Northern Gas Networks

APPENDIX A8

CLIMATE RESILIENCE STRATEGY

11th December 2024

Contents

1. Climate resilience

Extreme weather can pose a significant risk to energy infrastructure and thereby impact the level of service received by our customers. Scientific evidence shows that our planet's climate is changing due to anthropogenic greenhouse gas emissions. This means that the weather our region experiences will change in the long term and be subject to more extremes. In parallel, human activity is changing our landscapes. For example, increasing urbanisation and building on floodplains reduces the ability of the land to mitigate the consequences of extreme weather. To ensure continuity of service to our customers, our infrastructure must be able to reliably supply energy, whatever the weather and however our communities change.

1.1. Assessing, embedding and communicating climate resilience

NGN is designated as a reporting authority under the Climate Change Act (2008).[1] Since 2011, we have provided regular individual and collaborative energy sector reports to the UK government under the Climate Change Adaptation Reporting Power (CCARP). These reports detail climate change risk assessments for our assets and business operations. They also outline our actions to adapt to climate change, in addition to wider climate change risks to energy sector infrastructure. Our last assessment was prepared in 2021,[2] and a further report will be prepared in late 2024. In addition, we also publicly disclose our material physical climate change risks and opportunities annually.[3]

Built on this foundation of risk analysis, our understanding of the impacts of climate change to our assets and operations has developed over many years and will continue to evolve. This understanding has been used to develop this Climate Resilience Strategy. We do not consider climate resilience in isolation, instead our Climate Resilience Strategy forms a key pillar of our business-wide Resilience Framework which enables us to embed climate resilience throughout our organisational culture. Our Resilience Framework (as described in Chapter 5 of our RIIO-GD3 business plan and summarised in Figure A8-1 below) embeds what we have naturally done for many years to ensure we have an integrated approach to resilience. This approach ensures we can meet whatever demands we might face throughout RIIO-GD3 and beyond. The integration of our Network Asset Management Strategy and our Climate Resilience Strategy allows us to identify the risks facing our infrastructure and address them in the most appropriate and efficient way.

Figure A8-1 : NGN Resilience Framework

1 https://www.legislation.gov.uk/ukpga/2008/27/contents
2 Available here: www.northerngasnetworks.co.uk/wp-content/uploads/2021/12/NGN-CCA-Rnd-3-Report-FINAL-DECEMBER-2021.pdf.
3 Latest disclosure here, see pages 26 to 38: www.northerngasnetworks.co.uk/wp-content/uploads/2024/09/Northern-Gas-Networks-Holdings-Limited-Mar-2024-FINAL-signed-1.pdf.

Stakeholders tell us that they want to know about the actions we are taking to build and embed climate resilience. Throughout RIIO-GD3 we will continue to report our climate resilience actions via the existing mechanisms identified above. In addition, we will communicate updates of progress against our climate resilience strategy commitments in our annual regulatory reporting. We will also work collaboratively with our partners to develop and improve energy network reporting of climate resilience. This will include contributing to the development of appropriate climate resilience metrics/indicators.

1.2. Customer priorities for climate resilience

Stakeholder Insight 1: Keeping bills as low as possible continues to be domestive and small and medium-sized enterprise customers top priority, however stakeholders are supportive of investment to respond to significant challenges of climent resilence and decarbonisation.

Stakeholder Insight 8: NGN's focus should be on keeping customers' lives running by providing reliable and uninterrupted supplies and minimising disruption to their daily activities. Current performance is great and NGN can play a role in driving up industry standards.

Our customers consistently rank providing a reliable gas supply in their top two priorities for NGN, second only to keeping bills low[4]. They tell us that resilience means their gas supply is available to use whenever they need it, whatever the present and future weather conditions. Gas networks should prepare for this so that customer service performance doesn't diminish. Through specific conversations about resilience with our Citizens' Panel during 2024, customers told us that they consider NGN to be a resilient business (Insight 8). They therefore prefer us to adopt a cautious approach to further climate resilience investments. This will ensure that we continue to be resilient in the future whilst minimising costs to customers now. Our engagement with expert stakeholders during 2024[5] has identified a desire for us to invest more proactively in climate resilience. Our stakeholders want us to increase our readiness for the future and harness partnerships to deliver resilience effectively for them.

We have used the insight gained above to inform the development of this strategy.

The stakeholder insights referenced in this document can be seen in full in Appendix A3 of our RIIO-GD3 business plan.

1.3. Measuring climate resilience

Resilience, in particular to climate change, is difficult to conceptualise and measure. The main driver for the consideration of climate resilience is to ensure that energy networks can continue to reliably supply customers, short and long term. This is regardless of climatic conditions and impacts experienced by other interconnected sectors (such as telecommunications, road networks, etc.). As such, in the absence of a specific metric or indicator, perhaps the effective measure of climate resilience is therefore consideration of customer service performance. For gas distribution networks, the current metrics are identified below, and we have detailed our long-term performance against these in Section 1.4.1:Emergency gas escape response performance;

- Percentage of gas escapes extending beyond 28 days to repair;
- Number and duration of unplanned gas supply interruptions; and
- Customer satisfaction rating for speed of restoration of unplanned gas interruptions.

Stakeholders have identified to Ofgem that the development of climate resilience metrics and indicators for energy networks would offer potential benefits. These would include use of these indicators in stakeholder communication, cost benefit analyses, and reporting the benefits of actions taken. We will actively collaborate with our stakeholders and partners during the remainder of RIIO-GD2 and into RIIO-GD3, with the aspiration to begin monitoring and reporting during RIIO3.

1.4. The impacts of extreme weather

1.4.1 An introduction to our assets

Our network area covers approximately 25,000 km^2 across northern Cumbria, North East England and Yorkshire. It spans densely populated urban areas such as Leeds and Newcastle, and rural areas including the Lake District, Northumberland, North Yorkshire Moors and Yorkshire Dales National Parks.

