Gas & Electricity Transmission and Distribution Network Companies

4th Round Climate Change Adaptation Report

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The voice of the networks

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Introduction

About ENA

Energy Networks Association (ENA) represents the owners and operators of licenses for the transmission and/or distribution of energy in the UK and Ireland. Our members control and maintain the critical national infrastructure that delivers these vital services into customers' homes and businesses.

ENA's overriding goals are to promote UK and Ireland energy networks ensuring our networks are the safest, most reliable, most efficient and sustainable in the world. We influence decision-makers on issues that are important to our members. These include:

- Regulation and the wider representation in UK, Ireland and the rest of Europe
- Cost-efficient engineering services and related businesses for the benefit of members
- Safety, health and environment across the gas and electricity industries
- The development and deployment of smart technology
- Innovation strategy, reporting and collaboration in GB

As the voice of the energy networks sector, ENA acts as a strategic focus and channel of communication for the industry[1]. We promote interests and good standing of the industry and provide a forum of discussion among company members.

Our members and associates

Membership of Energy Networks Association is open to all owners and operators of energy networks in the UK.

- Companies which operate smaller networks or are licence holders in the islands around the UK and Ireland can be associates of ENA too. This gives them access to the expertise and knowledge available through ENA.
- Companies and organisations with an interest in the UK transmission and distribution market are now able to directly benefit from the work of ENA through associate status.
- As of January 1st 2025, gas distribution and transmission owners and operators are to be represented by the Future Energy Networks (FEN)

ENA members

ENA associates

- Chubu
- EEA
- Guernsey Electricity Ltd
- Heathrow Airport
- Jersey Electricity
- Manx Electricity Authority
- Network Rail
- TEPCO

Abstract

The cross-sector Climate Change Adaptation Reporting Group (CCARG) was established in 2009 with the ENA to address climate change adaptation reporting in the energy networks industry. This group was re-convened for each round of climate change adaptation reporting.

As part of the RIIO-ED2 price review Ofgem requested that network companies establish a group to look at climate resilience, so in 2021 the Climate Change Resilience Working Group (CCRWG) was formed. The group covers all aspects of climate resilience with a primary focus of addressing Ofgem's requirements for a Climate Resilience Metric that will measure how resilient networks are to the impacts of climate, both now and in the future.

The Climate Change Adaptation Reporting Group, re-convened for round four of reporting, reports to the CCRWG. The CCARG met for each round of reporting and produced reports in 2011, 2015 and 2021 representing the combined views of energy network companies.

This assessment report has been developed in response to the requirements placed on reporting authorities by the Climate Change Act 2008 under the fourth Round of Adaptation Reporting. ARP collates Gas and Electricity network reports to form an Energy Networks industry response to Climate Change. ARP4 aims to provide an update on existing risks set out in ARP3 whilst providing mitigation measures and programmes and the consideration of interdependencies and future climate risks. This report continues the progress made since the third round of reporting and should be read in conjunction with the third Round Report.

Method

This report provides an overview of identified risks and challenges that threaten the operation of part or whole of the energy system and outlines the industry-level mitigation progress to manage that risk through adaptative policy, standards and processes. It is intended that companies can use this report as a basis for their individual reporting under The Climate Change Act 2008, where member companies may provide a more specific information within their individual organisation reports. The development of the report follows the requirements and guidance set out by the Department for Environment, Food and Rural Affairs (DEFRA) to establish current risk against various climate hazards with the addition of 2050 and 2100 risk score predictions to establish future-focused climate change risk mitigation.

Transmission and distribution companies in Great Britain are regulated businesses and operate under licences issued by the Office of Gas and Electricity Markets (Ofgem), and are subject to common statutory requirements which are overseen by the Department for Energy Security and Net Zero (DESNZ), the Health and Safety Executive (HSE), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), and Natural Resources Wales (NRW). Allowed revenues for the industry are currently set by Ofgem in periodic price reviews and therefore any costs associated with adaptation to climate change need to be agreed with Ofgem. Transmission and distribution companies are responsible for transporting gas and electrical power from generating plants to customers over their networks. Under the terms of the Civil Contingencies Act, network operators are Category Two responders and work closely with other utilities, the emergency services and local authorities. They are also active participants in the DESNZ Energy Emergencies Executive Committee (E3C).

