

Adaptation to climate change report to Defra

Second round report 2016

Report to Defra

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Overview:

In addition to efforts to reduce carbon emissions (mitigation), the energy sector must prepare for the effects of an already changing climate.

The Climate Change Act (2008) introduced a reporting duty (the Adaptation Reporting Power, or ARP) on certain public and commercial organisations to produce reports on the current and predicted effects of climate change on their organisation, and their proposals for how they will adapt to these.

We first reported on these issues in 2011. This report provides an update to our 2011 report and satisfies the second round of reporting requested under the ARP.

In addition to understanding the direct risks to our day-to-day operations, we have a responsibility to develop regulatory frameworks to support and promote a resilient and adaptive infrastructure sector, which in turn allows network companies to identify and respond to climate risks.

Context

In addition to efforts to reduce carbon emissions (mitigation), the energy sector must prepare for the effects of an already changing climate.

The importance of ensuring a resilient, well-adapted energy sector was recognised as a key priority by the UK Government's Climate Change Risk Assessment (UK CCRA).

The energy sector is also undergoing a major transitional period as generation is increasingly decarbonised, and new scales of delivery (eg distributed energy) and demand trends (flexible, smart systems) start to emerge.

To help address these challenges, the Climate Change Act (CCA) 2008 gives the Secretary of State the power¹ to direct reporting authorities – including Ofgem - to produce reports detailing:

- the current and future predicted impacts of climate change on their organisation.
- proposals and policies for adapting to climate change,
- progress towards implementing the policies and proposals set out in previous reports.

In preparing this report we have paid regard to:

- Ofgem's first Adaptation Report prepared under s56 CCA, issued in 2011;
- The most recent programme for adaptation to climate change which the Govt published pursuant to s. 58 CCA 2008;
- Guidance issued by the SoS under s. 61 CCA 2008 as regards the preparation of this report;

We first reported on these issues in 2011. This report provides an update to our 2011 report and satisfies the second round of reporting requested under the ARP.

¹ Adaptation Reporting Power (ARP).

Associated documents

[Invitation to report under the second round of Adaptation Reporting](#)

Published: 2013

[Adaptation to Climate Change: Report to Defra 2011](#)

Published: 2011

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Executive Summary

The energy system is undergoing a radical low-carbon transformation in line with our national and international climate change mitigation commitments. At the same time, our climate is already changing and will continue to do so in the future. This report examines how Ofgem and the regulated energy sector is adapting so it is resilient to the impacts of climate change. It provides an update to our first adaptation report which was published in 2011.

Our principal objective is to protect the interests of existing and future gas and electricity consumers. We do this through a variety of means, but those of most relevance to supporting and promoting adaptation resilience in energy networks include:

- Agreeing the framework for setting **price controls for electricity and gas network companies**. The gas and electricity networks are regulated monopolies, and we set the revenues the network operators can earn. Within this revenue, we set allowances for investment in network maintenance and improvement which is carried out, and forms part of the overall cost to consumers.
- The **licensing** of smart meter communications in gas and electricity, of gas shipping, transportation, interconnection and supply, and electricity transmission, distribution, interconnection, generation and supply activities. This includes placing obligations on the various sectors with the overarching objective of protecting consumers.
- Promoting **security of supply and sustainability**, for present and future generations of consumers, domestic and industrial users. This involves close cooperation with government and the wider energy sector to understand changes in demand and generation and ensure a reliable and secure system.

Our adaptation report primarily focuses on the gas and electricity network companies responsible for transporting gas and electricity from the point of generation (or gas terminal or storage) to households and businesses. This focus reflects the scope of our powers and is in line with our ability to influence the resilience of this part of the sector via our regulatory tools.

In preparing our report we have considered the evidence of climate impacts facing the network companies, and met with industry stakeholders to discuss their plans.

In line with Defra's reporting guidance our report specifically addresses the following areas:

- Understanding of climate risk
- Understanding uncertainties
- Implemented and new actions
- Addressing barriers and understanding interdependencies
- Monitoring and evaluation
- Opportunities and benefits

Conclusions

As reported in 2011, Ofgem's own operational vulnerability to shorter-term (weather related) and longer term (climate change) risks is considered to be low. However, we continue to take appropriate action to enhance our resilience.

In line with the findings of our 2011 report, we consider that we have robust regulatory policies and approaches in place to ensure that the regulated energy system delivers a secure and reliable supply to customers; and that the network companies are responding to the challenge of adapting to climate change.

We have delivered this during the 2011-2015 period principally through our introduction of the RIIO framework – which incentivises network companies to deliver safe, reliable and sustainable network services at long-term value for consumers – and the licensing obligations and conditions we place on network companies and others to ensure system security, availability and quality. These measures have helped support and promote greater resilience within the regulated energy sector.

It is also clear that the energy sector is undergoing a major transitional period as generation is increasingly decarbonised, and new scales of delivery (eg distributed energy) and demand trends (flexible, smart systems) start to emerge. This means that the long term resilience of the sector needs to take into account risks to both current and new types of infrastructure, as well as consider future uncertainties and the interdependencies between sectors. Overall, our findings into the state of preparedness and resilience of the regulated energy sector suggest that the majority of electricity transmission and distribution companies are effectively identifying and assessing climate risks, and taking proportionate actions to build resilience. These findings are also consistent with the Adaptation Sub-Committee (ASC) 2014 report into the climate resilience of the UK's infrastructure.

We consider that risks and uncertainties are well understood across the sector, and that the network companies are continuing to work to address barriers and identify interdependencies within and beyond the energy sector. We are also confident that our regulatory tools enable us to drive the action required from the network companies to address any shortcomings identified, such as those noted in our DPCR5 performance report.

As we enter the next ARP reporting period, we believe that the energy sector is well placed to develop and enhance its resilience to climate change.

1. Scope of the report

Introduction

1.1. The energy system is undergoing a radical low-carbon transformation in line with our national and international climate change mitigation commitments. At the same time, our climate is already changing and will continue to do so in the future. This report examines the impact of climate change on Ofgem and the energy industry it regulates, and the adaptation measures taking place within Ofgem and the energy industry to ensure resilience. It provides an update to our first adaptation report which was published in 2011.

1.2. This report follows the reporting guidance and structure required by Defra.

Who we are and the scope of the report

1.3. Ofgem is the Office of Gas and Electricity Markets. We are a non-ministerial government department, an independent economic regulator established in statute, a National Competition Authority, and a National Regulatory Authority under EU directives. We work effectively with, but are independent of, government, the energy industry and other stakeholders to make a positive difference for energy consumers.

1.4. The energy sector is made up of a range of different assets and actors, including large scale generation (such as gas, coal and nuclear plants), distributed generation (such as solar PV and onshore wind), interconnectors (that provide electricity connection to the continent), gas terminals, gas shipping, plus gas and electricity transmission and distribution networks and end users. As an interdependent system, all parts of the sector need to plan for the impacts from climate change.

1.5. Our adaptation report focuses on the adaptation measures applying to Ofgem and to the gas and electricity network companies responsible for transporting gas and electricity from the point of generation (or gas terminal or storage) to households and businesses. Ofgem has developed regulatory frameworks to support and promote resilience in these energy networks.. These networks are known as transmission and distribution networks. In this report we refer to the Transmission Operators (TOs), Distribution Network Operators (DNOs) and Gas Distribution Networks (GDNs) as 'network companies' and 'the regulated network'.

1.6. Our principal objective is to protect the interests of existing and future gas and electricity consumers. We do this through a variety of means, but those of most relevance to supporting and promoting adaptation resilience in energy networks include:

- Agreeing the framework for setting **price controls for electricity and gas network companies**. The gas and electricity networks are regulated monopolies, and we set the revenues the network operators can earn. Within this revenue, we set allowances for investment in network maintenance and improvement which is carried out, and forms part of the overall cost to consumers.
- The **licensing** of smart meter communications in gas and electricity, of gas shipping, transportation, interconnection and supply, and electricity transmission, distribution, interconnection, generation and supply activities. This includes placing obligations on the various sectors with the overarching objective of protecting consumers.
- Promoting **security of supply and sustainability**, for present and future generations of consumers, domestic and industrial users. This involves close cooperation with government and the wider energy sector to understand changes in demand and generation and ensure a reliable and secure system.

Sector context

1.7. The energy system is undergoing a major transformation in response to the decarbonisation agenda, and it is important to acknowledge this will take place against a changing environmental and climatic baseline. In order to deliver energy safely, securely and sustainably, the energy system will need to incorporate the risks of climate change into its planning and investment cycles.

1.8. The main climate risks² to the transmission and distribution networks relate to long-term (30 year plus) changes in weather patterns (increased winds/storms and temperatures) and environmental conditions (flooding, ground movement). The impacts of severe weather events or environmental change relate to impairment of asset efficiency and/or disruption to energy supplies.

1.9. For example, the electricity transmission and distribution networks need to manage the risks posed to infrastructure (such as sub-stations and power lines) from flooding, increased temperatures and severe storms. The gas networks need to manage risks associated with coastal flooding and storm surges, increased temperatures at compressor stations, and the potential impact of ground movement on gas pipes. These risks are considered in more detail in chapter 3.

² More details are provided in Table 1 on page 12.

Our approach to reporting under the ARP second round

1.10. Objective 8 of the National Adaptation Programme is to “*to develop regulatory frameworks to support and promote a resilient and adaptive infrastructure sector*”³. As the GB energy regulator, we have developed regulatory frameworks to support resilient energy infrastructure assets and incentivise network companies to encourage adaptation activities.

1.11. As we noted in our 2011 report, we interpret our ARP duty to include ‘indirect risks’, ie. those affecting the electricity and gas network companies and reliability of supplies, as these are the most material to the well-functioning of the economy and society.

1.12. Assessing the risks and responding to the challenges of adaptation are primarily the responsibility of the network companies themselves. They are best-placed to understand their operations, and to identify where they need further advice and assistance. Our role is to enable them to undertake these actions via our regulatory framework.

1.13. Under the current approach to the Adaptation Reporting Power (ARP), generators and network companies have been invited to consider climate change adaptation risks and responses, and produce independent reports. In addition, a summary of the climate change risks and adaptation responses for electricity generators is produced by Energy UK on behalf of its members, whilst the equivalent report on behalf of the transmission and distribution operators is produced by the Energy Networks Association (ENA).