We transport gas to approximately 2.9 million customers via a network of underground pipes. This extends for approximately 36,000 km, of which approximately 1,300 km comprises our high-pressure (>7 bar) Local Transmission System (LTS). The operation of our pipe network is supported by over 5,500 strategic above-ground infrastructure sites. These comprise the following:

- 23 offtakes where we take gas from the National Transmission System into our network;
- 178 pressure reduction stations;
- Over 5,000 governors (district and service) which regulate gas flow through our network.

4 See pages 15 and 18: https://together.northerngasnetworks.co.uk/wp-content/uploads/2024/03/Customer-Perceptions-2024-Wave-4.pdf
5 NGN Hot Topics Workshop - Climate Resilience, June 2024

A summary of our main above-ground asset types is provided on pages 3–5 of our December 2021 Round 3 Report.

Core gas network infrastructure comprises sealed, pressurised, pneumatic mechanical equipment and pipes with supporting digital, electrical and instrumentation equipment. All network infrastructure is designed, installed and maintained to engineering standards established by the Institution of Gas Engineers and Managers to serve agreed customer service requirements. Key customer service requirements that our network must provide include maintaining minimum (21 mb) operating pressures at all network locations and providing a 1-in-20 years measure of peak demand. The 1-in-20 years peak day demand is the level of gas demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.

1.4.2 What risks does extreme weather pose to NGN?

Our assessments of climatic risks to our network performance identify the following factors. The characteristics and design of our network infrastructure, located underground and undergoing a long-term replacement programme to durable plastic pipes, provides it with high levels of physical resilience to normal weather conditions. Following review of 34 different potential climate-related risks, under current climatic conditions the most significant are considered to be:

- Significant ice and snow events resulting in access difficulties to key assets, locations and operational activities (most notably responding to gas emergencies as experienced during the winter of 2010/11); and
- Flooding of above-ground assets resulting in potential asset damage and supply loss incidents (although such incidents are rare).

Our LTS provides a critical role in the operation of our network, providing gas storage and bulk transfer from the national system to our lower pressure tiers. The majority of our LTS pipelines were built between 1960 and 1980. Given the criticality of these aged assets and the high cost of replacing them, they are regularly and proactively inspected, receiving targeted engineering remedial works to ensure their integrity and longevity.

Over recent years, our inspection programme has identified a small increase in the occurrence of our pipelines becoming exposed in riverbeds and banks due to erosion. Where this is identified remedial works are required to ensure the long-term integrity of our pipeline. An example of one of our recent remedial pipeline projects is provided in Case Study 1, along with the associated cost. It is noted that such projects can vary widely in scale and associated cost based on site characteristics and risks, and a significantly larger project is proposed for RIIO-GD3 (see Case Study 3). In the past we would typically expect to complete one such remediation project per year, but over recent years we have seen this increase to two per year. This recent experience has been used to inform our RIIO-GD3 asset investment plans.

CASE STUDY 1 – RIIO-GD2 RIVER BED EROSION REMEDIATION

A routine maintenance inspection of our 450mm diameter high-pressure pipeline crossing Black Burn in Cumbria identified that erosion of the riverbed had exposed a section of the pipeline. This was therefore threatening the integrity of the pipe by potentially exposing it to being undermined leaving it unsupported, and/or impacted by boulders transported by the river.

NGN commissioned a specialist geomorphological assessment of the river to identify and assess potential remedial options. Following a site specific multi-element options appraisal, a ramped rock weir was installed over the pipe. This used approximately 100m^3 of local, natural boulders and cobbles during summer 2021 to protect the pipe. This £35k Capex investment, was selected as the most sustainable solution as it provided robust protection, minimised impact on river flow and ecology, had limited perceptible visual impact and was low cost.

Considering high impact, low probability events

Consideration of rarely occurring extreme weather events, often referred to as 'high impact, low probability', is important when considering network resilience. These events occur infrequently, but consideration of their magnitude and associated impacts is an important demonstrator of the conditions that networks must be resilient to. Additionally, they provide a real-life stress test of current network resilience.

Due to the nature and operation of gas network infrastructure (underground with a small amount of low-rise equipment) extreme heat and wind do not typically pose significant threats. Extreme cold and wet conditions can, however, pose significant stresses to gas network infrastructure.

Extreme cold conditions

Extreme cold weather events exert additional stresses on our network by temporarily significantly increasing demand for gas. For example, during the 'Beast from the East' cold spell in February and March 2018, our region experienced several days of freezing temperatures, heavy snow and strong winds. This resulted in a significant increase in customer gas demand for heating. The design and maintenance standards of our infrastructure provide resilience by resistance and reliability. This meant that our network continued to supply customers with gas throughout this event, including temporarily operating at over 100% of its 1-in-20 peak demand capacity, without failure or associated loss-of-supply events.

It is noteworthy that due to a long-term reduction in customer gas usage, the peak gas demand capacity used for network design historically now comfortably exceeds current peak demand. This therefore provides inherent supply resilience. This level of resilience is maintained by continued investment in asset management to ensure integrity and performance.

A secondary outcome of periods of greater gas demand is that we typically experience increased numbers of reported gas emergencies which we must respond to. During this particular event, we were able to continue to meet our customer service standards, due to being sufficiently prepared, resourced and equipped in accordance with our Severe Weather Management Incident Procedure. As described in more detail in Section 1.4.3, this procedure requires constant refinement and investment to adapt to changing climatic conditions. It enables us to harness learning from each event to ensure that we can continue to deliver for our customers at the optimum level.

