast level in terms of number of installations, but nearing it in terms of capacity. This confirms the evolution of the market in the last couple of years towards bigger size installations, which is especially acute in Yorkshire. Also, the number of small installations (G83) has dropped significantly year over year, which was unforeseen in the projections.