



electricity
north west

Bringing energy to your door

Second Round of Climate Change Adaptation Reporting



Second round of Climate Change Adaptation Reporting

Electricity North West Summary

1. Introduction

This document sets out the activities that have been undertaken by Electricity North West in response to the challenges of climate change, since our initial report in June 2011.

It is designed to be read in conjunction with the ENA Engineering Report – “Climate Change Adaptation Reporting Power - Second Round” which is attached as an appendix to this document. Electricity North West was an active member of the ENA working group which produced this engineering report.

Whilst the ENA report looks at the national picture and follows the structure and questions suggested in the Defra guidelines of December 2013, this document is designed to provide a brief summary of the activities within Electricity North West.

We will briefly look at:

- a review of the conclusions of our 2011 report, which have led us to concentrate on reducing the risk from flooding
- how we select the assets that we will protect from flooding risk and examples of the types of protection that we employ
- how our flood protection programme is financed through the price control process
- how the work at 132kV and 33kV substations will reduce the risks to customers
- Electricity North West’s commitment to delivering our flooding programme
- how we monitor the number of faults we have on our system and their causes
- how we are incentivised to reduce the number of faults from all causes, including weather related faults
- the work we are doing on tree cutting to improve resilience
- how we engage with a range of stakeholders
- how the national work on flood protection has been recognised by the Adaptation Sub Committee of the Committee on Climate Change

2. Conclusions following our 2011 report

Whilst we continue to work with colleagues in industry and academia to identify potential risks from climate change, the science has not moved on significantly since 2011, so the challenges we face today are the same as those we faced four years ago. These were summarised in our 2011 report as follows:

Extract from the covering letter to our Climate Change Adaptation Report - June 2011

At Electricity North West we are aware that climate change will have an impact on the infrastructure that we are responsible for. We are undertaking work to meet current challenges and we are taking part in a number of research projects to quantify the impact in the future.

However the impact of climate change will be just one of the drivers for change on our network over the next forty years. The move to the low carbon economy with the introduction of smart grid technology, the connection of new generation and the growth in use of electric vehicles will lead to major changes. This will take place at the same time as we are replacing aging assets.

Consequently we expect that much of the work to adapt to climate change will be built into our ongoing business-as-usual procedures.

The main potential impacts identified for Electricity North West can be summarised as follows:

- **Flooding** – we expect that the number of flooding incidents will increase and we are currently taking action to protect vulnerable substations from floods. We have already improved flood defences at 28 substations, with plans in place to upgrade defences at a further 22 substations by 2014.
- **Increase in temperature** – as temperatures increase the performance of our equipment will change. Typically we expect this to reduce the capacity of the equipment by less than 0.2% per year. We expect demand on our network to increase by up to 2% a year in the long term, so the climate change adaptation activity will be built into our programme to meet increased load.
- **Increased vegetation growth** – change in climate is expected to lead to an acceleration in the rate that trees grow, so we will need to modify our inspection and cutting programmes to minimise the interference from trees on our overhead lines.
- **Resilience to extreme events** – whilst all electricity networks can be vulnerable to lightning and high winds there is currently no evidence to suggest that the intensity of these events will increase in the future. We will continue to work with industry experts to monitor research in this area.

With the exception of flooding we expect that the impacts on our business from climate change will be gradual, largely indistinguishable from other factors, and that we will be able to deal with them with a long term approach. We will continue to work with our colleagues in the industry and other expert bodies to regularly assess our vulnerability to climate change, and we will adapt our policies and procedures accordingly when required.

Consequently our major focus in adapting to climate change has been in the development of defences against flooding, so this document concentrates on our work in this area.

We have also been active in protecting our network from trees that may fall during high winds, both through the ENA committee which is reviewing the guidance on vegetation management and through the delivery of our tree cutting programme. We also provide an update on this activity.

We are not complacent about other risks from climate change, so climate change, climate change adaptation and flooding are all included as risks in our corporate risk register. The register is reviewed regularly at the highest levels within the company. As flooding is one of our higher scoring risks, updates are provided to the Chief Executive and his leadership team on a monthly basis.

We continue to support research work undertaken in the academic community and with other network companies to identify and investigate other potential impacts of climate change.

3. Identifying assets at risk from flooding

Our response to managing the risk of flooding has been guided by the Energy Networks Association's (ENA) *Engineering Technical Report ETR 138 - Electricity Substation Resilience to Flooding*. This sets out industry guidance on:

- standards of resilience
- how to take account of increasing risk due to climate change
- methods of assessing the likelihood and impact of flooding
- measures to reduce flood risk
- cost-benefit analysis of measures.

Electricity North West was an integral part of the ENA group which developed ETR 138, working with representatives from other network companies, Ofgem, DECC, the Environment Agency (EA), Scottish Environment Protection Agency and the Met Office.