Extreme wet conditions

During December 2015 and January 2016, our region was subjected to two extreme weather episodes commonly known as: 'Storm Desmond' and the 'Boxing Day Floods'. This resulted in widespread flooding, six pipe water ingress events impacting 469 customers' properties (one of which was declared a major incident by NGN), and damage to three road bridges in Yorkshire carrying our pipes. Our emergency response procedures ensured that whilst our pipes were exposed to potential damage during the episodes, our customers continued to be supplied with gas or quickly had their supply restored. The average loss-of-supply duration due to water ingress was 77 hours across the six pipe water events. Responding to the damage to the three bridges carrying our pipes incurred total costs to NGN of £65,000 (in 2015 prices) associated with workforce, materials and equipment (Opex) (individual incident costs ranged from £7,000 to £40,000).

Considering interconnectivities and cascading risks

Interconnections between different industry sectors is a source of risk for energy networks, with failures from one sector potentially causing downstream impacts to others. Electricity, telecommunications, road transport and water infrastructure are thought to be the most significant sources of risk.

Much of gas network infrastructure is mechanically operated and can continue to provide its core function of transporting gas in extreme conditions, including under water. Telecommunications are already important for automated and remotely controlled equipment, sharing demand and supply data between distribution and transmission networks, and for communication with personnel in the field. As gas network digitalisation increases and network electrical and instrumentation systems become more advanced, interconnectivity between the gas, electricity and telecommunications networks also increases, alongside the associated potential for cascading risks.

The storms and associated widespread, long-duration electricity outages experienced by our region during the winter of 2021/22 (including 'Storm Arwen' – see Case Study 2) has brought this interconnectivity into greater focus. Whilst some of our key gas infrastructure sites experienced network electricity outages during this period, our own backup power provision was able to ensure continuity of gas supply without any related supply interruptions. As detailed in Case Study 2, we have since undertaken a targeted capital investment programme, supported by contingency operational investment, to enhance our our backup power provision to further ensure that we are resilient to such cascading risks.

Interconnectivity between gas and electricity networks is also important during large loss of gas incidents. This is because customers, in particular vulnerable customers, are typically provided with alternative electrical cooker and heating devices whilst their gas supply is restored. Distribution of this equipment and its use must be monitored carefully and in collaboration with the electricity distribution network operator (DNO) via our emergency incident communication procedures. This ensures that the local electricity network won't become overloaded, which would exacerbate the impact on customers.

Road transport is essential for gas networks for attendance at gas emergencies, to protect our customers and enable restoration of supply, and to access assets for routine maintenance and emergency restoration. As such, any extreme weather events which impact the road network (e.g. lying snow and ice or fallen trees due to storms) bring with them potential impacts to our customer service performance.

Water ingress into gas networks results in loss of supply and the requirement for deployment of gas network resources to remove the water and reconnect customers. For example, during March 2023, one such incident in Stanley, County Durham impacted supply to 383 NGN customer properties and resulted in a total interruption duration of 34,200 hours. Water ingress events are often associated with leaking water mains. This can arise as a result of ground movement, in particular after cycles of wet and dry weather in certain soil conditions. These water ingress events typically impact older, brittle metallic gas mains. Changing weather patterns could result in increased occurrence of water main leaks, resulting in increased water ingress events in the future. Our emergency procedures must evolve to ensure that we are able to respond to these stresses. However, the impact of these events will be mitigated by the continual evolution of our network to more robust plastic pipes.

CASE STUDY 2 – STORM ARWEN

In November 2021, Storm Arwen brought extreme weather to the UK, with winds reaching up to 98mph in some areas. This brought widespread electricity outages, with over 1 million customers losing power. Approximately 40,000 customers were without electricity for more than three days and nearly 4,000 customers off supply for over a week. An Ofgem report identified recommendations for increasing electricity network resilience, incident handling and customer communications and support.

Large areas of our network, particularly in North East England and Cumbria, experienced significant power outages, which impacted some of our key gas infrastructure sites. Our own backup power provision was able to ensure continuity of gas supply without any related gas supply interruptions throughout. None of our gas infrastructure network infrastructure was subject to significant storm damage.

We have since undertaken a review of our backup electricity supply provision to ensure that we are resilient to such cascading risks. Based on this event, we have identified investments in enhanced backup power provision at key sites which will be implemented across RIIO-GD2 and further investments to increase our resilience during RIIO-GD3. Our RIIO-GD2 programme of work includes installing additional or enhanced back-up power provision at more than 20 sites at a cost of more than £2m Capex. Whilst this programme is underway we also hire supplementary standby generators for use at key sites over the winter period at an annual cost of approximately £90,000 Opex.

Following Storm Arwen and the experiences of the electricity distribution networks, we stress tested our website and emergency call-handling system. To ensure that we can manage increased customer contacts during future incidents, we expanded our call-handling capacity to allow us to accept up to 900 calls at any one time. This incident also further highlighted how gas and electricity distribution networks can assist each other during times of emergency to benefit customers.

1.4.3 Preparing for extreme weather

We first developed a procedure to manage the impacts of winter weather upon our business operations during 2011. We had failed to meet mandatory targets for attending and assessing gas escapes during the severe weather of winter 2010/11, resulting in NGN receiving a regulatory financial fine. This management procedure has been continuously refined since to improve our level of business preparedness for extreme weather and to ensure we always meet our business performance standards.

During RIIO-GD1, we observed that our business operations were becoming exposed to impacts from the increasing occurrence of extreme weather outside of the winter season (e.g. summertime flooding incidents). In response, we took the proactive step to evolve our management procedure to become an all-year-round Severe Weather Incident Management Procedure.