1.14. Consistent with our 2011 report, we have reviewed the climate change risks highlighted by the regulated network companies in their adaptation reports, and looked at whether our regulatory tools and policies are enabling those companies to adequately identify, plan and prepare for climate change-related risks. The climate change scenarios have not changed since we submitted our last report and the sector’s risk profile remains largely the same. This view is borne out by the network companies’ assessment which includes experience of recent extreme weather events and academic views. Climate modelling however suggests the incidence and significance of weather-related impacts is likely to intensify from the 2020s onwards.

1.15. Our focus in producing our second round report is therefore on assessing *current network resilience* and company approaches to *future preparedness*. This includes preparation for future predicted risks both within and to a degree between infrastructure sectors.

³ UK Government National Adaptation Programme (Area 2, objective 8 Para 104).

2. Direct operational risks to Ofgem

2.1. As reported in 2011, Ofgem's own operational vulnerability to shorter-term (weather related) and longer term (climate change) risks is considered to be low, principally due to the office-based nature of our work. We have re-confirmed the three main direct risks identified in 2011; flooding; travel disruption preventing staff getting to work; and communication failures.

2.2. The most immediate business continuity risk we face is from fluvial flooding, which could affect our London and Cardiff offices although the level of risk is low. Our Glasgow office is not deemed to be at risk from flooding due to its elevation.

2.3. In July 2014, we updated our Business Continuity Management (BCM) procedures. This looked at the risks to our business operations, which includes the risk of flooding, and implemented a series of staff protocols and communication measures to make us more resilient to these risks. For example, if our offices were significantly disrupted, we have an offsite data backup which can be used as our primary servers in an emergency. Additionally, we have remote working arrangements able to accommodate up to 1,100 staff per day, which will let us carry on working even during extreme weather.

2.4. Our registry systems are located with our main office. We are currently undergoing a program of moving all our servers off site which will alleviate any system down time should we lose the use of our main office.

2.5. Since we updated our BCM procedures, there is now a text messaging service to alert staff to incidents, and a dedicated staff information phone line (providing staff with information if an incident means they can't travel into work, our buildings are inaccessible and/or our IT systems are down).

2.6. We have also established an ISO 14001-compliant Environmental Management System (EMS) which takes account of adaptation needs, for example by improving the energy efficiency of our cooling system. Since our last report in 2011, we consider that we are now better able to manage business continuity risks to our main operational sites thanks to the additional measures we have implemented.

2.7. Ofgem's London office is set to relocate from Millbank in 2017-18. Climate change resilience will be one of the many factors we take into consideration when choosing where to move to. At the same time as the office relocation, our IT and telephone systems will be enhanced to provide full capacity for all staff working remotely. This will also make us more resilient to extreme weather events in future.

3. Understanding climate risk

Alignment with Defra reporting guidance

This section sets out our understanding of climate risk to the regulated energy sector. It provides an update on the evidence and research undertaken to better understand those risks, and the key issues arising from that work.

3.1. Developing and maintaining a thorough understanding of the risks posed by climate change – and ensuring the companies we regulate are enabled and incentivised to do the same – is a key part of our role in helping deliver the government’s vision of *“an infrastructure network that is resilient to today’s natural hazards and prepared for the future changing climate.”*⁴

3.2. Assessing the risks and responding to the challenges of adaptation are primarily the responsibility of the network companies themselves. They are best-placed to understand their operations, and to identify where they need further advice and assistance. Our role is to enable them to undertake these actions by developing *“regulatory frameworks to support and promote a resilient and adaptive [infrastructure] sector.”*⁵

3.3. However, we have reviewed the network company reports⁶ made available to us in order to provide an additional layer of assurance, and our assessment of the second round of network company reports has confirmed that:

- Their risk assessment is primarily based on the UK Climate Projections 09⁷ (UKCP 09) which is still recognised as the leading source of climate change information for UK land and marine areas.
- The main risks for the sector identified under a high emissions scenario out to 2080 from that assessment remains largely unchanged since the first round of reports.
- Their monitoring and evaluation of the impacts of extreme weather is improving their understanding of their risks and approaches for managing those risks.

3.4. We consider that the risks identified in the companies’ 2011 and 2015 adaptation reports represent a thorough assessment of the climate risks posed to the energy network. We have drawn on these reports to produce a summary of the main risks identified in the first and second round reports, and the actions that are being taken to manage those risks. This summary is presented in table 1 below:

⁴ See HM Government publication here:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69197/summary-report-final-version2.pdf

⁵ UK Government National Adaptation Programme (Area 2, objective 8 Para 104)

⁶ We note that a number of network companies have used shared reporting via the ENA Report under this voluntary reporting round which limits some of the granularity of the information available in those reports.

⁷ See Climate Projections here: <http://ukclimateprojections.metoffice.gov.uk/>

Table 1: Summary of climate risks to the regulated energy sector

Risk	Main area of network impact	Description of network impact	How the understanding of risk is being improved and addressed
High winds (and compound risk of high wind speeds and saturated ground)	Electricity transmission and distribution	<p>Predominantly affecting High Voltage overhead transmission lines. The impact can be exacerbated by debris moved by wind (which in turn is affected by the growing season and maintenance work on trees).</p> <p>Saturated ground and high wind-speeds could lead to more uprooting of trees and vegetation which could impact on power lines.</p> <p>In coastal areas, wind and a lack of rain can lead to salt accretion on power lines which can add weight and increase vulnerability.</p>	<p>Research partnerships between Universities and the sector looking at the link between climate change and high wind speeds.</p> <p>The issue of extreme storms uprooting vegetation from wet ground are being considered on a cross-industry basis by the review of Engineering Technical Report (ETR)132, <i>Improving Network Performance under Abnormal Weather conditions</i></p>
Temperature increase	Electricity transmission and distribution	Higher temperatures can have an impact on the electrical rating of assets, reducing transmission capacity which in turn could reduce the ability of the network to meet demand.	<p>To be addressed via on-going network design and strengthening.</p> <p>Work has been carried out by consultants, to consider possible mitigation measures against high temperatures. However, the initial results from the study have shown that further work is necessary before any firm recommendations can be made.</p>

	Gas transmission	Gas compressor stations are also at risk of failure at elevated temperatures.	Remedial works are being considered through technical modifications (using refrigeration for example) or upgrading in line with planned replacements.
Changing demand patterns	Electricity transmission and distribution	High temperatures are expected to increase demand for cooling, such as air conditioning. There is a risk of interruption to supply where peak electrical loads (which can be reduced by high temperatures) exceed capacity.	Loading on substations and transformers is reviewed annually to ensure that adequate headroom is available to meet forecast demand and growth. The significance of this risk is uncertain but reporting organisations believe it to be small at present and likely to become a more significant issue in 20-40 years.
Ground movement	Gas distribution and transmission Electricity transmission and distribution	Primarily (although not exclusively) a concern for the gas network. Old gas pipes could be susceptible to cracking in the event of subsidence and ground movement resulting from ground saturation. Impact of changes to river flows and river beds also identified as a risk as they can expose previously buried pipes. Landslides can also pose a risk to network infrastructure.	Lack of evidence on this is identified as an issue by the sector. A research partnership between the sector and Cranfield university is currently considering climate impacts on the gas pipeline network. This current lack of evidence is further addressed in our recommendations section.
Flooding from rivers and flash pluvial events.	Electricity distribution	Flooding is clearly identified as the most significant risk to the electricity network.	Improved flood mapping in conjunction with the Environment Agency (EA) and Scottish

			<p>Environment Protection Agency (SEPA). This is helping network companies improve their understanding of the exposure of key assets to flood risk and to target their investment more effectively.</p> <p>Systematic assessment to protection being delivered via guidance set out in the ENA's ETR 138.</p>
Lightning	Electricity transmission and distribution	Potential to cause damage and transient interruptions to electricity transmission and distribution networks.	<p>Damage can be minimised by including shielding and suppression devices.</p> <p>More evidence on frequency would be required to support further actions and recommendations on adaptation.</p>
Sea level rise and storm surge	<p>Electricity transmission and distribution</p> <p>Gas transmission and distribution</p>	Coastal infrastructure and assets at risk from storm surge events & sea level rise.	<p>Highly dependent on flood defences and coastal management plans administered by the EA and the SEPA.</p> <p>As noted above, network companies are taking steps to improve site specific flood defences.</p>
Snow and Ice	Electricity transmission and distribution	<p>Ice and snow accretion can make overhead electricity cables vulnerable to high winds.</p> <p>Snow and ice can also make it challenging for field teams to reach sites requiring repair in the event of a fault.</p>	<p>Addressed via combination of design approaches:</p> <ol style="list-style-type: none"> 1) semi-probabilistic designs (to allow variation) 2) designs based

		Snow, Sleet, Blizzard (SSB) faults (including ice) are projected to decrease due to a reduction in the number of days when snow falls.	on International Standards
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Source: *Network company ARP reports*

Sector use of evidence

3.5. Even though our assessment of the network companies' reports shows that the risks arising from climate change are largely unchanged from those in 2011, it is clear that the network companies have been working to improve the quality of 2010-2020 weather estimates and to better understand longer-term climate risks. The companies are using a combination of the UKCIP09 projections, further bespoke research, and their own experience of extreme weather events to strengthen the available evidence base, which is summarised below.

Table 2: Evidence base for the sector

Evidence	Description
UK Climate Projections	Met Office validation of the UKCIP2009 projections in light of the 2014 IPCC ⁸ assessment,
UK electricity network company studies with UK Met Office (RESNET)	Study to: (1) identify business impacts of climate change. (2) risk model to quantify relationships between climate and network faults, and the vulnerability and exposure of the network to those faults.
Flood mapping	Improved flood mapping for surface water has been incorporated into detailed analysis of substation flooding resilience. Work with EA and SEPA to understand the latest surface flood water information.
Improving locational data and other weather related impact data for the network	Newcastle University to complete more research on the effects of climate change. They have simulated the effects of climate change on the whole range of environmental impacts on the network.
Long range forecasting	Cooperation with the Met office in relation to the long range winter forecast and emergency planners.
Mapping of physical impacts of climate change.	The project was initiated with Landmark Information Group Ltd (Landmark) to close the gap between UKCIP09 forecasts and actual physical impacts. This was in order to inform reporting authorities and wider users to be able to make justified investment decisions to

⁸ See IPCC assessment here: <http://www.ipcc.ch/report/ar5/wg2/>

	adapt to climate change. Information from this project has been shared, including with the Infrastructure Operators Adaptation Forum.
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Source: Network companies ARP reports

3.6. This research (alongside experience of extreme weather) is enhancing the sector's understanding of risk, but we note that this can lead to variable approaches to risk evaluation and management. As new approaches to risk assessment and management roll out it is important that the sector looks to share best practice and develop a common understanding of risk assessment and management.