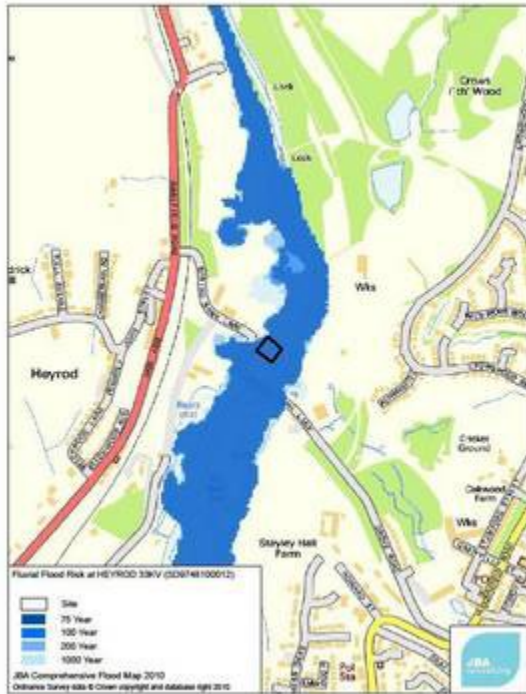
Following ETR 138 guidance we use the Environment Agency Flood Maps and other supporting data to identify major substations that are at risk of flooding. The EA maps show areas that would be affected by flooding, if there were no defences, categorised as follows:

- flooding from a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.
- flooding from the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year;
- a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.
- areas where flooding from rivers and the sea is very unlikely. There is less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.

We will then plan our work programme to prioritise those substations where the largest number of customers are at the greatest risk of interruptions to supply due to flooding.

The diagrams below show examples of flood risk maps for an area of Stalybridge containing two substations, illustrating both the fluvial risk from streams and rivers and the pluvial risk due to surface water in periods of heavy rain.

Fluvial flood risk at Heyrod 33kV



Pluvial flood risk at Heyrod Primary



The type of flood defence to be deployed will depend on the flooding risk and the layout of the substation to be protected. It may take the form of a waterproof membrane, such as the one protecting the switchgear house in the following illustration:



or we may increase the height of a bund wall as in the picture below. The bund wall will originally have been built to protect against oil escaping into the environment if a leak occurs. By increasing the height of the wall it will also protect against flood water entering the substation and affecting the equipment inside the wall.



We only employ permanent flood defences at our major substations, connected at 132kV and 33kV. If flooding occurs at lower voltages it will usually be the case that the communities that those substations serve will also be flooded, so for safety reasons we will disconnect those properties from the electricity supply. Once the flooding has subsided we will then check that every property is safe before re-energising the supply. This will involve an engineer entering each property individually.

Our experience in flooding incidents in Carlisle in 2005 and Cockermouth in 2009 has shown that for the lower voltage substations we are generally able to repair or replace any damaged equipment before customers' premises have been dried out sufficiently to be re-connected to the network.

We do have the ability to deploy temporary flood defences when we receive a warning from the Environment Agency of a flood that may affect one of our substations. This is illustrated in the picture below showing a HV substation in Burnside, Carlisle, being protected from flooding in January 2015.



In addition to the basic level of protection provided by sand bags, we have temporary flood protection equipment located at seven of our major sites which can be relocated as required. Additional support from our contractors is also available through our civil framework contracts during period of heightened risk identified through weather warnings and flood alerts.

We are also reviewing our substation flood protection policy as it relates to distribution substations located in basements of buildings, especially in Manchester city centre.

4. Financing our programme of work

As a monopoly network company our income is regulated. Our allowed revenue is agreed at periodic price reviews, based on our planned programme of works. Because our economic regulator, Ofgem, was involved in the development of ETR 138, they are fully aware of the issues that we are facing from flooding and the processes that we are following to mitigate the risks.