We prepare for severe weather in several ways to ensure that we meet our business performance standards regardless of weather conditions. The following steps are aligned to the National Infrastructure Commission's (NIC) principles for resilient infrastructure systems[6] and NGN's Resilience Framework controls:

- **Anticipate / Reflection:**
- Receipt of detailed daily weather forecast data for our individual network sub-regions, including indicators of significant temperature swings;
- Preparation of a daily dashboard of business performance against 14 key performance indicators from our Severe Weather Incident Management Procedure. This highlights potential areas of failure and triggers appropriate responses (e.g. additional resource allocation). To illustrate this, in December 2022, a proactive decision was taken by NGN Senior Management prior to a forecasted cold spell to temporarily cease planned mains replacement work. NGN and contractor resources were diverted to support gas emergencies workload to ensure that we could meet our critical customer service requirements, most notably with regard to gas emergency response performance. This decision was enabled by the proactive changes to contractor terms and conditions driven by NGN as detailed below.
- **Resist / Resistance:**
- Modernising the terms and conditions of employment of our gas engineers and key contractors to provide us with a sufficiently resourced flexible workforce always able to manage our workload;
- Permanent recruitment of additional gas engineers and training our own staff as emergency reservists. We also train and equip an additional c.30 third-party contractors so they can act as reservist emergency response engineers to supplement our own staff in times of peak demand to ensure that we are adequately resourced;
- Hire of supplementary 4x4 vehicles during winter each year, in addition to fitting all of our fleet vehicles with all-weather tyres, to provide vehicle fleet resilience in winter weather.
- **Absorb / Reliability and Redundancy:**
- Investment in enhanced and additional backup power provision at more than 20 sites during RIIO-GD2 as described in Case Study 2.
- Stress test of our emergency call-handling capability, increasing its capacity to allow it to accept up to 900 calls at any one time;
- Completion of access risk assessments for our priority infrastructure sites;
- Maintenance of vegetation at our infrastructure sites so that access and asset performance are not impacted by storm damage.
- **Recover / Response and Recovery:**
- Investment in innovative new and upgraded water extraction resources for managing water ingress into our pipe network for more effective response;
- Flexibility to re-deploy colleagues and contractors to where they are most needed, with the ability to call on other gas networks for additional support if required.

We produce an annual report of our performance against the requirements of our Severe Weather Incident Management Procedure and review the procedure regularly (typically biennially) to identify potential improvements.

Partnership working

Stakeholder Insight 10: Regional collaboration with utilities partners has identified opportunities and best practices for handling increased exposure to severe weather incidents, especially those which support vulnerable customers.

The gas networks of Great Britain have mutual aid agreements in place to enable the sharing of resources (such as gas engineers and customer care officers) when necessary, such as during large loss-of-supply incidents, to ensure customers are restored to gas as quickly as possible. NGN has provided such support to other gas networks in recent years.

Following learnings from Storm Arwen and stakeholder feedback (Insight 10), NGN is currently proactively working with the electricity distribution network operators in our region to establish a similar mutual assistance arrangement. This can be called upon in times of need to enable customers to have their energy supply restored as quickly as possible.

Under the terms of the Civil Contingencies Act, as a gas network operator, NGN is a Category Two responder. As such, NGN is required to co-operate and share relevant information with other utilities, the emergency services and local authorities. We are also active participants in the Department for Energy Security and Net Zero (DESNZ) Energy Emergencies Executive Committee (E3C) National Emergency Exercise scenario and Gas Task Group emergency scenarios. These provide stress testing of the UK's gas network. In addition, given our role as an energy provider, we are members of local resilience forums (LRFs) in our region. We support the LRFs in their work to identify potential risks and produce emergency plans to either prevent or mitigate the impact of any incident or catastrophe, including climate-related events, on their local communities.

NGN has been an active participant in the cross-utility Energy Networks Association (ENA) Climate Change Resilience Working Group since its establishment. This has enabled the sharing of best practice as well as collaborative and consistent reporting of network climate change risks and adaptation actions. Through this group, NGN has also played an active role in the UK government-funded CS-NoW project, which ultimately aims to strengthen the climate resilience of UK infrastructure, housing and communities, with specific focus on energy networks.

1.4.4 Our long-term performance

To ensure that our network delivers our customer service requirements, we measure and report our performance through a range of common metrics under the RIIO-GD2 regulatory framework. In addition, we monitor our performance internally by a number of bespoke metrics, with the objective of providing class-leading customer service.

As identified Section 1.3, in the absence of a specific climate resilience metric, perhaps the most appropriate and effective measure of climate resilience is consideration of customer service performance against key metrics. NGN has demonstrated excellent, long-term, resilient customer service performance since the start of RIIO-GD1 (2013/14), spanning a wide range of weather conditions as demonstrated in Figures A8-1 and A8-2, most notably:

- Attendance at uncontrolled gas escapes within one hour 99.5% of the time or better, compared to a regulatory target of 97%;
- Attendance at uncontrolled gas escapes within two hours 99.6% of the time or better, compared to a regulatory target of 97%;
- 2% of gas escapes extending beyond 28 days to repair;
- Consistent, improving performance for number and duration of unplanned gas supply interruptions, regardless of the cause and extreme weather conditions (see Figures A8-1 and A8-2);
- Average duration of unplanned gas supply interruptions of 5.0 to 5.6 hours, compared to a regulatory target of ten hours during RIIO-GD2 to date;
- Average customer satisfaction rating of 9.59/10 for speed of restoration of unplanned gas interruptions (2023/24).

Our RIIO-GD2 performance to date for the above metrics is provided in our [2023/24 Strategic Commentary report].

Based on the integrity of our assets and our continuously evolving management procedures, we have not been directly significantly impacted by extreme weather in recent years. This is our baseline level of resilience against which we measure our future performance. Customers have clearly told us that our current levels of resilience are high (Insight 8), but they will not accept a reduction in service performance in future.