Academic and industry collaborations

3.7. A number of key research projects have also been developed since our 2011 report:

- Adaptation and Resilience in Energy Systems (ARIES)
- Resilient Electricity Networks for Great Britain (RESNET) (noted above)
- Adaptation and Resilience of Coastal Energy Supply (ARCoES)

3.8. The key findings from these projects were shared at a policy briefing event for the Adaptation and Resilience in the Context of Change (ARCC) Network in November 2015⁹. These findings are presented below.

3.9. ARIES has developed a comprehensive risk framework to assess UK energy system resilience to climate change. Its principal findings presented at in relation to supply/demand and climate include:

Up to 2050, a changing climate will affect renewable energy (solar, wind and hydro) through changes in resource and operational performance but changes are modest and tend to reinforce existing seasonal and regional variations.

Some resources such as solar and hydropower are likely to increase slightly, while wind and wave show limited changes. In most cases the need for adaptation is low but there appears to be evidence for positive adaptation measures to maximise yields from small-scale hydropower.

Whilst there are clearly climate impacts on both supply and demand, the expected changes appear to be less significant than the changes that will be brought about through technological and behavioural change arising from efforts to decarbonise (primarily as a result of changes in the housing and transport sectors).

⁹ ARCC Policy Briefing Event - <http://www.arcc-network.org.uk/delivering-energy-in-a-changing-climate-policy-briefing/#.V7W7E3ITHZ6>

3.10. The RESNET project has developed a comprehensive approach to analysing, at a national scale, climate-related changes in the reliability of the UK's electricity system, and to develop tools for quantifying the value of adaptations that would enhance its resilience measures. Its key findings include:

The physical infrastructure of the national grid is likely to remain resilient to direct climate change impacts over the coming twenty years, *assuming that electricity demand does not significantly increase*. Whilst higher temperatures will impact transmission capacity, there are a range of measures that can easily mitigate this in the near term.

However, the effect of policy changes related to decarbonisation will likely outweigh any climate impact related issues. For example,

(Inter)national decarbonisation commitments

The grid will need very substantial upgrading and expansion if the UK is to make the changes necessary to deliver on its international 2°C commitments, driven by both rapid increases in electricity demand and the addition of new low-carbon generating plants.

Nature of Renewable generation + its underpinning role for decarbonising other sectors

Increasing levels of intermittent supply will have repercussions for grid operation, but the electrification of heating as well as road transport will place substantial new loads on the grid, with potential for interruptions in the electricity supply and associated implications for societal resilience.

Decarbonisation of heating and cooling

In the event of widespread adoption of air conditioning within the commercial and domestic sector, there will be a significant increase in summer electricity demand, potentially shifting peak annual demand from winter to summer in the future.

Wind-related impacts

The impact of the future wind climate on electricity networks is still uncertain. The latest round of climate projections are still dominated by uncertainty, as the projected changes are relatively small compared to the range of results from different models. This is particularly true for wind extremes, where the problem is compounded by the limited ability of the models to reproduce wind extremes with any degree of spatial resolution. The risk of wind storm failure of the UK's transmission network will likely continue to be small in coming decades. In the longer term shifts in spatial patterns of generation and demand may require additional network connections. A follow on NERC project (STRAIN) will incorporate the new CONVEX high resolution climate model results to try and reduce these uncertainties and analyse the risks to distribution networks in greater detail.

In the absence of significant global emission reductions, as climate impacts begin to increase over the coming decades the grid will increasingly require significant investment if it is to deliver 'acceptable' levels of performance (depending on climate sensitivity, a 4°C average global temperature rise is still possible by ~2060). What is considered 'acceptable' needs to be made explicit as the modelling suggests that

even very high levels of investment in reinforcing the transmission grid will likely be insufficient to guarantee resilience if increases in extreme weather events are realized through climate change. The failure of investment in the near-term, both in catering for the different performance criteria of low carbon supply and in failing to transition the grid in line with changing demographics and demands, will leave the UK maladapted and vulnerable to future extreme weathers and unable to absorb the scale of change in the diurnal, seasonal and spatial loads placed on it.

3.11. ARCoES is providing projections of future flooding, erosion, sediment, transport and sedimentation due to climate change to the 2020s, 2050s & 2080s. Whilst principally relevant to generation assets (site location and site defence decision-making), the projections may also be of use to transmission and distribution network operators.

Coastal flooding risks

Flooding due to storm surges, wave overtopping of sea defences and high river flows may combine to produce greater areas and depths of flooding. This risk is likely to increase with sea-level rise.

3.12. In addition to this emerging research, the network companies have drawn on their recent experience of extreme weather events to assess their current resilience.

3.13. An extreme weather event described across many reports are the storms experienced over the Christmas period of 2013/14. While extreme weather events can occur at any time, it is important that levels of resilience are reviewed in light of such events, and that long term trends (including severity, frequency and impact) of these events are monitored so that they inform planning for ensuring resilience in a changing climate. The 'Christmas storms' and more recent extreme weather events are discussed in chapter 5.

Our engagement with evidence and stakeholders

3.14. We have also been active in enhancing our understanding of the potential climate change risks to the energy sector. In 2013, as part of a project to consider the impacts and interactions between the regulated energy system and the natural environment, we commissioned Ricardo-AEA to produce a synthesis of risks and adaption measures included in the Adaptation Reporting Power reports by transmission and distribution operators. This work confirmed the main risks summarised in Table 1 and also served to highlight second and third-order environmental impacts associated with climate change, including the management of contamination at gas facilities.¹⁰

¹⁰ Intense periods of rainfall, leading to an increase in ground saturation and water migration can mobilise contaminants in the soil, potentially impacting on the local environment.

3.15. Although less of a priority than the secure and reliable operation of the energy system, our discussions with network companies have identified similar second and third-order type issues, which we consider to be an indicator of the overall level of maturity of adaptation reporting within the sector. Additionally, consideration of these wider environmental factors relates directly to our strategic aim of reducing environmental damage, now and in the future.

3.16. The challenges ahead require the contribution of a wide range of stakeholders on key strategic issues and we have responded by initiating or collaborating in several key groupings.

3.17. Sharing information amongst key industry participants and stakeholders is vital in ensuring the transition to a secure, reliable and resilient energy system. In response to this need, we established the Energy Network Strategy Group with the involvement of network companies and – together with DECC¹¹- the Smart Grid Forum (SGF).

3.18. The DECC/Ofgem Smart Grid Forum (SGF) is a platform for industry, government and other key stakeholders to engage on the significant challenges and opportunities posed by GB's move to a low-carbon energy system, particularly for electricity network operators. We jointly established the forum in 2011 with DECC to support the transition so it is safe, secure, efficient and delivers the best value for current and future energy consumers.

3.19. Climate change related impacts can affect all aspects of the energy system. In recognition of this, our internal policy formulation and engagement with external stakeholders reflects the need to look end-to-end across the system to ensure a consistent approach.

3.20. This practice led to the establishment of the Integrated Transmission Planning and Regulation (ITPR) project (considering long term arrangements for operation of the on and off-shore transmission networks) and our involvement with the Future Power System Architecture (FPSA) Project.¹²

3.21. We have also contributed to the development of the second UK Climate Change Risk Assessment (CCRA) which provides an update on the main risks and opportunities for the UK, arising from climate change, over the coming years.

3.22. The outputs from the work noted above, along with any future update of the UKCP, and the outcomes from the National Flood Resilience Review will help us and the companies better understand the risks from climate change on the energy sector, and better incorporate measures to address these risks within future regulatory policy.

¹¹ DECC is now part of DBEIS

¹² The FPSA project is a collaboration between the Energy Systems Catapult (ESC) and the Institution of Engineering and Technology (IET) on behalf of the DECC (now DBEIS) .

4. Understanding uncertainties

Alignment with Defra reporting guidance

This section sets out our approach to managing uncertainty in our price control framework, and provides an update on actions taken to identify new uncertainties and to address information gaps.

- 4.1. The energy sector is changing as we move towards a decarbonised energy system in line with our national and international commitments. This raises the challenge of how the sector can build its current and long term resilience to climate change while we and the energy companies (and wider sector) don't yet know exactly how the energy system is going to develop.
- 4.2. To help understand this transition, many organisations have created forward-looking energy scenarios such as National Grid's Future Energy Scenarios¹³. Understanding these can help identify future challenges, including those relating to climate change adaptation. At Ofgem we have analysed a number of these forward-looking energy scenarios to gain insight into future trends and regulatory challenges. The scenarios we have considered describe a series of possible demand profiles for electricity and gas, which in turn supports assumptions about the possible shape and size of the respective gas and electricity networks. They also tell us about the different mix of technologies (eg generation and heat) that might need to adapt (eg a thermal plant might be faced with warmer climate, which could affect its efficiency in cooling).
- 4.3. We actively consider adaptation implications when considering possible energy futures. For example, the move to a smarter, more flexible grid is likely to bring network resilience benefits (eg dynamic demand-management offers the means to manage constraints and disruptions more cost-effectively) and challenges (a greater proportion of intermittent renewables on the system may lead to more unequal loading on networks, which may increase network vulnerability where this coincides with extreme and/or persistent weather effects).
- 4.4. We are also aware that the role of the energy networks could evolve over time to accommodate new technologies such as electric vehicles and hydrogen networks. This in turn will require new infrastructure, and network companies (possibly including new network operators such as smaller scale local operators) will need to ensure that they and the infrastructure that they operate are well adapted to climate change.
- 4.5. We have also initiated a new Insights for Future Regulation Project¹⁴ to help us better understand what is driving system change, the likely impacts on

¹³ <http://fes.nationalgrid.com/>

¹⁴ <https://www.ofgem.gov.uk/publications-and-updates/open-letter-call-engagement-insights-future-regulation>

consumers and the implications for regulation. This includes consideration of environmental factors, including impact from climate change. This project will help us set our future priorities for the evolution of regulatory arrangements.