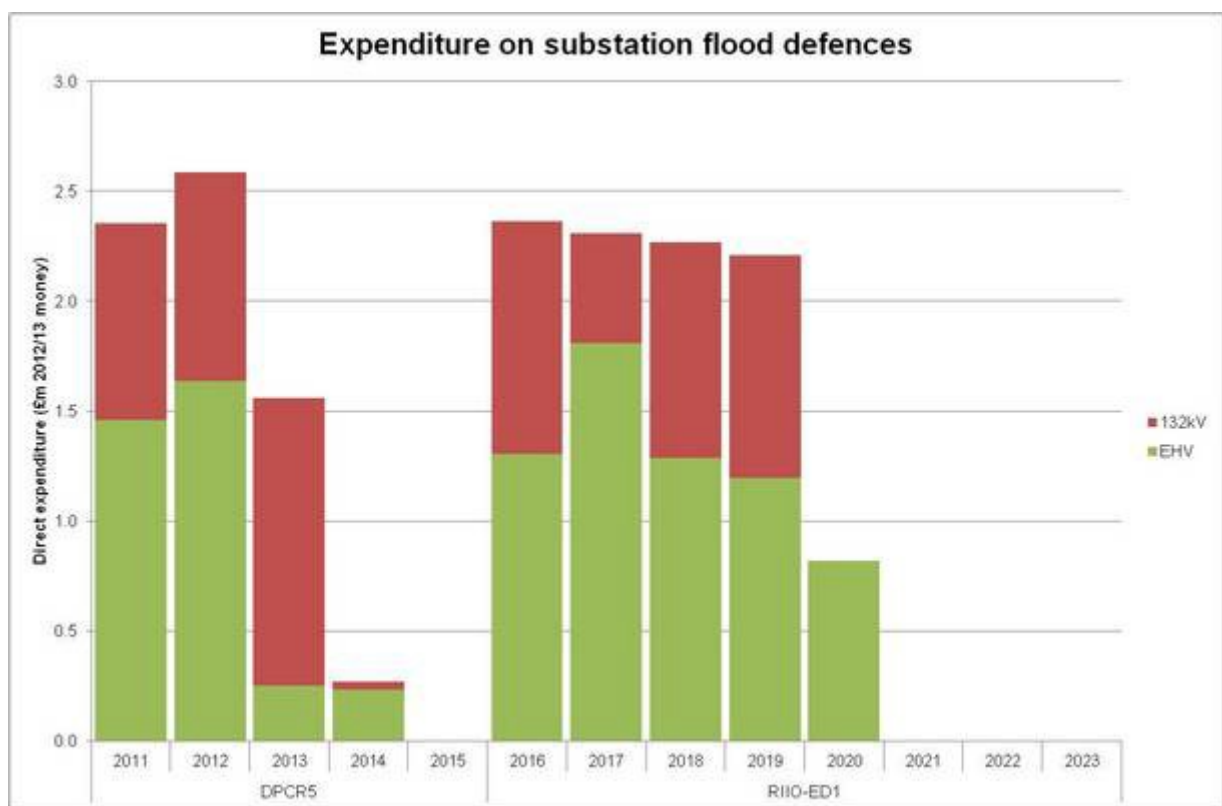
Consequently in both the DPCR5¹ price review, for the period from 2010 to 2015, and the RIIO-ED1² review, for the period from 2015 to 2023, the regulator agreed that our submission for flooding expenditure was appropriate and made no adjustments in calculating our allowances.

¹ DPCR5 is the fifth Distribution Price Control Review

² RIIO-ED1 is the first electricity distribution price review under the RIIO framework (RIIO: Revenue = Incentives + Innovation + Outputs)

Our programme for DPCR5, where we spent £6.8m mitigating flooding risk at 31 major substations was completed in 2013/14. In the RIIO-ED1 period we plan to spend £10m protecting all remaining major substations to at least a 1 in 100 year flooding risk in line with ETR 138. We plan to complete this work by the end of 2019/20. This will include provision for the forecast impact of future climate change as outlined in our 2011 Climate Change Adaptation Report

Our expenditure profile for flooding over the last five years and the forecast for the next eight years is shown in the following chart. We accelerated the programme of defence installation in DPCR5 to deliver our commitment earlier than originally planned. The revised maps to enable study of pluvial (surface water) risk were issued by the EA in early 2014, enabling us to plan for the development of this further phase of flood protection to be delivered early in the RIIO-ED1 period.