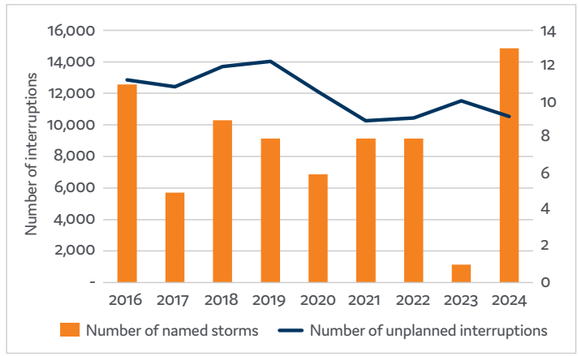

Figure A8-1: Number of NGN unplanned gas interruptions versus number of named storms impacting the UK during regulatory year. Note storms only commenced being named in the UK during 2015/16. Storm data source: UK Storm Centre

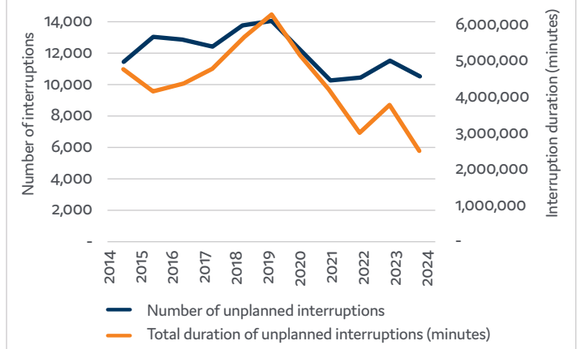

Figure A8-2: Number and duration of NGN unplanned gas interruptions.

6 https://nic.org.uk/anticipate-react-recover-28-may-2020/

1.5. Assessing and preparing for the future

1.5.1 Climate scenario analysis

In considering adaptation to climate change, we have used the UK Climate Projections 2018 (UKCP18) published by the Met Office[7] to consider how the climate of our region might change by 2050 and 2100. This assessment is informed by analysis completed by a collaborative project between the ENA members (including NGN) and the Met Office in 2020, and the findings of the collaborative CS-NoW project 'Enhancing Resilience in UK Energy Networks'.

The UKCP18 projections cover four different future climate scenarios known as Representative Concentration Pathways (RCPs) which represent a broad range of potential future climate outcomes as summarised in Table A8-1. The plausibility of each of these scenarios remains open to debate. Also, whether any of these scenarios come to fruition, and if so which one, depends on the scale and timescales of global society actions to mitigate climate change, most notably the transition to net zero.

Over the course of the 21st century, the UK's climate is expected to typically become more extreme, with hotter, drier summers and warmer, wetter winters, with increased storm occurrences. A summary of the general climatic trends for 2°C (RCP 4.5) and 4°C (RCP 8.5) future warming pathways at 2050 and 2100 for our region is provided in Table A8-2. This data indicates that our region is already demonstrating these climatic trends and that the climate of our region can be expected to experience similar trends to the wider UK. In addition, the data identifies relatively limited differences in climate change projections for the alternative climate change projections by 2050 but much greater divergence by 2100.

RCP scenario used in UKCP18	Associated indicative societal response to greenhouse gas emissions reduction	Change in average surface temperature (°C) by 2081–2100 compared to average in 1850–1900
2.6	Strong/high level of emissions reduction	+1.6 (low warming)
4.5	Moderate level of emissions reduction	+2.4 (moderate warming)
6.0	Moderate level of emissions reduction	+2.8 (moderate warming)
8.5	Minimal level of emissions reduction	+4.3 (high warming)

Table A8-1 : Summary of RCP emissions scenarios used in UKCP18 and equivalent average surface temperature increases. Source: Met Office (2018).

Climate variable	Yorkshire and Humber			North East England		
	2010–2029	2040–2059	2080–2099	2010–2029	2040–2059	2080–2099
Mean annual temperature (°C): RCP 4.5 RCP 8.5	 +0.7 +0.8	 +1.3 +1.7	 +2.4 +4.0	 +0.6 +0.7	 +1.1 +1.6	 +2.2 +3.7
Mean winter temperature (°C): RCP 4.5 RCP 8.5	 +0.6 +0.7	 +1.2 +1.6	 +2.0 +3.4	 +0.5 +0.6	 +1.0 +1.4	 +1.9 +3.1
Mean summer temperature (°C): RCP 4.5 RCP 8.5	 +0.9 +1.0	 +1.6 +2.1	 +3.0 +4.9	 +0.8 +0.8	 +1.4 +1.9	 +2.9 +4.7
Mean winter precipitation (%) RCP 4.5 RCP 8.5	 +2 +2	 +5 +7	 +9 +15	 +3 +3	 +5 +7	 +11 +17
Mean summer precipitation (%) RCP 4.5 RCP 8.5	 -3 -3	 -11 -13	 -20 -30	 0 0	 -7 -10	 -18 -28
50th percentile climate variable difference compared to equivalent for 1981–2000 period for different climate change scenarios						

Table A8-2: Summary of future climate change projections for NGN region at mid and end 21st century for 2°C and 4°C warming scenarios. Source: Met Office (2022).

7 https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index

The analysis completed by the Met Office for ENA members (including NGN) reviewed the UKCP18 data to understand the risks to energy infrastructure assets from climate change. This assessment was based on the pessimistic 4°C warming scenario (RCP 8.5) and reviewed a broad range of pertinent climatic hazards to energy infrastructure to identify the likely changes for 2050. This is summarised in Table A8-3. This worst-case scenario was selected for the analysis to fully consider the potential risks of climate change to energy networks in light of their critical roles.

In consideration of more extreme acute weather conditions, a summary of future changes to key climate hazards for our region as produced by the CS-NoW project to 2080 is provided in Table A8-4. This confirms the broader patterns identified in Table A8-3 – limited changes in extreme winds, reduced occurrence of extreme cold spells but the chance remains, and wet spells and hot spells becoming more intense and frequent.