Supporting the sector to manage uncertainty

4.6. Since our last report we have concluded our Distribution Price Control Review (DPCR)⁵ which ran from April 2010 until March 2015. This price control provided for investment in resilience measures and this has continued into our new price control framework.

4.7. We have built on DCPR⁵ and ensured that network resilience and managing uncertainty are key features within our eight-year RIIO (Revenue = Incentives + Innovation + Outputs)¹⁵ performance-based price control framework for network companies. This regard for adaptation is also clear in our RIIO-ED1 strategy document¹⁶ published in 2013 where we state:

- *“RIIO-ED1 is the first price control in electricity distribution to use the RIIO model. The decisions that we set out in this document are designed to:*
- *encourage DNOs to deliver safe, **reliable and sustainable network** services at long-term value for money to consumers;*
- *enable them to finance the required investment in a timely and efficient way; and*
- *remunerate them according to their delivery for consumers.”*

4.8. In designing the framework, we recognised that there may be uncertainties about the appropriate outputs companies will need to deliver and the expenditure requirements that will be needed over a price control period to ensure delivery (particularly when planning for uncertain events such as weather impacts). The RIIO framework therefore includes a number of elements to help manage these uncertainties. It also places the onus on network companies to set out how they intend to manage risk through the period.

4.9. Under RIIO, uncertainty is addressed via:

- a range of uncertainty mechanisms (eg specified re-opener windows,¹⁷ automatic revenue adjustments through revenue drivers)
- a mid-period review of output requirements

¹⁵ More information on the RIIO price control can be found in chapter 7

¹⁶ See RIIO ED1 strategy document here: <https://www.ofgem.gov.uk/ofgem-publications/47067/riioed1decoverview.pdf>

¹⁷ Price controls help to achieve value for money by providing regulatory and financial stability. At the start of a price control, pre-specified 'windows' allow for decisions to be 're-opened' to address unforeseen events without affecting stability.

- provision for disapplication of the price control (in extreme circumstances)
- risk sharing through the efficiency incentive rate.

4.10. We are confident that the RIIO price control frameworks allows companies the flexibility to adapt to the level of climate impacts projected under the UKCP09 climate change scenarios.

4.11. The ENA's Adaptation report highlights the potential for the eight-year cycle of the RIIO price control to create a "delay between any climate knowledge and a corresponding change in investment", but does not consider this to be a significant risk. We agree that this is not a significant risk because the nature of the RIIO price control allows companies to deliver set outputs, but in a flexible manner (without defined inputs). Allowances are given at a total expenditure (TOTEX) level, as opposed to being broken down by project or investment type. Through various uncertainty mechanisms, we have also given companies opportunities to apply for additional funding or otherwise adjust their allowed revenues for unforeseen or less certain investments. The RIIO price controls allow for a "Mid-Period Review" (MPR) of outputs at the 4 year mark.¹⁸ There are also various uncertainty mechanisms for within-period adjustments.

Sector engagement over uncertainties

4.12. We have reviewed the companies' reports and consider that they have engaged with and are seeing to better understand climate change uncertainties. For example, the companies have commissioned bespoke studies¹⁹ on the effects of climate change, using examples of recent extreme weather events to help them plan.

4.13. These studies have served to highlight new risks and interdependencies, such as prolonged rainfall increasing the likelihood of trees being uprooted by strong winds.

4.14. Another uncertainty highlighted in this round of company reporting was how other sectors in the economy are adapting to climate change. Some companies highlight the need for cross-sector scenario planning for extreme weather events. The Infrastructure Operator's Adaptation Forum (IOAF)²⁰ is playing a key role coordinating cross sectoral working and information sharing.

4.15. We are also mindful that political decisions can have a significant impact on the energy system. We work closely with Government to understand the implications of different policy decisions.

¹⁸ Such a review would focus on changes to outputs that are driven by clear changes to government policy or new outputs that are required to meet the needs of consumers and other network users.

¹⁹ See more information included in Chapter 3

²⁰ IOAF was set up by the Environment Agency to be a forum where members can share and discuss information on climate risks and how to tackle them.

5. Details of implemented and new actions

Alignment with Defra reporting guidance

This section sets out the actions that we have taken on adaptation since our last report. We have also prepared a high-level assessment (Annex 1) of how effective each action has been in: achieving beneficial outcomes; mitigating climate change risks; increasing our readiness to respond and recover from impacts, and; contributing to sustainable development.

5.1. In our 2011 report, we set out a number of actions/commitments related to adaptation. Our actions are set out in the section below and also summarised in a table in Annex I.

Interdependencies

5.2. We said that we would continue to meet with other economic regulators in order to coordinate on regulation that allows for adaptation. We have continued to meet with the other economic regulators in the UK, for example, we hosted the Joint Regulator Group meeting in 2013 and participated in an Environment Agency Climate Ready workshop in 2014. We are also active members in the UK Regulators Network (UKRN) Adaptation sub-group and the Infrastructure Operators Adaptation Forum (IOAF) and have met with both groups through 2015/16.

Monitoring & review

5.3. We said that we will continue to monitor and assess the effectiveness of our regulatory tools and policies in ensuring that energy companies meet their adaptation needs. If we were to find that our tools and policies were not working in consumer's best interests, we would consider whether reforms would be necessary.

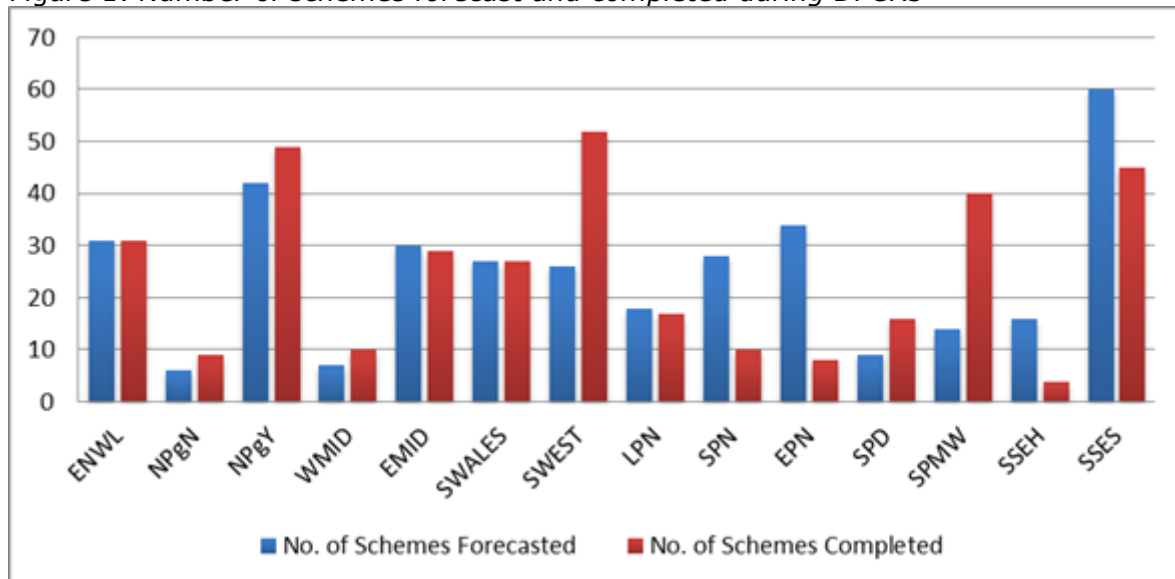
5.4. As part of our monitoring and review processes we have published our DCPR5 Performance Report.²¹ It notes that the companies have made significant performance improvements and outperformed in a number of elements of our price control arrangements, reflecting improved delivery to consumers as well as enabling the DNOs to earn incentive rewards. For example:

- we set incentives for Distribution Network Operators (DNOs) to reduce the number and duration of interruptions. This has worked well during DPCR5 with DNOs reducing the average number of customers' interruptions by 21% and the average length of these interruptions by 36%. DNOs have earned £611m in incentive payments by beating their targets regarding interruptions.

²¹See DCP5 Performance Report here: <https://www.ofgem.gov.uk/publications-and-updates/electricity-distribution-company-performance-2010-2015>

5.5. The main area of costs where DNOs were outperforming our price control assumptions was network investment. DNOs overall have spent 10% (£823m) less than our cost baselines. The main factors driving this were improvements in efficiency, with unit costs for asset replacement work falling significantly during DPCR5, falling input prices and a drop in reinforcement, demand connections and High Value Projects because of economic conditions.²² We are still in the process of closing out several DPCR5 mechanisms and will have a complete picture of company performance next year. However, in some areas the DNOs have underspent and have not delivered on their commitments. As an example, there was lower than expected expenditure on flooding.

Figure 1: Number of schemes forecast and completed during DPCR5



5.6. Figure 1 shows the number of flood mitigation schemes forecast to be completed in DPCR5, and the number actually completed by the end of the period. Most DNOs delivered (or over-delivered) on their forecast, but some have delivered fewer schemes than forecast. In some cases this difference is due to updated flood modelling, which meant some sites originally forecast to be at risk no longer required protection. Despite this, two of UK Power Networks' DNOs (SPN and EPN) and both of Scottish and Southern Energy Power Distribution's DNOs have sites that have not been protected. This has raised concerns that some DNOs may have reduced the scope of their work, or changed their technical solutions. We are working closely with the DNOs on this, as well as with DECC on their review of flood resilience.

5.7. We have requested that all DNOs provide the Gas and Electricity Markets Authority with their internal assurance analysis in relation to their flood risk obligations over 2010 to 2015. We expect that DNOs will review their progress in delivering their obligations with regards to flooding in DPCR5 and if there is any

²² High Value Projects (HVPs) were defined in DPCR5 as discrete projects with a value of more than £15m over the lifetime of the project (in 2007-08 prices).

outstanding work, they will address this promptly in RIIO-ED1 without additional funding from consumers. This is in addition to schemes forecasted for RIIO-ED1.