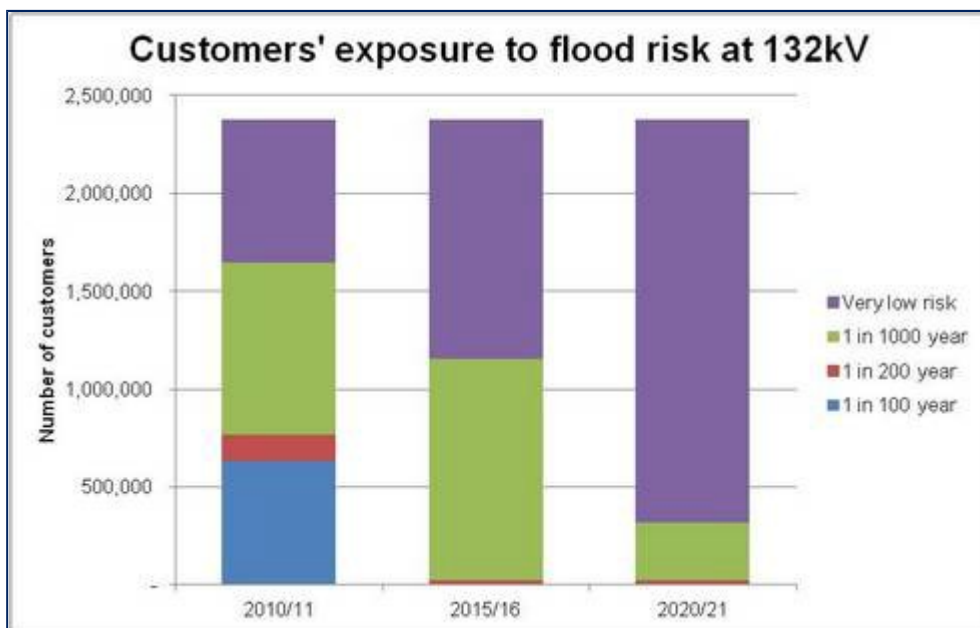
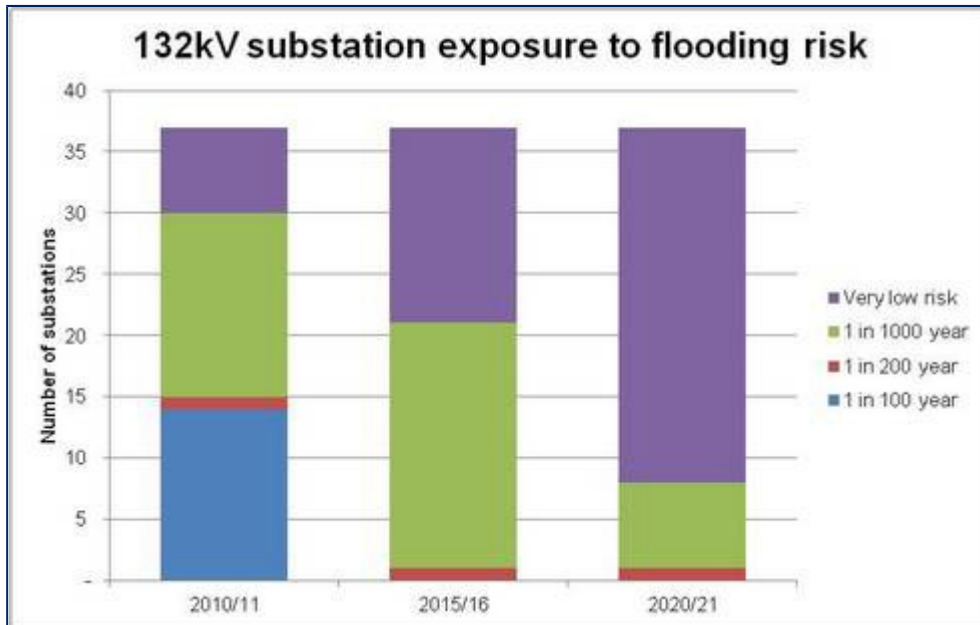
5. Work at our 132kV substations

All our 2.4m customers will be supplied from one of our 132kV substations and we have assessed the flood risk for all of them. The charts below illustrate how the exposure to flooding risk will change at those substations where a flood risk has been identified and the number of customers this will affect.

The risk levels shown in the charts are based on those used in the EA Flood Maps but take into account the impact of the flood defences.

It can be seen that at the start of the DPCR5 period in 2010/11, 14 substations, supplying 634,142 customers were at risk from a 1 in 100 year flood. Work at these substations means that by the end of 2014 there were no 132kV substations exposed to this level of risk.

It should be noted that not all reduction in risk will be due to flooding expenditure. At some substations we will be doing other work, such as asset replacement, and we will ensure that the new assets will have measures of flood risk mitigation built in, such as placing switchgear on elevated platforms. In this way managing flood risk will become part of our business-as-usual programmes.