Climate hazard	Climate signal at 2050 for 4°C warming scenario
Snow and ice	Reduced occurrence with lying snow events disappearing almost completely over low elevation areas, but possibility of extreme cold events remains.
Temperature	General increase and increased number of extreme heat temperature days, in particular in the south-east of the UK (outside of our network area).
Precipitation	General reduction in overall summer rainfall but greater occurrence of intense prolonged summer rainfall events, and overall increase in winter rainfall, with west of UK experiencing more change than the east. Extreme hourly rainfall events are expected to increase in summer (in particular in the north of the UK, which might include our network area), winter and notably during autumn.
Sea level rise	Increase of up to 1m by 2100, in particular impacting the southern coasts of the UK and Northern Isles (outside our network area), and the Yorkshire coastline (which is in our network area and noted to be subject to significant coastal erosion).
Storm surge	Best estimate is no change in storm surge compared to current conditions.
Increasing occurrence of wet and dry weather cycles	Overall drier summers leading to typically drier soils. Clay soils, such as those found in the east of England (including our network area) and London area, are more susceptible to movement as a result of quick drying.
Strong winds	No significant changes compared to current conditions.
Lightning	Increase in lightning flash rate in summer, especially in south of UK (outside of our network area), with decreases in autumn across most of the UK and little change in winter and spring.
Wildfire	Evidence of increasing risk as a compound result of, or exacerbated by, other climate change hazards.

Table A8-3: Summary of climate change signal for 2050 under UKCP18 projections for RCP8.5. Source: NGN 2021 CCARP report.

Climate hazard	Sensitivity of NGN network to hazard	Pattern of change versus 1980-2000 period	Future approximate return interval of a 1 in 20 years event during 1980 to 2000 period
Windstorms – max windspeed	Low	Minor increase in intensity by 2060–2080.	2020–2040: no change 2060–2080: 1 in 14 years
Cold spell – minimum temperature	High	Becomes warmer and less severe. Some uncertainty in signal.	2020–2040: >1 in 50 years 2060–2080: >1 in 50 years
Hot spell – maximum temperature	Low	Becomes hotter and more frequent.	2020–2040: 1 in 5 years 2060–2080: 1 in 1–2 years
Wet spell – total rainfall	Medium	Becomes wetter and more frequent.	2020–2040: 1 in 8 years 2060–2080: 1 in 6 years

Table A8-4: Projected climate hazards for NGN region to 2080 based on RCP 8.5 compared to 1980-2000 conditions. Source: CS-NoW.

1.5.2 Climate risk assessment

Being located predominantly underground and operating as a sealed and pressurised system, UK gas network infrastructure has proven in the long-term to reliably deliver energy to customers in a dynamic climate. Gas network infrastructure and operations have an overall low to medium risk to climate related hazards currently and into the future[8] with a lower climate risk profile to that of electricity infrastructure.

Table A8-5 summarises the principal climate related physical risks facing NGN currently, and in 2050 and 2100. This assessment is based on our latest analysis of climate related risks to our network performance for 2050 and beyond. It assumes continuation of our current management procedures and activities in mitigating climate change impacts and the climate change projections identified above. In addition, our assessment of risks in 2050+ assumes that gas networks will continue to play a critical role in the UK energy system. In addition, it is assumed that our infrastructure assets and network operation and maintenance requirements, as well as associated management procedures, will be similar to the current situation. Given the similar climate signals at 2050 for the different warming scenarios, a combined risk rating is provided for the 2°C and 4°C scenarios, with separate risk ratings at 2100 to reflect divergence in the climate signals.

The overall risks posed to our network from the following climatic-derived sources of damage to our assets, and associated potential for supply loss incidents, are expected to remain similar in 2050 compared to current:

- Flooding of above-ground assets (CR2)
- Flood damage to pipes crossing watercourses (CR3);
- Damage to underground pipes from river erosion (bed and banks), including land slippage (CR4).

This assessment is based on consideration of the physical aspects and integrity of our assets, and the strength of our asset management procedures (assuming continued current levels of management and investment).

The risk posed to our above-ground assets from wildfire related damage (CR5) is expected to increase by 2050 as the likelihood of extreme heat events increases. It is noted however that this is an emerging risk and our understanding is relatively nascent.

The overall risk associated with significant ice and snow events impacting the management and operation of our network (CR1) is expected to remain as current by 2050, but with a lower likelihood of occurrence. This is because whilst temperatures will generally increase, there remains the potential for extreme cold spells (CR1). In addition, the risk of underground asset damage as a consequence of cycles of dry and wet weather, or frost heave (during extreme cold weather), resulting in ground movement (CR6), is expected to reduce from medium to low risk by 2050. This is as a result of completion of our long-term programme of replacing aged, brittle metallic gas mains with more durable, flexible plastic pipes.

Climate hazard	Current risk rating	2050		2100		
		Risk rating 2°C and 4°C	Confidence	Risk rating 2°C	Risk rating 4°C	Confidence
CR1: Extreme cold spells impacting transport and operational response performance	Medium	Medium	Medium	Low	Low	Medium
CR2: Flood damage to above-ground assets	Medium	Medium	Medium	Medium	Medium	Low
CR3: Flood damage to pipes crossing over watercourses	Medium	Medium	Medium	Medium	Medium	Low
CR4: Damage to underground pipes from river erosion and land slippage	Medium	Medium	Medium	Medium	Medium	Low
CR5: Above-ground asset damage from wildfire	Low	Medium	Low	Medium	Medium	Low
CR6: underground pipe damage by ground movement	Medium	Low	Medium	Low	Low	Low
CR7: cascading risks due to interconnectivities between energy and telecommunications networks, e.g. storm-related power cuts	Low	Low	Medium	Low	Medium	Low

Table A8-5: Principal NGN climate related risks currently and in 2050 and 2100 for different future warming scenarios assuming continuation of current levels of mitigation and management.

8 https://www.energynetworks.org/assets/images/CCRA3%20report%20v1.0%20final.pdf

Cascading risks due to interconnectivities between energy and telecommunications networks (CR7) is expected to remain as current in 2050 as this risk is already recognised and managed (e.g. by the provision of standby generators). It is recognised, however, that high impact, low probability events such as Storm Arwen should be considered in resilience planning.