Overall levels of supply security are agreed with Ofgem and these standards and processes to maintain the availability of alternative supplies at various levels of customer load allows for loss of sections of the networks. However, they do not provide for certain high-impact low-probability events including multiple failures or the total failure of the network. In addition, certain customers may require greater levels of resilience if they are vulnerable or a crucial site to maintain. Uniform levels of resilience for the future networks may not be appropriate to address their customer need and their willingness to meet additional costs associated with improved resilience. Particular attention must therefore be given to key sites when considering network resilience as the entire network cannot be resilient.

Climate Change Data

ARP3 included the involvement of the Met Office UK Climate Projection (UKCP18) tool to take into account projections towards the end of the 21st century. In 2020, on behalf of its members, the ENA commissioned the Met Office to undertake a review of the UKCP18 data and provide an RCP 8.5 worst case scenario in order to understand the changes in potential impact to energy infrastructure assets from climate change. The report from this research has been used to assess the current and future risks to the energy network, and to guide future mitigation or management actions. In addition, other tools, for example the Landmark Flood Mapping Tool, have been used by energy network organisations in research and risk assessment independent to the ENA Met Office research. ARP3 can be located in Annex 1.

As per DEFRA's guidance for adaptation reporting bodies, this report does not present any additional climate data projections but does review the data given in ARP3, more specifically, the Met Office data provided in ARP3. The scenarios used for electricity and gas ARP4 risk data is based on the Met Office's predicted 4°C degree scenario (RCP 8.5) which is suggested to occur by close of the current century if global emissions continue unabated at their current rate. Electricity and Gas systems justify the choice of omitting the 2°C degree projections (RCP 2.6, RCP 4.5 and RCP 6.0) from the collective industry report as the industry primary adapts to worse-case scenarios and any adaptation and mitigation progress towards the 4°C scenario will encompass 2°C scenarios by default. However, 2°C degree scenarios are still being explored within the industry.

RCP8.5 project the following predictions:

In comparison to 1990's climate, by 2070:

- *Winters are expected to be between 1 and 4.5°C warmer*
- *Winters are expected to be up to 30% wetter*
- *Summers are expected to be between 1 and 6°C warmer*
- *Summers are expected to be up to 60% drier, depending on the region*
- *Hot summer days are expected to be between 4 and 7°C warmer*

Future Risk Scoring

Future Risk Scoring for 2050 and 2100 have been utilised to establish grounds for future risk mitigation. Climate Change has been highlighted to be as significant for the future of the system as it is at present and ARP4 needed to reflect this to become more forward-looking. However, future climate projections rely on assumptions and reduce in accuracy the further in the future the prediction is made. All scoring for 2050 and 2100 are expected to be subject to unseeable variables and is thus accompanied by a confidence rating. Confidence rating are provided for each future risk score to flag uncertainty in the data based on the confidence that the score will be accurate by 2050 and 2100. 2050-70 projections in current climate data have reasonable confidence, however beyond 2070, confidence decreases significantly.

Climate Change Adaptation Risks

The adaptation risks referenced in the previous rounds of reporting have been retained, but each risk description has been reviewed to provide more clarity to suit the purpose of ARP4. All assessed risks for both gas, electricity, and gas management from the previous round have been reevaluated for this report, with each risk evaluated in the Risk Matrix as set out in the following spreadsheet. Each climate variable and their impact on the gas and electricity networks have been identified and is accompanied by mitigation progress to showcase any changes/improvements since the previous round. The ARP4 risk assessment can be located in Annex 2.

Findings:

Electricity

The ARP3 and ARP4 risk scores sees little variation as the timescale between these rounds of reporting is 3 years. The general trend sees risk either maintaining, or increasing towards 2050 and 2100. AR4 and AR5 shows underground assets not being more or less susceptible in 2050 and 2100 to climate change due to rigorous design standards that accommodate for ground movement and extreme temperatures in the far future.