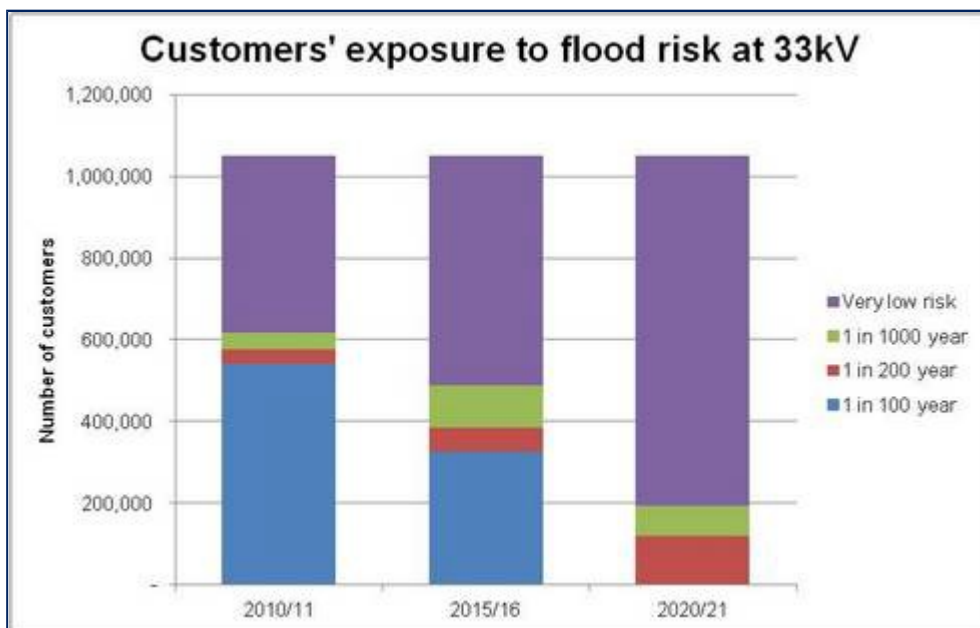
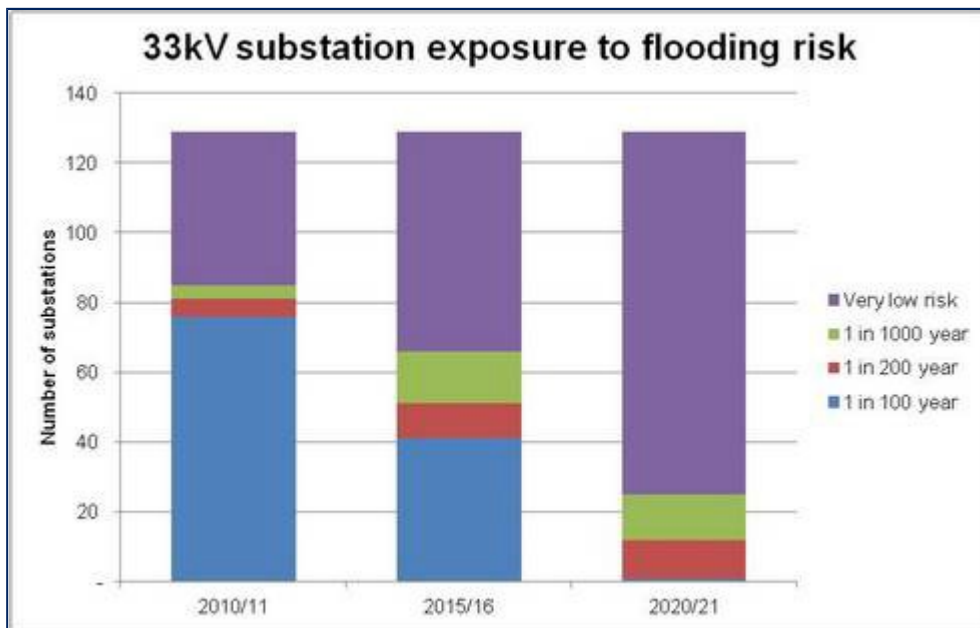


6. Work at our EHV substations

We initially undertook desktop studies for all our EHV (33kV) substations, which identified 129 sites that were at risk from flash flooding. These serve just over 1m customers. We then completed detailed studies of each of these substations to identify the level of risk and the investment required.

As with the 132kV network the charts below illustrate how the flooding expenditure programme will reduce the exposure to risk of these customers.

The figures for 132kV and 33kV are presented separately to avoid the double counting of customers.



7. Electricity North West Output commitments

In our price review submission for RIIO-ED1, the Well Justified Business Plan³, we have made 40 commitments to our customers which we will deliver in RIIO-ED1, known as Outputs. They have been developed following stakeholder consultation and reflect the obligations placed on us as a distribution business.

Our Output for flood risk mitigation reads as follows:

³ <http://www.enwl.co.uk/about-us/regulatory-information/business-plan>

Flooding risk – we will continue our programme of protecting substations against the risk of flooding. All our major substations identified as being at risk will be protected against a once in 100 year flooding risk (in line with the national specification ETR 138) by the end of RIIO-ED1.

We will be publishing our progress against this target annually from 2016 as part of our obligation to report on all our output commitments.

Whilst there is no direct financial incentive in place for output commitments Ofgem will use our historical performance to judge how credible our plans are at future price reviews.

8. Monitoring and evaluation of network reliability

As noted in the ENA Engineering Report attached to this submission, as an electricity distribution company we have a comprehensive system of recording and reporting the occurrence of faults, in particular their causes.

Eleven of the cause categories are weather related:

- Lightning
- Rain
- Snow, Sleet, Blizzard
- Ice
- Freezing Fog and Frost
- Wind and Gale (excluding Windborne Material)
- Solar Heat
- Airborne Deposits (excluding Windborne Material)
- Condensation
- Flooding
- Windborne Materials

So using our fault data we can monitor how weather and climate is affecting the reliability of our network, which enables us to identify trends and respond accordingly.