5.8. We continue to engage with the DNOs on this issue and we have worked together to contribute to the Government's National Flood Resilience Review.

Implemented and ongoing actions (2011-2015 and ongoing)

5.9. Our principal actions to address climate resilience within the energy sector are carried out via our agreeing the framework for setting **price controls for electricity and gas network companies**, and the **licensing** of gas shipping and transportation, and electricity transmission, and distribution.

5.10. We have also made changes to the way in which we consider new regulatory policies through our **Impact Assessment (IA) guidance**, which now requires consideration of long-term climate resilience.

5.11. The following section describes these implemented and ongoing actions in more detail. We also address the sector's progress in responding to our 2011 recommendations, the sector assessment undertaken by the Adaptation Sub-Committee (ASC) in 2014 and future actions.

Our new price control framework

5.12. Since our 2011 report, the RIIO (Revenue = Incentives + Innovation + Outputs) price control framework has been implemented. This is the key regulatory tool that we are using to drive action on adaptation. There are three separate price controls that apply to the different areas of energy transportation:

- Transmission (RIIO-T1) – This price control relates to the high voltage transmission of electricity and high pressure transmission of gas for the period 2013 to 2021.
- Gas Distribution (RIIO-GD1) – This price control relates to the period 2013 to 2021 for the companies that transport gas at a lower pressure to homes and companies for domestic and commercial use.
- Electricity Distribution (RIIO-ED1) – This price control relates to the companies that transport electricity at a lower voltage to homes and companies for domestic and commercial use for the period 2015 to 2023.

5.13. The energy sector continues to face the challenges of decarbonisation and replacement of ageing assets, without exposing consumers to unnecessary costs. The eight year RIIO price control model ensures companies focus on long term planning horizons.

5.14. Under RIIO each network company must set out what it intends to deliver for consumers of network services over time and what revenue it needs to earn from

existing and future consumers to ensure delivery. The onus is on network companies to justify their view of required expenditure in well justified business plans.

5.15. In their plans, we required the companies to produce evidence-based forecasts of: output requirements; demand for network services over time; cost of delivery (including input prices) and financing costs. These informed, to a large degree, our assessment of the outputs that network companies are required to deliver and the associated revenues to be earned from consumers.

5.16. We stated that, in the context of the next price control, we will assess the evidence submitted in companies business plans to determine what work, including the work carried out in adaptation to climate change, is reasonable.²³

5.17. The business plans submitted under each of the relevant RIIO price controls all considered network risks, which included environmental risks as part of their methodologies. Network operators are funded to ensure their networks are resilient, and their investment programmes are often designed to withstand harsher conditions than those anticipated under current climate models.

5.18. Our assessment found that the network companies' long-term business plans included consideration of potential environmental changes on their network over the coming years. The investment in assets in response to climate change is included within this consideration.

5.19. We monitor how the companies are progressing against the agreed outputs and allowances on an annual basis, as part of our regular reporting process.

5.20. We launched a mid-period review for the RIIO-T1 price control looking at some specific issues in Electricity Transmission for National Grid Electricity Transmission and Gas Transmission for National Grid Gas Transmission in May. We did not identify any issues within scope of an MPR in RIIO-T1 for either of the Scottish Transmission Owners. We decided not to launch an MPR for the RIIO-GD1 price control.

5.21. We will initiate work on the strategy for the next price controls (RIIO-T2 and GD2) partway through the current price control, in the next few years. The strategy for RIIO-ED2 will follow these.

5.22. We also note there are types of transmission infrastructure outside of the RIIO price control framework, including electricity interconnectors and offshore transmission networks that connect the onshore network to offshore generation.

²³ See RIIO ED1 strategy decision document here:
<https://www.ofgem.gov.uk/sites/default/files/docs/2013/03/riioed1decoverview.pdf>

5.23. Although interconnector and offshore cables themselves are relatively resilient to climate impacts, the onshore assets (eg convertor stations) are often located close to coastlines and therefore are potentially exposed to flooding impacts due to storm surges and overtopping of sea defences (exacerbated by predicted sea-level rises of up to 1m by 2100). Operating these assets is a licenced activity in Great Britain²⁴. The most appropriate connection point to the GB network for these assets is provided by the GB system operator through the Connections and Infrastructure Options Note (CION) process.²⁵ We would expect that the potential impacts from climate change are managed within the owner/operators risk management procedures, as well as considered as part of the cost-benefit analysis carried out through the CION process where appropriate.

Responding to near-term extreme weather events

5.24. In addition to setting the RIIO price control (which provides for 8-year planning cycles); we are also pro-active in responding to current and near-term weather impacts. For example, we reviewed the resilience of the electricity distribution sector to the Christmas Storms of 2013/14.²⁶ As part of our assessment we considered whether the network companies adequately understood the risks associated with such storms, and their preparedness and response to such events.

5.25. An independent review of the Christmas Storms showed that while the affected distribution companies were badly affected by the storms, they could have done more to get customers reconnected faster and to keep them better updated on what was happening. In light of these findings, the companies agreed to make donations totalling £3.3 million to organisations such as the British Red Cross, which play an important role in helping vulnerable customers during power cuts and severe weather.

5.26. Following the review, we requested that all companies write to us setting out the additional steps they are taking to prepare for extreme storm events. They have all done so and we expect these steps, along with the additional payments required under the Guaranteed Standards,²⁷ to result in improved levels of performance across the DNOs in the future for any major interruptions.

5.27. In addition to the 2013/14 Christmas Storms, the December 2015 flooding in Cumbria following the record rainfall from storm Desmond demonstrates the potential vulnerability of the energy networks to extreme weather events. Despite recent investment on improved flood defences at the Lancaster substation in 2010, the defences were breached and supplies to 55000 properties in

²⁴ The Utility Regulator is responsible for regulating the electricity, gas, water and sewerage industries in Northern Ireland

²⁵ See CION process guidance note here:

<http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=43631>

²⁶ See Ofgem Christmas Storm report here: <https://www.ofgem.gov.uk/publications-and-updates/stage-two-review-christmas-2013-storms-impact-electricity-distribution-customers>

²⁷ The Guaranteed Standards specify minimum levels of service expected of the DNOs in a range of circumstances, including (but not limited to) long duration interruptions. If a DNO fails to meet a standard, the affected customer(s) may be entitled to a payment.

Lancaster, Morecambe, Carnforth and the surrounding area were interrupted. The investment at the substation had upgraded the site to provide defence against a 1-in-100 year flood but the volume of rainfall exceeded current forecast models. This event, along with further storms experienced over the 2015/16 winter period demonstrate the need for the regular review of network resilience by the network companies, underpinned by monitoring of impacts, and use of the latest science and information available on potential climate impacts at a national and local level.

5.28. While these recent storms exposed the limits of some of the current physical adaptation measures it is clear that the network companies responded very positively to help those communities affected. Electricity Northwest reported that:

*"During Storm Desmond more than 500 employees worked around the clock to restore supplies, they completed three months' of work in just three days and 75 generators from around the UK provided power to 23,000 homes, the most generation ever connected in the UK."*²⁸

5.29. They have also already committed investing £2.5m to help further protect power supplies to customers in the Lancaster area.

5.30. Storm Desmond led to Government to launch a Review of National Flood Resilience²⁹, which is focussing on an update of the national climate models and assessment of the resilience of infrastructure like electricity substations. We expect the network companies to ultimately adopt the new models.

Our existing licencing regime

5.31. Through our licensing regime,³⁰ Ofgem sets specific obligations on the network companies, shippers, generators and suppliers to ensure supply is protected. This has remained broadly unchanged (in relation to adaptation-relevant conditions) but is kept under continuous review.

5.32. We monitor licensed companies and have powers to take enforcement actions, if appropriate, when they do not meet licence conditions.³¹ If licensees are found in breach of these conditions, or their obligations under standards of performance, the options available to Ofgem include:

- issuing an order for the purpose of securing compliance with relevant conditions or requirements and, or

²⁸ <http://www.enwl.co.uk/news-and-press/latest-news/2016/02/02/02-02-16-david-morris-mp-visits-lancaster-substation-and-praises-staff-for-storm-response>

²⁹ <https://www.gov.uk/government/news/national-flood-resilience-review-government-action-to-tackle-floods> . A the time of drafting the review had not published its findings.

³⁰ See Ofgem website here: <https://www.ofgem.gov.uk/licences-codes-and-standards/licences>

³¹ See Ofgem website here:

https://www.ofgem.gov.uk/sites/default/files/docs/2014/09/enforcement_guidelines_12_september_2014_published_version_1.pdf

- imposing financial penalties up to 10 per cent of the turnover of the licensee's business.

5.33. There are also conditions within the licences which relate indirectly to adaptation to climate change. For example:

- In the gas transporter licence,³² standard licence condition 16 sets an obligation on the licensee to ensure pipe line system security standards. This standard is designed to ensure that supply meets the peak aggregate daily demand. Gas transporters will need to assess climate change risks to ensure they can carry out this function.
- Both the electricity distribution licence and gas distribution licence include a requirement for distribution network owners to publish annual long-term development statements. The statements must provide an indication of the usage of their systems and likely developments. Companies that are contemplating connecting to the system or entering into transportation arrangements can use the statement to help identify and evaluate opportunities. The statement contains information on actual volumes, the process for planning the development of the system, including demand and supply forecasts.

5.34. Under standard licence condition 24 of the electricity distribution licence,³³ the licensee must submit to Ofgem a statement that sets out criteria by which the licensee's quality of performance in maintaining the security, availability, and quality of service of its distribution system may be measured. The licensee must provide Ofgem a yearly report detailing their performance during the previous year. If the company did not meet its performance standards due to climate disruptions, we would be alerted through monitoring these reports.

Interactions between generation and network resilience

5.35. When considering generators, standard condition 7 of the electricity generation licence³⁴ requires electricity generators to comply with the fuel security code. The code requires generators to follow the instructions from the Energy Emergency Executive (E3) Committee, and to maintain certain emergency stocks of fuel. The E3 Committee sets emergency planning and operational response rules in

³² See gas transporter licence here:

https://epr.ofgem.gov.uk//Content/Documents/Gas_transporter_SLCs_consolidated%20-%20Current%20Version.pdf

³³ See electricity distribution licence here:

<https://epr.ofgem.gov.uk//Content/Documents/Electricity%20Distribution%20Consolidated%20Standard%20Licence%20Conditions%20-%20Current%20Version.pdf>

³⁴ See generation licence here:

<https://epr.ofgem.gov.uk//Content/Documents/Electricity%20Generation%20Standard%20Licence%20Conditions%20Consolidated%20-%20Current%20Version.pdf>

the event of a gas and/or electricity supply emergency, which include emergencies caused by weather events.