The majority of electricity risks see both an increase in impact and likelihood towards 2050 and 2100 and thus a higher risk in the future. Risk confidence for these scores are low as a result of a lack of definitive projections and the uncertainty of future risk predictions affecting mitigation progress. Electricity distribution organisations do naturally adapt to current risks and as new risk emerge or as current risks maintain or increase in severity. Societal impacts factor into the uncertainty of risk scoring as it is unclear how impactful the increased reliance on electricity will be as the UK transition towards Net Zero and CP2030. The energy network industry also have a reactive process to threats towards energy assets. Larger assets have a long lifespan (approximately 40-50 years) therefore once older network assets are upgraded, new assets will include adaptation requirements and be presently adapted to the current climate. Most risks see a gradual increase in 2100 up to 3 points higher than present. The exceptions are AR10, AR11 and AR12 concerning fluvial, pluvial and sea flooding. ETR138 is utilised to shape flood mitigation policy to accommodate for increased risk however, there is high confidence that flooding will become a more significant impact on the system. Innovation projects are being considered in this area to counteract this increasing risk.

Gas

Risk scoring between ARP3 and ARP4 shows that gas system risk to climate change hazards vary but are generally decreased. The most notable decreases in scoring are the impacts from snow and ice, river erosion affecting underground pipes, groundwater flooding, IT system vulnerability, and ground contamination. All the aforementioned risks see the score decrease between 2-4 points due to increased monitoring and management of the assets. Additionally, as the majority of GDN assets are

located underground, there are very few severe risks to raise concern. Despite these results, it is noted that lightning impacts increased significantly in score from 3 to 8 and increasing in the band of risk. Gas networks are responding to this risk by providing high degrees of earthing protection and carrying out risk assessments on new sites to ensure the protection systems are sufficient. When assessing future risk, scoring is expected to increase at varying degrees of severity. Whilst no identified risk is expected to be of highest priority, gas systems are looking to address the risk and maintain manageable levels. Snow and ice, ground contamination, and ground moment from wet and dry are exceptions, where the level of risk is expected to drop significantly due to a lack of correlations that these risks pose threats towards GDN assets.

The future projections of the gas system are not high in confidence nor variation and future projections lack confidence due to the lack of confidence of gas system climate change data and management data. The data accuracy and granularity of climate model scenarios does provide significant barriers for risk assessments. Additionally, the majority of gas infrastructure is underground creating little direct impact from climate change and increasing uncertainty.

It has been realised that gas risks could be revised in future rounds of reporting to cater more specifically to potential impacts of GDN assets. GDN management risks are seeing a sharp decline in risk as GDNs climate strategies are more robust and mature. There is greater awareness of climate hazards towards gas assets within executive and management teams and the gas industry has increased reporting and planning to reduce and accommodate for impacts to the system. Management is expected to reach business-as-usual levels of risk for gas and can be considered for removal in future rounds of reporting if the risk continues to decrease.

Interdependencies

Energy networks have been increasingly aware of interdependencies and identified the vulnerabilities of interdependent energy systems. Operational and functional interdependencies were explored in ARP3, specifically the relationship of interrupted gas supplies leading to an increase in electricity demand and vice versa. Climate change can exacerbate this relationship since warmer periods have increased in both duration and intensity from rising global temperatures which inflates air-conditioning purchase and usage across commercial and domestic environments. Air conditioning affects electricity demand, which is often supported by gas fired generation, resulting in a drawdown of gas reserves which could impact domestic supplies as pressures are reduced to meet generation demand. Energy systems can be seen as a system of systems, each reliant on another's outputs to operate and therefore being more susceptible to climate change impacts.

One specific case to highlight the interdependent relationship and cascading failure between energy systems is the Leicestershire water, gas, and electricity failure in January 2024. The intrusion of water into gas pipes after a water pipe burst cut off gas supply to Leicestershire villages. The resulting effect caused electricity demand to increase from a switchover to electrical heaters and cookers. Ultimately, the sudden electrical demand led to an electrical outage. The incident highlights the pressure and strain that one system puts on the other when that original system has been impacted and emphasises the vulnerabilities of the system that have been recognised by the energy industry.

Energy networks have identified telecommunication networks as an interdependency to their operations; not only are the telecommunication networks increasingly reliant on an electricity supply to operate the fibre network but energy networks rely on the telecommunications network for their operational communication to assets and staff on site. Recognising that there is resilient telecoms which SCADA is routed through, there is still an operational reliance on the public network for communicating with on-site staff and remote assets are often reliant on parts of the public telecommunications networks and any loss of communications connection, either from loss of mobile mast supply or physical damage, can impact on energy network restoration times following a significant event and create challenges with remote switching.