9. Incentives on network reliability

In the ENA report we also discuss the incentives to avoid loss of supply through the Interruptions Incentive Scheme (IIS) and the Guaranteed Standards of Performance, which apply to all types of interruptions due to faults.

Under the IIS scheme we agree targets with Ofgem for the number and duration of interruptions and we can gain additional revenue by beating these targets or lose revenue if we do not meet them. The cost of an individual customer going off supply for over three minutes is currently approximately £15, with every additional minute costing a further £0.37⁴.

At the start of the RIIO-ED1 period our IIS targets for unplanned interruptions is that on average customers would lose supply due to an unplanned incident every 26 months and that interruption would last an average of 88 minutes. We are expected to improve performance over the eight year period so in the final year of the price control period our target is an interruption every 27 months which would last an average of 80 minutes.

⁴ Figures quoted in 2012/13 money before application of IQI efficiency factors.

Our exposure to IIS is capped at £13.6m each year (in 2012/13 prices), which means that if we perform well we can gain up to that amount, but if we perform badly it will cost us up to £13.6m.

Under the guaranteed standards scheme, if a domestic customer is off supply for more than 12 hours we will pay them £75, with an additional £35 for each subsequent 12 hour period. A non-domestic customer will receive £150 for the first 12 hours. Our exposure to guaranteed standards payments is not capped.

These incentives give us a clear financial signal of the importance of keeping customers on supply, whether the risk is weather related or from another source.

10. Vegetation management

Vegetation management is an important area of work for us because falling trees and branches interfering with overhead lines can be a major cause of faults, particularly in stormy weather. We currently spend over £3m annually on cutting and felling trees.

We have two programmes of vegetation management, which are referred to by the names of the technical guidance documents we follow: ENATS 43-8, which focuses on safety compliance, and ETR 132, which focuses on network reliability.

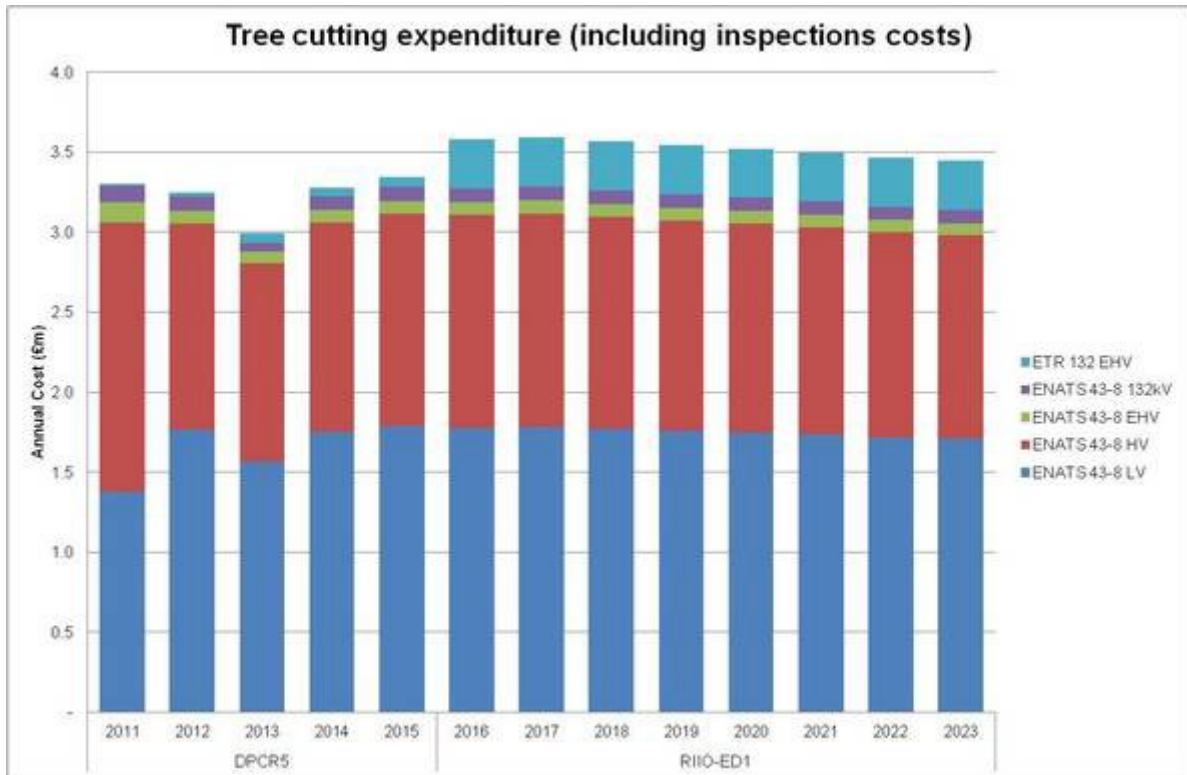
- ENATS 43-8 is the Energy Networks Association Technical Specification for Overhead Line Clearances, published in 2004. Under this programme we cut back vegetation to meet legal requirements for the clearance from overhead lines, with the intention that we would normally return every five years to ensure safety compliance.
- ETR 132, *“Improving Network Performance Under Abnormal Weather Conditions by Use Of A Risk Based Approach To Vegetation Management Near Electric Overhead Lines”*, deals specifically with the risk of disruption due to falling or uprooted trees in storms. This will generally require a higher level of cutting or complete removal of the tree.