Beyond 2050, the overall risks from the identified climate hazards remain broadly stable across both climate scenarios assessed, albeit with potentially increased likelihoods of occurrence, in particular under a 4°C warming scenario. This assessment is based on the assumption that risks will continue to be mitigated to current levels by continuation of business-as-usual proactive asset management. It is noted that there is relatively low confidence in the 2100 risk ratings due to uncertainties associated with climate projections for that time horizon and how they would impact network infrastructure.

The climate scenario risk analysis did not identify high risks for either the 2°C or worst-case 4°C warming scenarios assessed. As such, this recognises our resilience to material climate change risks in the long to very long term (2050+). This is due to our comprehensive asset integrity and management procedures that are in operation to ensure asset condition and performance. In addition, there is inherent resilience afforded by gas infrastructure assets being a sealed, pressurised system principally located underground. Resilience levels to climate change risks will be greater in lesser warming scenarios should they arise, due to lower climatic extremes.

The findings of this risk assessment have been used to inform our RIIO-GD3 climate resilience investment strategy as detailed next.

1.6. RIIO-GD3 climate resilience commitments

1.6.1 Considerations for climate resilience investments

Stakeholder Insight 7: Both businesses and the public believe that within our current energy system, the risks and benefits of climate change will not be fairly distributed. Those most at risk must be protected from carrying undue costs and burdens they have neither created nor have the means to avoid. Customers in vulnerable circumstances, young people, rural customers and small businesses require special consideration.

Customers consistently tell us that their top two priorities are keeping bills low whilst having a reliable source of gas. Whilst the requirement to keep bills as low as possible continues to be customers' top priority, stakeholders have told us that they are supportive of investment to respond to the significant challenges of climate resilience and decarbonisation (Insight 1). Investments in climate resilience must be viewed as a trade-off between increased costs to customers now from proactive investment, vs delaying investment, which may impact customer service performance in the future and incur greater costs to future billpayers.

Consideration must also be given to:

- Uncertainties regarding the accuracy of climate change projections;
- The trajectory of global action to tackle greenhouse gas emissions;
- The long-term future of gas network infrastructure compared to risks that might become apparent post-2050.

Stakeholders have identified to NGN that climate resilience should be viewed as one aspect of resilience for energy networks, in particular alongside energy security and net zero. It is difficult to do this currently for gas networks whilst their long-term future is uncertain.

It is also important to consider that whilst gas networks currently have high levels of resilience due to the nature of their assets, this resilience may change as the nature of the networks changes. For example, future partial or sequential decommissioning of gas networks would create more single-feed sub-networks. These would have lower supply continuity resilience than currently and may need reinforcement investment to retain supply resilience at current levels. This necessary investment would be spread over a smaller customer population potentially increasing affordability issues. Alternatively, if such investment did not materialise, it poses the risk of leaving gas customers, some of whom will include those who cannot switch from gas due to cost issues or the electricity network configuration, with reduced levels of energy supply resilience and therefore facing greater levels of vulnerability (Insight 7).

As identified in Section 1.2, our customers have told us they prefer NGN to adopt a cautious approach to further climate resilience investments to ensure we continue to be resilient in the future whilst minimising costs to customers now (Insight 1). This is contrasted by the views of expert stakeholders who identified a desire for us to invest more proactively in climate resilience to increase our readiness for the future.

As described in Chapter 5 of our RIIO-GD3 business plan, NGN adopt a Network Asset Management Strategy with the aims of:

- Maintaining resilience to provide a safe and reliable service to our customers as we transition towards net zero;
- Remaining agile so that we can respond to continuing industry uncertainty.

We can achieve these aims by prioritising targeted investment that balances the interests of consumers, investors and the environment whilst also recognising the uncertainties that we face in this changing world. This approach has been applied in the development our RIIO-GD3 climate resilience investments.

1.6.2 Our RIIO-GD3 climate resilience investments

We will continue to evolve and refine our Severe Weather Incident Management Procedure throughout RIIO-GD3 to ensure that it is optimised to best serve our customers, notably to manage the risks to our operational performance from extreme cold events (CR1). In addition, Table A8-6 identifies investments that we will make as part of our wider RIIO-GD3 operational and asset management investment plans, to be completed as a rolling programme throughout RIIO-GD3. These will enhance our resilience to the identified principal climate risks and enable us to continue to provide our customers with the levels of service they currently receive, or better. This programme of work is scoped to be necessary, cost efficient and targeted to address known specific risks. It is also forward looking and flexible to enable us to respond to anticipated risks based on recent experiences and future projections.

As detailed above, there is limited difference in the climate risks to NGN for either the 2°C or 4°C warming scenarios, in particular at 2050. As such, it is difficult at this stage to identify different investment plans to prepare for either scenario. As the climate science and understanding of the implications for energy networks advances, we will work with stakeholders to explore the scope and cost differential of resilience investments necessary to prepare for the different scenarios.