Updated Impact Assessment guidance

5.36. To support the development of our regulatory policies, our Impact Assessment³⁵ (IA) guidance helps to identify the effects of regulatory proposals which have an impact on consumers, industry participants, and on social and environmental issues. In 2013 we updated our IA guidance to reflect best practice, and incorporated requirements³⁶ to consider climate resilience:

Table 3: *Updated areas in IA guidance:*

Embedding a strategic and sustainable assessment approach	P21-23. To take account of factors that are complex, difficult to monetise, very long-term and/or inherently unpredictable, we will assess the implications for each option against strategic and long-term sustainability considerations. These include: <ul style="list-style-type: none"> - Assessing security of supply issues out to at least the mid 2020s - Considering longer-term sustainability issues, including sector resilience to external shocks including extreme weather events, as well as how the energy system will need to respond and adapt to a changing climate
Long-term infrastructure and energy system resilience	P25, para 3.55. In some areas our decisions may exert very long-term influences on the evolution of the UK energy system, and on its competitiveness. In this instance, the hard-to-monetise assessment should refer to assessments of competition and resilience (including climate resilience) to consider more enduring implications for the trajectory of the UK system. The assessment should consider whether these impacts indicate a more or a less sustainable direction.

Our 2011 recommendations to sector

5.37. In 2011, we identified two main areas we felt it was important for the companies to concentrate efforts on in order to ensure adaptation to climate change continues to be appropriately planned for. These areas were cooperation and implementation of appropriate internal systems and processes for adaptation.

Cooperation

5.38. We set out that the companies should continue with their cooperation and joint research through collective organisations, such as the Association of Electricity

³⁵See Ofgem Impact Assessment Guidance here: <https://www.ofgem.gov.uk/publications-and-updates/impact-assessment-guidance>

³⁶Including our requirements under DECC's Social and Environmental Guidance

Producers (AEP).³⁷ There is evidence of cooperation within the company reports. As discussed in chapter 3, there has also been research conducted by the ENA and Energy UK, and independently by network companies including input from universities. We consider that this is an area that companies have continued to engage in strongly, and believe these types of studies will enhance the evidence base on which informed decisions can be made on adaptation.

Internal processes

5.39. We also set out that the companies should ensure the implementation of good internal systems and processes to continue assessing the risks from climate change. Although this area is not addressed in detail in company reports, our internal assessment is that adaptation to climate change is well embedded in company risk processes, and is considered in their risk portfolio alongside any other potential disruption.

Adaptation Sub-Committee (ASC) progress assessment (2014)

5.40. Since our last report, the Committee on Climate Change Adaptation Sub Committee reported to Parliament on the UK's progress in preparing for climate change.³⁸ To evaluate the progress being made by the National Adaptation Programme, the adaptation Sub-Committee considered three questions in each of the areas identified as a priority for adaptation, including energy transmission and distribution. The ASC provided the following assessment of the sector:

Table 4: Summary of Adaptation Sub-Committee report assessment

Area	Assessment	Comments
Is there a plan?	Green	Ofgem's RIIO performance standard for gas and electricity companies incentivises investment in safe and reliable services.
Are actions taking place?	Green	The electricity transmission and distribution companies have agreed business plans with Ofgem to address river and coastal flooding risks by the early 2020s. The cross-industry ETR138 standard for network resilience to flooding is being reviewed. More deployable flood barriers were purchased by National Grid after the 2013 storms. The Environment Agency has assessed water demands for electricity generation through to the 2050s.
Is progress being made in managing	Green	Electricity transmission and distribution companies are improving flood protection for critical substations over the coming decade. The national

³⁷ The AEP is now part of Energy UK

³⁸ See Adaptation Sub-Committee report here: https://d2kix2p8nxa8ft.cloudfront.net/wp-content/uploads/2015/06/6.736_CCC_ASC_Adaptation-Progress-Report_2015_FINAL_WEB_070715_RFS.pdf

vulnerability?		coverage and resilience of the transmission grid means that even if individual power stations are disrupted, customers can continue to be supplied from elsewhere. The gas transmission and distribution networks are less exposed to climate change risks.
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5.41. This provides a positive high level assessment of both the regulatory tools and the plans that are in place across the sector. We consider that this provides the sector with a robust baseline against which all parties can continue to develop and enhance resilience to climate change.

Future actions

5.42. The ASC report also included a recommendation for a cross-sector review of reward and penalty regimes. It recommended that:

"The UK Regulators Network should ensure that proportionate and cost-effective approaches to increasing resilience and reducing climate change risks are in place for the economically-regulated sectors. A cross-sector review of reward and penalty regimes should be conducted in time for the ASC's next progress report in 2017, to ensure there are sufficient incentives in place for operators to manage severe weather incidents effectively and preserve services where possible." (Timescale: Early 2017)

5.43. We will be working with our partners in the UKRN to consider our response to this recommendation. We consider that RIIO has already put strong incentives in place to ensure reliable supply is maintained for customers. Some examples of reliability incentives are:

- Guaranteed Standards – minimum standards for length and frequency of interruptions, below which consumers receive compensation.
- Requirements for gas networks to meet a 1 in 20 winter peak demand.
- Energy not supplied – a financially incentivised measure of the amount of energy not supplied to consumers due to network interruptions

5.44. In relation to electricity distribution, we have also made a number of updates to our reliability incentives since the last report, such as:

- We have updated the Interruptions Incentive Scheme to include an improvement factor for all companies, meaning targets will get tighter each year. This will drive further performance improvements and improve the quality of supply customers receive.
- We have reduced the amount of time customers need to be off supply before they qualify for a payment under the Guaranteed Standards from 18 to 12 hours. We have also increased the payment levels to account for inflation, and further increased payments for interruptions during severe weather.

- DNOs will have to make these payments automatically to vulnerable customers. These payments apply to all customers equally, including those living in the Scottish Highlands and Islands, who were previously exempt.
- The 'worst served customer' funding will remain for DNOs to make network improvements in more remote locations. This is a 'use it or lose it' fund for the DNOs, to ensure that companies are only funded for what they provide for customers.

5.45. Under RII0 ED1, there are also arrangements in place which recognise genuinely exceptional circumstances (*force majeure*) and which allow the distribution companies to claim for periods of their performance to be excluded based on the impact of severe weather on their network. For performance to be excluded, an event must meet pre-determined thresholds. These compare the number of faults caused by the event with the daily average number of faults at higher voltages. For an event to be exceptional, there must be at least eight times the daily average at HV and above in a 24-hour period. There are arrangements in place for the companies to call upon extra resource if they need it during times of severe weather. They can ask other DNOs for additional staff if available.

6. Addressing barriers and understanding interdependencies

Alignment with Defra reporting guidance

This section highlights work to address barriers and interdependencies within and beyond the energy sector. It notes where and how these are being addressed and highlights where further work may be required.

6.1. As we reported in 2011, there are strong interdependencies between energy and other regulated sectors. For instance, the electricity system affects the functioning of the telecommunication sector (and vice versa). The generation of electricity also depends on water as a cooling resource. So it is important that measures to adapt to climate change are taken across all sectors in order to be fully effective.

How we understand and address barriers within the energy sector

6.2. At a national level, we work with DECC, the Cabinet Office, and other official bodies on projects relating to the security and resilience of critical national infrastructure.

6.3. The Energy Emergencies Executive (E3) and its Committee (E3C) are the principal fora for identifying and mitigating the risks to the supply of gas and/or electricity to consumers in GB. They are key bodies for industry, regulators and government to work together to make energy supplies resilient.

6.4. Because there are so many issues to consider, E3C devolves its activities to a number of Task Groups each with a specific focus, such as: Cyber Security, Electricity, Gas, and Communications. These task groups are responsible for completing work plans, under the oversight of E3C and strategic direction of E3.

6.5. After the Christmas Storms, and the consequent disruption to electricity supplies, E3C Task Groups worked to overcome barriers to improvement in the industry's response and how it engages with customers. The groups reviewed processes before potential disruption, and the engineering resources for responding to disruption, along with communication systems and contact centre resources (to improve the service a customer can expect during and after a disruption). DNOs also agreed good practices for letting customers know how quickly their supply will be restored, including via social media.

6.6. In addition, a project is underway to deliver a single national phone number for electricity customers to contact when their supply is disrupted. This single national number will launch in 2016.

6.7. Emergency plans are tested in exercises involving many government departments and a wide range of stakeholders.

6.8. The UK CCRA 2017³⁹ has also served to highlight interdependencies between infrastructure assets. In particular it noted that:

"Infrastructure networks near rivers, especially bridges, electricity and communication cables, and gas pipelines, will become more vulnerable to higher flows and erosion of bridge foundations.

The collapse of ageing bridges in recent flood events highlights the potential for knock-on impacts. As well as allowing passage of people and goods, bridges often carry gas pipelines, and electricity, telephone and data cables."

6.9. The Government's National Flood Resilience Review is considering options to improve the resilience of important infrastructure assets to flooding.

Engaging with stakeholders to collectively address barriers

6.10. We engage effectively with other economic regulators through the United Kingdom Regulators Network (UKRN) adaptation working group, the Infrastructure Operator's Adaptation Forum, the UK Research Council's Infrastructure Interdependencies Dialogue. This is as well as our participation in the Environment Agency's Climate Ready Support Service workshop. We have recently requested that the IOAF considers developing some guidance on how infrastructure operators should consider interdependencies.

6.11. In addition to being active at engaging with a wide range of stakeholders, we also incentivise the companies that we regulate to value stakeholder engagement. For example, to promote best practice in stakeholder engagement from the network companies, we introduced a Stakeholder Engagement Incentive (SEI) for the current electricity distribution, gas distribution and transmission price controls. The incentive encourages electricity distribution network operators, gas distribution network operators and transmission operators to talk to their stakeholders to help them plan and run their businesses. For example, the SEI encourages companies to address the needs of common stakeholders, and those who are hard to reach. It also encourages them to work with other sectors to address common issues across a number of industries. We do not tell them who to engage with, but we expect them to have a strategy in place that lets them engage with a range of stakeholders on key issues.