ENATS 43-8 is our ‘routine’ programme of cutting back trees to avoid contact with overhead lines. In our initial Climate Change Adaptation Report we observed that climate change could cause an acceleration in vegetation growth, which would lead us to modify our inspections and tree cutting programme. Current observations are that whilst we have had individual years of above average growth, we have not seen a sustained impact yet, so our routine cycle of work remains unchanged.

ETR 132 is a specific programme to reduce the risk of trees falling into lines in stormy conditions. Since the programme started in 2009 we aim to make 0.8% or 86km of our overhead network resilient to the risk of falling trees each year, in line with industry recommendations. Our initial focus has been on our EHV network because this is where the greatest numbers of customers are at risk.

Following the winter storms of 2013/14 a review of ETR 132 has been initiated, to ensure that any lessons learned from those storms are reflected in the document and particularly the potential impact of prolonged heavy rainfall and high winds.

Our annual expenditure on both programmes for the last five years and the next eight years is shown in the chart below.



For both ENATS 43-8 and ETR132 tree cutting programmes we are meeting our targets for delivery. Whilst we have not seen the impact of climate change in this area yet, ensuring that we are meeting or beating our targets means that we are in a good position to move forward should an acceleration to our regular programme be required.

11. Stakeholder engagement

In developing our business plan we regularly consult with customers and other stakeholders to understand what their priorities are. However a challenge we face is that many customers are unaware of the industry structure and our place in it.

For our RIIO-ED1 submission we worked with an ‘engaged consumer panel’. These were a group of customers that had some knowledge of the industry, who then received further briefings on Electricity North West and our role as a Distribution Network Operator (DNO). While ‘engaged consumers’ are no longer representative of the population at large, their views provide a customer perspective on particularly complicated issues, including long term investment decisions, that ‘typical customers’ tend to be unwilling or unable to discuss.

In our initial survey in 2012 the panel were invited to answer 30 questions. For each question the panel were asked whether they would pay more to achieve a higher level of service or reduce payments for a lower level. The survey included three questions which are specifically associated with the issue of the impact of climate change.

2012 Engaged Customer Panel Survey - Climate Change questions

Full Question	Question descriptor for report/tables	Low	£ decrease	Medium/default proposal	£	High	£ increase
Growing trees have a major impact on our power lines and we cut them regularly to minimise the chance they will cause disruption in big storms. What should our approach be in this area?	Cutting trees near overhead lines	Spend less money on tree cutting, increasing the risk that in big storms supply will be disrupted.	0.150	Carry on as we are by cutting trees near our lines every five years so that they are unlikely to come into contact with our lines in a storm.	0.450	Spend more money, minimising the chance that in a storm there will be a power cut.	0.150
We can invest money in protecting your supply from very rare events. What should our approach be to large floods?	Protection against flooding	Protect all major substations from the type of large floods that might only be seen once every 100 years, increasing the chance that when floods occur your supply will be affected.	0.150	Protect the most important substations from floods that might occur once every 1000 years, and all other major substations from the type of large floods that might only be seen once every 100 years.	0.150	Protect all major substations from floods that might occur once every 1000 years, reducing the chance that when floods occur your supply will be affected.	0.300
We can invest money in protecting your supply from very rare events. What should our approach be to the risk of large storms and severe weather?	Protection against storms	The risk is so low that we do not need to invest at all, increasing the chance that if storms or severe weather occurs your supply will be affected.	0.150	Invest to strengthen the resilience of our most important overhead lines.	0.150	Extend our programme of investment beyond the most important overhead lines to include all lines serving major population centres, reducing the chance that in storms or severe weather your supply will be affected.	0.150

All the thirty questions were asked twice. Once without any costs associated with the improvements and once with costs, as in the examples above. Before knowing the impact on their bill, customers opted for investment which would cost an additional £6.03 annually. After considering the impact that investment decisions would have on their bill, willingness to fund drops to £2.27 above the cost of our ‘medium’ investment level.

For the three climate change questions customers supported our proposals and in the case of tree cutting near overhead lines and resilience to storms, they were prepared to pay for interventions above our default proposals.

We also continue to engage with colleagues in industry and academia to look at the potential impacts of climate change. At Electricity North West we spend around £3m each year on our innovation programmes which funds the research and development required to build a sustainable network.