Networks have identified other interdependencies beyond operations such as cascading interdependencies. Increased storm frequency, snow and ice, flooding and tree felling can impact transportation links affecting utility operators from reach faults for repair and restoration due to the reduced accessibility. Cyber and communication interdependencies threaten the whole industry, impacting coordination and security, and hostile actor interference can impact every part of the network from loss of control to overload damage to the network.

Outlook

Energy networks have reconsidered their investments post-Storm Arwen to prioritise resilience against climate change hazards and threats. Looking ahead towards 2050-2100, equipment would need to adapt and evolve in response to climate impacts.

All energy network operators were required to produce a Climate Resilience Strategy for the RIIO-ED2 price control/review period. This requirement will continue with all energy network operators being expected to produce a Climate Resilience Strategy as part of their next price control business plan submissions for the RIIO-3 price control period. These are expected to include measures required adapt to changes in climate and assess the impact on assets to improve network resilience. Awareness already includes understanding the impact of increasing temperatures on the operation and capacity of assets, the ground mounted asset flood protection programmes, in place since 2010, are continually under review as flood risk profiles are updated. It is expected that the Climate Resilience Strategies will include options for the energy networks to evolve to adapt to climate change and make changes as plant and equipment come to the end of their natural operational life.

With the inclusion of Climate Change Resilience Strategies and requirements in RIIO-2 and RIIO-3 and the climate resilience metric being developed by the CCRWG and Ofgem, there is more emphasis on tracking progress in adapting networks to a changing climate and ensuring best practices are being utilised. It has been highlighted that there were previously fewer measures of monitoring resilience, and increased awareness suggests more adaptation and mitigation progress than what the data suggests.

When reviewing climate impact data on gas and electricity, it is important to consider firstly the societal impacts on the system, where climate will change the way people use energy and those changes need to be accommodated for in the network. As demand has increased in summer, a significant majority of risks are remaining constant or increasing but there is a lack of confirmation over the degree of severity as climate impact data is both uncertain and not easily identified. Secondly, gas systems are a evolving industry and it is important that the current levels of resilience and reliability are maintained.

Wind Storm risk

During the development and review process it was noted that wind storms had not been specifically drawn out in the ARP3 risk assessments and subsequently have not been highlighted in this ARP4 report due to the shorter timeframe for submission compared to previous rounds. Wind was mentioned briefly in previous reports but the climate data during the development of those reports suggested that wind storms were expected to only increase in frequency, with evidence starting to support an increasing in severity as well. This hazard poses significant risk to the overhead line network, directly and indirectly from wind blowing debris and toppling of trees into overhead line, and that there is growing belief that wind storms are increasing in both frequency and severity of wind storms. It has now been established as a changing risk for electricity systems and the impact of wind storms will be considered to be fully assessed as a risk in the next ARP reporting period. Electricity organisations may report on wind storms in more detail in their organisation-specific ARP4 reports.

In order to adapt to this risk, networks are reviewing existing overhead line networks, replacing poles and shortening spans where permitted by wayleaves and relocating overhead line routes away from vegetation, where wayleaves can be re-negotiated.

Emerging Risks

Other risks not mentioned in previous rounds of reporting may be considered in future rounds. Groundwater flooding has been an identified risk to electricity systems, affecting ground-mounted substations and assets. Humidity has been identified as an emerging risk to gas systems, causing corrosion and water ingress of underground gas assets. Both emerging risks are not included in this report due to the shortened timeframe of reporting but are being considered as an industry. Combination hazards may also be considered in the future to align with other workflows in the CCRWG.

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Adaptation Reporting Power (ARP4) Annex 1 – Climate Change Adaptation Report 3 (ARP3)

This is the 3rd Round Report published in 2021. ARP4 is an update to this report.

CCRA3 report v1.0 final.pdf

Adaptation Reporting Power (ARP4) Annex 2 - Risk Assessment

This assessment is an excel spreadsheet which provides definitions of each assessed risk, the assessed score of both each individual organisation and their industry-wide score, 2050 and 2100 projected scores and confidence and the risk matrix for both gas and electricity.

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