Sector awareness of barriers and interdependencies

³⁹ <https://documents.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Synthesis-Report-Committee-on-Climate-Change.pdf>

6.12. The majority of companies acknowledge the interdependencies with several related sectors including transport, telecommunications and water. Within their reports, the companies have identified the impact to their own networks if other pieces of infrastructure (for example disruption to wider transport networks) affect their ability to reach sites requiring emergency repairs.

6.13. Some specific interdependencies and issues were raised within the companies' reports, including:

- the availability of telecommunications for control systems and operational/field staff communications when dealing with extreme weather events.
- concerns over the future maintenance of potential joint flood protection schemes. Joint schemes could reduce costs and protect communities, but the network companies need clarity about who would be responsible for the construction and long term management of flood protection works.
- the dependency on external agencies (the EA and SEPA) for coastal flood defences and shoreline management plans for assets in coastal regions at risk from flooding.
- the need for cross-sector planning scenarios based on common assumptions. This could help infrastructure operators understand the risks and opportunities posed by cross-sector interdependencies.

6.14. Whilst they identify impacts on their networks caused by other infrastructure failures, we note that the companies' sections on interdependencies don't consider the potential impact of their own infrastructure being disrupted which could lead to wider infrastructure effects and impacts. Such an event could affect related sectors that depend on a reliable energy supply, and we would expect companies to consider this in their planning. For example, we note the ASC report outlines a clear interdependency between energy supply and airport resilience. They note that passengers at Gatwick Airport were considerably disrupted on Christmas Eve of 2013 and cite the Brown Review⁴⁰ which concluded *that poor siting of critical power and IT equipment may be a common vulnerability across many sectors that should be addressed as a matter of urgency.*

⁴⁰ See Transport Resilience Review here:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335115/transport-resilience-review-web.pdf

7. Monitoring and evaluation

Alignment with Defra reporting guidance

This section sets out the monitoring and evaluation that we have put in place to assess the performance of the sector, including under the price control framework. It also highlights the monitoring arrangements that the network companies have in place.

7.1. The complexity, inherent uncertainty and long timescales associated with climate change require a comprehensive approach to monitoring and evaluation. In order to inform our understanding of current and future risks, we draw on three 'levels' of information: Market monitoring, company performance monitoring and sector monitoring.

Market monitoring

7.2. In October 2015 we launched a new set of Sustainable Development Indicators (SDIs).⁴¹ These show the key trends relating to the overall sustainability of the gas and electricity markets in Great Britain (GB). They are also closely aligned to the outcomes we aim to deliver to make a positive difference for energy consumers

7.3. They are updated annually, on a rolling basis, as data becomes available. Drawn from a wide range of sources, they present information across three core themes:

- Environmental impact
- Social outcomes, bills and quality of service
- Reliability and safety.

7.4. Of the 18 SDIs, the following 5 are the most relevant to climate change adaptation as they describe different aspects of network resilience and reliability.

- The average minutes of supply lost per gas customer.
- The average minutes of supply lost per electricity customer.
- The projected flood risk profile (in terms of customers supplied by substations of GB substations) over a 10-year period.

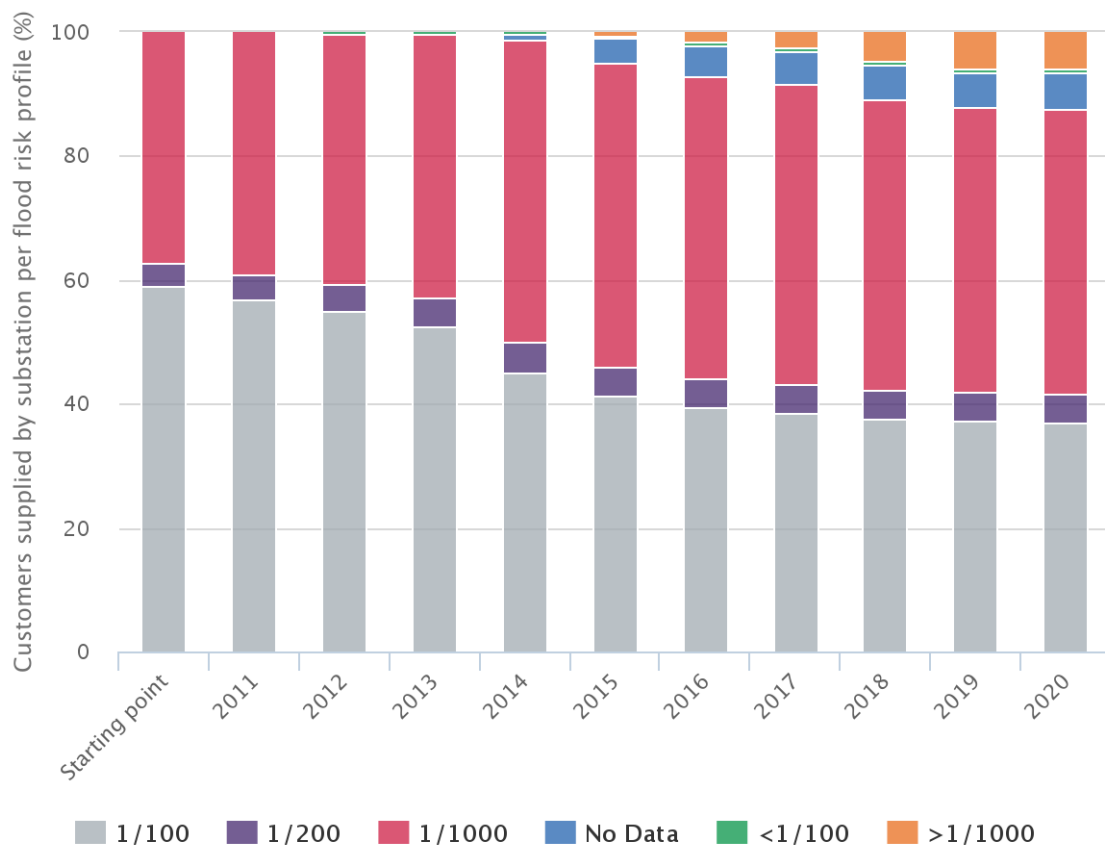
⁴¹ See Sustainable Development indicators here: <https://www.ofgem.gov.uk/about-us/how-we-work/promoting-sustainability/sustainability-reporting>

- The main sources of demand for water abstracted from non-tidal surface and groundwater in England and Wales, including for power generation.
- The cumulative total amount of overhead lines that have been replaced by underground cables (which cannot be damaged by high winds or storms) in Areas of Outstanding Natural Beauty, National Parks and National Scenic Areas since 2006.

7.5. Taken together, these 5 indicators provide a useful market-level assessment of network reliability and resilience (on an 'in-year' and 'year-on-year' basis) to weather impacts, including severe storm events such as those experienced in 2011, 2014 and over the winter 2015/16.

Figure 2 – Estimated substation flood risk scenarios (GB)⁴²

Estimated substation flood risk scenarios (GB)



⁴² 'No data' represents aspects of the data set that do not readily fit into other categories. They include schemes that are in the pipeline of works but have not yet been allocated a completion date, and/or those whose final designated level of protection has not been provided.

Company performance monitoring

7.6. Over the next decade, network companies face the significant challenge of maintaining a resilient, reliable and secure network, whilst dealing with the changes in demand and generation that will occur in a low carbon future. As the regulator, we must ensure that this is delivered at a price fair to current and future consumers.

7.7. To help monitor how effective the RIIO price control is in enabling these changes, we require network companies to report annually on their performance, which allows us to assess:

- their performance in delivering their workload and output commitments;
- the costs they have incurred in delivering their service; and
- the underlying reasons behind their performance.

7.8. From this reporting and assessment, we are able to monitor how effective company investment decisions are in addressing climate-related risks. For example, the two RIIO ED-1 outcome measures dealing with gas and electricity customer interruptions provide a means of evaluating whether company investments are resulting in a more resilient and reliable network.

7.9. We note from our reviews of the companies reports that the adaptation reporting process has allowed them to do a gap analysis with their existing business-as-usual (BAU) risk assessments, and that their BAU processes already incorporate the risks that arise from climate change.

7.10. Across the sectors, the companies are required to report against various environmental metrics. For example, DNOs are required to produce annual environment reports. Alongside the formal reporting areas (such as Business Carbon Footprint and Sulfur hexafluoride (SF 6) emissions – also reported on by electricity transmission owners), DNOs are also encouraged to report on other environment-related areas, including adaptation/flood preparedness.

7.11. As part of our commitment to transparency and providing the public with relevant information, we publish network performance reports on our website.⁴³

Sector-level monitoring and evaluation

7.12. In addition to reporting on their individual performance, network operators also participate in sector-wide monitoring and evaluation activities. They monitor

⁴³See network performance reports here: <https://www.ofgem.gov.uk/network-regulation-riio-model/network-performance-under-riio>

and evaluate their performance during extreme weather events and report on the scale and nature of the disruption they experience. They also assess the main issues they learned from the disruption, such as in customer communication or resourcing.

7.13. Importantly, this information is shared with us to allow sector-level monitoring and evaluation to occur. For example, companies catalogue outage incidences and causes through National Fault and Interruption Reporting Scheme (NAFIRs), which is described in more detail below.

7.14. Within the NAFIRs system, network companies capture detailed data on faults. They attribute faults to one of 99 different direct causes, including the weather related causes included in table 5.

Table 5: Weather related causes of faults

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

7.15. Network companies are therefore actively monitoring how their networks are performing and are well placed to evaluate their vulnerability to weather impacts. This active monitoring should help network companies plan and prioritise their work to enhance the resilience of the sector to current weather events, while developing an understanding of emerging trends as the climate changes. This should allow for regular review and development of plans for delivering climate change resilience.

Future monitoring actions

7.16. For gas distribution, we note from the Northern Gas Networks' report that there is a lack of monitoring of ground movement associated with climate change and that this needs investigating further (we have included this as a recommendation in Chapter 9).