Climate risk	NIC resilience principle / NGN resilience control	Strategic investment details and investment category*
CR1: Extreme cold spells impacting transport and operational response performance	Anticipate and Absorb / Resistance	Continual review and refinement of severe weather management procedures and preparations (Direct Opex – work execution).
CR2: Flood damage to above-ground assets	Resist / Resistance	Flood mitigation by proactive raising of electrical equipment at 14 critical sites located in/near flood zones as part of wider site condition upgrade works (Capex - non-load related). Link to RIIO-GD3 business case: Offtakes and PRS E&I, and Offtakes and PRS Civils.
CR3: Flood damage to pipes crossing over watercourses	Resist / Resistance	Overcrossing inspection and remedial programme: proactive condition inspection programme for pipes crossing watercourses ('overcrossings') (Direct Opex – work execution) with targeted bespoke remedial measures (such as upgrades or diversion) to ensure integrity (Capex – non-load related). Link to RIIO-GD3 business case: LTS Pipelines, and LTS and Distribution Overcrossings
CR4: Damage to underground pipes from river erosion and land slippage	Resist / Resistance	Pipeline integrity management programme: proactive pipeline condition inspection programme (Direct Opex – work execution) with targeted bespoke remedial measures (such as armouring – low cost) or diversion (high cost) to ensure integrity based on recent experience of occurrences (Capex – non-load related). A specific RIIO-GD3 project case study for this workstream (River Allen) is provided as Case Study 3. Link to RIIO-GD3 business cases: LTS Pipelines, and Major Project - River Allen, and Offtakes and PRS Civils
CR5: Above-ground asset damage from wildfire	Resist / Resistance	Asset maintenance programme: proactive maintenance of site vegetation across NGN's portfolio of gas infrastructure sites and gas pipeline easements (Direct Opex – work execution).
CR6: Underground pipe damage by ground movement	Resist / Resistance	Iron mains replacement programme: continuation of 30-year programme of replacing aged metallic pipes with durable plastic alternatives (Repex). Link to RIIO-GD3 business cases: Mandatory Repex, and Non-mandatory Repex
CR7: Cascading risks due to interconnectivities between energy and telecommunications networks, eg storm-related power cuts	Absorb / Reliability	Installation of enhanced standby power provision (battery systems or generators) at 26 critical gas infrastructure sites (Capex – non-load related) as part of site condition upgrade works. Newly installed generators will have enhanced fuel storage capacity and telemetry systems to remote enable monitoring of fuel levels where practicable and appropriate. Link to RIIO-GD3 business case: Offtakes and PRS Preheating, and Offtakes and PRS E&I
Mutual assistance agreements with DNOs	Recover / Response and Recovery	Establishment of mutual assistance agreements with the DNOs in our region to enable customers to have their energy supply restored as quickly as possible in times of emergency. This is captured in our new voluntary commitment for RIIO-GD3 to establish a Mutual Support Framework with regional DNOs to support customers during energy supply incidents. Further details are provided in Section 3.3.2 of our RIIO-GD3 Business Plan.

* As per RIIO-GD3 BPDT categories.

Table A8-6: RIIO-GD3 climate resilience investments.

CASE STUDY 3 – RIIO-GD3 RIVER BED EROSION RESILIENCE

Routine maintenance inspections of our 450mm diameter high-pressure pipeline crossing the River Allen in Cumbria during summer 2023 identified that erosion of the riverbed has exposed sections of the pipeline, with the potential for exposure in the river banks as well. This threatens the integrity of the pipe, and the associated gas supply to over 100,000 customers, by potentially exposing it to being undermined leaving it unsupported, and/or impacted by 1m+ sized boulders transported by the river. Emergency remediation measures were completed during November 2023 to provide temporary protection to the pipeline (rock filled bags) whilst a permanent, durable solution was determined.

During 2023/24 NGN commissioned a specialist site-specific technical assessment of the river to identify and assess potential long-term resilience options. Following a site specific appraisal of 11 potential nature-based and engineering solutions (in isolation and hybrid), pipeline diversion has been determined as the optimum solution to provide long-term (50 years+) resilience and minimised environmental impact. The design works for this solution will be completed in RIIO-GD2 (costing £400,000) with engineering works to be completed during RIIO-GD3. The total project is anticipated to cost £7.7m (Capex). Refer to the Major Project - River Allen business case for further details.

Pipeline inspection and maintenance works at River Allen crossing.

1.6.3 Commitment to collaboration

NGN has been an active participant in the cross-utility ENA Climate Change Resilience Working Group since its inception. We will continue to work collaboratively with our energy network partners and other stakeholders throughout RIIO-GD3. This will enable:

- The sharing of knowledge and best practice;
- The standardisation of reporting;
- Input into the development of climate resilience metrics/indicators.

These efforts will continue irrespective of the departure of the gas networks from the ENA in 2024.

We will also continue to actively participate in climate resilience focus groups in our region to encourage local collaboration, data sharing and partnership working to benefit our customers and stakeholders. Our engagement with utility network partners in our region during 2024[9] identified multiple areas where we can work together to build resilience. We will pursue opportunities to work together throughout RIIO-GD3 to deliver benefits for our stakeholders and customers.

1.6.4 Reporting

Given the existence of the three-yearly CCARP programme in which all gas networks actively participate, we propose to report performance against our climate resilience investment commitments in our Annual Regulatory Report. We will summarise further key advancements in our Annual Environmental Report (e.g. advancement with the development of climate resilience metrics/indicators). Reporting could also include 'leading' indicators of climate change resilience actions, such as risk assessments completed or proactive mitigation works completed. This would provide stakeholders with an understanding of the actions being taken to build resilience.

9 Cross-utility workshop, July 2024.

1.7. Stakeholder acceptance

Stakeholder Insight 9 and 10: Stakeholders, customers and colleagues are supportive of NGN's Climate Resilience Strategy, and are looking for evidence on how customers will be supported.

As part of the RIIO-GD3 planning process, we have tested our Climate Resilience Strategy with our stakeholders.[10] Expert stakeholders gave our strategy a high level of acceptance:

- 89% support for the principles underlying the strategy;
- 89% approval that it complements their own organisations' policies on climate resilience;
- 100% support that our strategy contains sufficient preparation to meet the climate challenges of the future;
- 89% support that our strategy strikes the right balance of proactivity vs reactivity.

Insights 9 and 10 confirm that our stakeholders, customers and colleagues are supportive of our Climate Resilience Strategy. The RIIO-GD3 climate resilience investments summarised in Table A8-6 demonstrate our continued efforts to provide our customers with a reliable and resilient source of energy.

"Our climate is changing so we are continuously reviewing our processes and assets in collaboration with our stakeholders. This will ensure that we can provide our customers with a reliable source of energy, whatever the weather."

Neil Whalley,
Head of Environment and Sustainability

Key statements

Level of expert stakeholder support that our Climate Resilience Strategy contains sufficient preparation to meet the climate challenges for the future

100%

10 Hot Topics workshop, June 2024.

Northern Gas Networks