The two specific projects related to climate change in the DPCR5 period were:

Innovation Initiative	Project Cost
Investment Planning - Network Resilience - Investigation into the potential impacts of climate change on network resilience	£24,000
Investment Planning/Network Operation – Vegetation Management - Identification and definition of vegetation growth rates as affected by climate	£298,000

We worked with the Met Office and other DNOs on the EP2 project to assess the potential impact of climate change on electricity networks. On average 20% of all faults on the low voltage overhead network are related to tree-induced damage. Using Met Office projections relating to the future effects of temperatures, we commissioned work on future vegetation growth rates in defined UK bioclimatic zones.

The outcome of this research will allow us to produce mitigation measures and accurate expenditure forecasts for tree cutting, flood resilience and electricity demand fluctuations attributable to climate change. This means customers will benefit from greater network reliability and reduced asset replacement costs.

As noted in the ENA annex to this document network companies are currently working with Newcastle University to look at potential changes in wind speed and with Manchester and Newcastle universities looking at network resilience.

During RIIO-ED1 we will commission new studies and innovation projects as appropriate, either individually or through a consortium of network companies.

12. External endorsement

In July 2014 the Adaptation Sub-Committee (ASC) of the Committee on Climate Change published their progress report: *“Managing climate risks to well-being and the economy”*.⁵

In this report the ASC recognise the work of Electricity North West and the other network companies, noting that:

Electricity transmission and distribution companies are implementing comprehensive strategies to safeguard the resilience of their networks to climate change.

⁵ http://www.theccc.org.uk/wp-content/uploads/2014/07/Final_ASC-2014_web-version-4.pdf

Electricity transmission and distribution companies are

- i) assessing risks from climate change,
- ii) taking action to build resilience and
- iii) reporting on the delivery of resilience measures in a transparent manner.

Electricity transmission and distribution assets were severely disrupted during the 2007 floods. Since then, coordinated steps have been taken with the economic regulator Ofgem to assess current and future flood risk, establish standards of protection and deliver a programme of resilience measures. Once implemented, nearly 90% of customers currently reliant on substations at high risk will have been protected by the 2020s, even after accounting for projected increases in the likelihood of flooding with climate change.

Electricity transmission and distribution: The National Fault and Interruption Reporting Scheme (NaFIRS) mandates that distribution network operators (DNOs) report disruptions using common classifications, including weather and environment-related events. Between 1995 and 2012, 35% of all customer minutes lost from high-voltage substations were due to natural hazards. High winds and storm damage were the major causes of weather-related disruption. Although less frequent, flooding caused the longest average length of disruption per incident.

The following table taken from the report summarises the ASC view, based on the evidence provided by each of the sectors:

Table 3.1: Summary of the ASC's assessment of progress in improving resilience and adapting to climate risks

Sector	Risk assessment	Resilience measures	Progress reporting
Electricity transmission and distribution	●	●	●
Rail	●	●	●
Strategic Road Network	●	●	●
Ports	●	●	●
Airports	●	●	●
Water	●	●	●
ICT	●	●	●

Source: ASC.
Notes: These colours refer to whether we have complete (Green), partial (Amber), or no evidence (Red) for the following:
 – Risk assessment: Evidence of detailed assessments to understand how current weather and projected changes in climate are likely to affect operations.
 – Resilience measures: Identification of resilience measures to reduce risks based on cost-benefit assessments (sector/companies may not be on track to achieve all their targets).
 – Progress reporting: Regular reporting on progress in implementing resilience measures in a clear and publicly available format (this information may not be in a specific publication focusing solely on resilience).
 Note that an Amber may mean that some, but not all, companies within a sector provide evidence.

It can be seen that the electricity networks companies are the only sector to have provided evidence of compliance in all three areas. Pages 75 to 78 of the ASC report give further details on their assessment of the network companies.

13. Summary

The ASC report firmly endorses the strategy adopted by Electricity North West and the other electricity network companies. We believe that we are at the forefront in applying these strategies with:

- Well established risk assessment procedures
- Well developed programmes of resilience measures, both through our flooding programme and our tree cutting programmes
- Progress reporting through our annual regulatory reporting cycle

Our flooding programme remains our main area of adaptation work because of the immediate risk it poses to our customers and we plan to complete that work by 2020.

Whilst we have not experienced a sustained increase in the rates of tree growth yet, the fact that we are successfully meeting all our targets for vegetation management means that should the expected acceleration occur, we are well positioned to meet the challenge.

We will continue to monitor other potential impacts and work with our partners to investigate solutions if required, but as noted in our original submission, the scale of these impacts is likely to be dwarfed by the other work which we will be undertaking on our network to facilitate smart grids and load growth, so our climate change work will be largely indistinguishable from business-as-usual.