8. Opportunities and benefits

Alignment with Defra reporting guidance

This section sets out the main benefits for the energy sector deriving from the Adaptation Reporting Power.

Cross-sector collaboration benefits

- 8.1. As mentioned in chapter 6, since 2011 the ARP has resulted in regular discussions and collaboration between the economic regulators on adaptation issues.
- 8.2. For example, in 2013 Ofgem convened a Joint Regulators Group (JRG) adaptation workshop (involving Defra, EA, Ofcom, National Grid and Ofwat), and we initiated discussions amongst Ofwat, Ofcom & UREGNI over the issue of critical interdependencies between the energy, water and telecommunications sectors.
- 8.3. This latter discussion help lead to the formation of a dedicated Adaptation Working Group⁴⁴ within the UK Regulators Network (UKRN), the successor body to the JRG. Ofgem is an active participant in the Adaptation Working Group, which enables all economic regulators to collaborate effectively and share knowledge.

Transparency benefits

- 8.4. A beneficial effect of the reporting duty has been to increase transparency about adaptation within the sector, and improve awareness of the issues between the regulated network companies and ourselves. It has helped us understand more about how adaptation is considered as core business within the network companies, as well as the risks and interdependencies that the regulated sectors share.
- 8.5. We note from the companies' reports that the opportunities and benefits identified by the sector were limited. Some organisations state that they have taken the opportunity to strengthen their relationships with key organisations in climate change, such as the Met Office and universities.

Reporting benefits

- 8.6. The adaptation reporting process has also helped to bring about a common framework and reporting intervals within the energy sector, which aids future network planning processes.

⁴⁴ See Adaptation Working Group page here: http://www.ukrn.org.uk/?page_id=662

9. Conclusions

9.1. As reported in 2011, Ofgem’s own operational vulnerability to shorter-term (weather related) and longer term (climate change) risks is considered to be low. However, we continue to take appropriate action to enhance our resilience.

9.2. In line with the findings of our 2011 report, we consider that we have robust regulatory policies and approaches in place to ensure that the regulated energy system delivers a secure and reliable supply to customers; and that the network companies are responding to the challenge of adapting to climate change.

9.3. We have delivered this during the 2011-2015 period principally through our introduction of the RIIO framework – which incentivises network companies to deliver safe, reliable and sustainable network services at long-term value for consumers – and the licensing obligations and conditions we place on network companies and others to ensure system security, availability and quality. These measures have helped support and promote greater resilience within the regulated energy sector.

9.4. It is also clear that the energy sector is undergoing a major transitional period as generation is increasingly decarbonised, and new scales of delivery (eg distributed energy) and demand trends (flexible, smart systems) start to emerge. This means that the long term resilience of the sector needs to take into account risks to both current and new types of infrastructure, as well as consider future uncertainties and the interdependencies between sectors. Overall, our findings into the state of preparedness and resilience of the regulated energy sector suggest that the majority of electricity transmission and distribution companies are effectively identifying and assessing climate risks, and taking proportionate actions to build resilience⁴⁵. These findings are also consistent with the Adaptation Sub-Committee (ASC) 2014⁴⁶ report into the climate resilience of the UK’s infrastructure.

9.5. We consider that risks and uncertainties are well understood across the sector, and that the network companies are continuing to work to address barriers and identify interdependencies within and beyond the energy sector. We are also confident that our regulatory tools enable us to drive the action required from the network companies to address any shortcomings identified, such as those noted in our DPCR5 performance report.

9.6. As we enter the next ARP reporting period, we believe that the energy sector is well placed to develop and enhance its resilience to climate change.

⁴⁵ The gas transmission and distribution sector is intrinsically more resilient to climate impacts due to the underground nature of much of the distribution network.

⁴⁶ See ASC Report on Managing climate risks to well-being and the economy here:

https://d2kix2p8nxa8ft.cloudfront.net/wp-content/uploads/2014/07/Final_ASC-2014_web-version-4.pdf

9.7. However, to help build on this position we have developed the following recommendations:

- That the work underway within the Infrastructure Operators Adaptation Forum (IOAF) on use of shared assumptions across interdependent sectors should be further developed and actively disseminated among members;
- In order to enhance risk assessments, further work is required to improve the spatial resolution, forecasting of probable event frequencies and relationships within climate scenarios. However, we recommend this should be done at a national level to ensure consistency and cost-effectiveness (possibly in the form of an update to the UKCP scenarios).
- Industry to ensure network resilience remains a consideration within the ongoing transition to a smart, low-carbon power system. To support this, we will continue to engage with our partners, including network companies to develop our understanding of how climate vulnerabilities will be affected by changes to generation and distribution.
- That the network companies actively take on board key issues identified in the various research projects under way (such as ARIES and RESENET) and that they should continue to fill evidence gaps where possible, such as those identified on ground movement risks to underground pipelines.

9.8. As the GB regulator, we will:

- initiate work on the strategy for the next price controls (RIIO-T2 and GD2, followed by ED2) in the next few years. As part of this, we will review the best available climate risk evidence and adaptation will be a future strategy consideration.
- work with our partner organisations in the UKRN to consider how to respond to the ASC recommendation over a review of reward and penalty regimes.
- continue our engagement with / input to the forthcoming UK Climate Change Risk Assessment (CCRA2)
- continue with our monitoring and review of our regulatory arrangements with respect to climate change adaptation. This will help determine what further actions might be required.
- work with the sector to take account of the conclusions of the Government's National Flood Resilience Review.

Appendices

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Appendix 1 – Table of Actions

Implemented actions:

Summary of actions (as set out in our first round report)	Timescale over which actions were planned	Progress on implementation of actions	Assessment of extent to which actions have mitigated risk	Benefits / challenges experienced
We said that we would continue to meet with other economic regulators in order to coordinate on regulation that allows for adaptation.	2011-2015	<p>We have continued to meet with the other economic regulators in the UK, eg. we hosted an adaptation meeting of the Joint Regulators Group in 2013, and instigated discussions in 2014 amongst Ofwat, Ofcom, UREGNI over critical interdependencies between sectors.</p> <p>We are also active members in the UK Regulators Network (UKRN) - which includes a dedicated Adaptation Working Group - and the Infrastructure Operators Adaptation Forum (IAOF)</p>	Not applicable.	Benefits have included effective knowledge sharing amongst regulators, with the IOAF in particular helping to bring together the infrastructure operators and regulators over key challenges.
Monitoring and assessing the effectiveness of our regulatory tools and policies in ensuring that energy companies meet their	On-going	<p>We have published the DPCR5 Performance Report</p> <p>Under the RIIO framework, each year, network companies report on their performance under the price control. We then assess:</p>	Having reviewed annual performance returns and company-specific adaptation reports, we believe our regulatory	Regular monitoring allows us to continuously evaluate the effectiveness of the price control mechanisms. If we were to find that our tools and policies were not working in consumers best

<p>adaptation needs.</p>		<ul style="list-style-type: none"> • their performance in delivering their workload and output commitments; • the costs they have incurred in delivering their service; and • the underlying reasons behind their performance. <p>We publish our reports and performance data on our website.⁴⁷</p> <p>We also monitor sector-wide performance (e.g. through NAFIRs reports) and market-level trends via our Sustainable Development Indicators.</p>	<p>arrangements have provided companies with the flexibility and incentives necessary to mitigate risk (through activities completed, underway or planned).</p>	<p>interests, we would consider whether reforms would be necessary.</p> <p>Our DPCR 5 report notes that DNOs delivered (or over-delivered) on their forecast. However two of UKPN's DNOs and both of SSEPD's DNOs have delivered significantly fewer schemes than they forecast. We also have concerns that some DNOs may have reduced the scope of their works or changed the technical solutions give the extent to which companies have underspent our assumptions for expenditure on reducing flood risk. We are working closely with the DNOs on this.</p>
<p>Since our 2011 report, the RIIO (Revenue = Investment + Innovation + Outputs) price control has been</p>	<p>Transmission (RIIO-T1) – This price control relates to the high voltage transmission of electricity and</p>	<p>As noted above (TOs also report against reliability and environmental measures)</p>	<p>As above</p>	<p>As above</p>

⁴⁷ <https://www.ofgem.gov.uk/network-regulation-riio-model/network-performance-under-riio>


<p>implemented.</p>	<p>high pressure transmission of gas for the period 2013 to 2021.</p> <p>Gas Distribution (RIIO-GD1) – This price control relates to the period 2013 to 2021 for the companies that transport gas at a lower pressure to homes and companies for domestic and commercial use.</p> <p>Electricity Distribution (RIIO-ED1) – This price control relates to the companies that transport electricity at a lower voltage to homes and companies for domestic and commercial use</p>			
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	for the period 2015 to 2023.			
Updated Impact Assessment guidance	2013	In 2013 we updated our IA guidance to reflect best practice, and incorporated requirements ⁴⁸ to consider climate resilience.	Our IAs are internally peer-reviewed, and samples are subject to external quality assurance.	New regulatory policy proposals are now required to consider climate resilience (where appropriate)

New actions:

Further or new actions planned	Risks addressed by action	Timescale for new/further actions
We will initiate work on the strategy for the next price controls (RIIO T-2 and GD2, followed by ED-2) in the next few years. As part of this, we will review the best available climate risk evidence and adaptation will be a future strategy consideration.	New and/or intensified climate risks (above and beyond those already anticipated within the UKCP09 projections).	2015-2020
We will work with our partner organisations in the UKRN to consider how to respond to the ASC recommendation over a review of reward and penalty regimes.	Use of disproportionate and/or cost-inefficient measures to promote climate resilience amongst regulated sectors.	Pending a final decision by UKRN but potentially taken forward in 2016
We have also initiated a new Insights for Future Regulation project to help us better understand what is driving system change, the likely impacts on consumers and the implications for regulation. This includes consideration of environmental factors, including impact from climate change. Knowing this	This will help us better understand the potential consumer impacts and implications for regulation of key drivers of change in the energy system. This will improve our risk management and help make our approach to	Key findings to be reported at the end of 2016.

⁴⁸ Including our requirements under DECC's Social and Environmental Guidance



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will help us set our future priorities for the evolution of regulatory arrangements.	regulation more resilient.	
Ongoing monitoring and review of the regulatory framework set out above will determine what further actions might be required.	N/A	N/A