national gas transmission

STRATEGY

OFFICIAL- SENSITIVE

Climate Resilience Strategy

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RIIO-GT3 NGT_A06

Contents

1 Executive Summary

Our Climate Resilience Strategy sets out our holistic approach toward maintaining an appropriate level of climate resilience for our current methane network.

1.0.1. This strategy paper discusses the proposed [redacted] (2023/24 price base) of investment request related to improving our network's resilience against the seven climate hazards identified in our Adaptation Reporting Power 3 (ARP3) report and one additional driver, which will be included in our upcoming ARP4 report.

1.0.2. These hazards have the potential to disrupt the security of supply to our customers and consumers downstream, especially if several hazards act together in an adverse climatic incident.

1.0.3. £12.38m of this total proposal is related to investments where Climate Change Adaptation (CCA) is the primary driver for the proposed works. £28.10m of the total value is proposed for investments where CCA is a secondary driver and £1.14m is dedicated to our proposed climate change impact assessment studies.

1.0.4. In RIIO-GT3, we intend to carry out interventions to bolster flood defences at [redacted] which are deemed to be most susceptible to flooding risk.

1.0.5. We intend to deepen our understanding of the potential impact of climate hazards (of raised temperatures and flooding) on our assets by carrying out targeted site-specific studies on 58 (11%) of our critical sites.

1.0.6. We have sign-posted and collated all these proposed climate resilience interventions and their brief description and individual costs within this document as required by the Ofgem BPG. Detailed justification for them is included in their relevant Engineering Justification Papers (EJPs), which have also been referenced.

1.0.7. This is a new area of investment as our RIIO-GT2 plan did not include any dedicated climate resilience investments.

1.0.8. We have incorporated views and feedback from key stakeholders on this strategy paper (including representatives of Ofgem, DESNZ, gas and electricity transmission and distribution network operators, and industry and academia experts on this subject) and will be expanding our engagement on this subject with stakeholders in the UK and with gas transmission operator internationally.

1.0.9. We have discussed costs related to the recovery from a recent weather event, which detrimentally affected the operation of one of our critical sites.

1.0.10. Finally, we have discussed some of the barriers which prevent us in making longer-term intervention plans for climate resilience projects, including the lack of climate resilience metrics and data on the existing impact of climate change hazards on our asset performance.

2 Introduction

2.0.1. Resilience is defined by the Intergovernmental Panel on Climate Change (IPCC): Resilience - The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation (IPCC, 2018).

2.0.2. At National Gas Transmission (NGT), we are acutely aware of the potential impact of climate change on our critical national infrastructure and are keen to explore ways to improve our understanding of the risks posed by it to our assets. Maintaining a safe, reliable, and resilient NTS is something we pride ourselves on.

2.0.3. This document is our dedicated Climate Resilience Strategy (CRS), which sets out our approach towards ensuring operation of the National Transmission System (NTS) remains resilient and reliable in a changing climate, in line with what our stakeholders want and value. This document builds upon our reporting within climate change Adaptation Reporting Power (ARP) process. The Climate Change Act 2008 enables the Government to require infrastructure providers and bodies with functions 'of a public nature' to provide reports on how we manage climate risks. Department for Environment, Food and Rural Affairs (DEFRA) review these reports to help ensure reporting organisations are taking appropriate action to adapt to climate change. We will continue to provide the necessary ARP reports as and when required by the Government.

2.0.4. Our CRS outlines our balanced approach toward tackling our challenges through a mix of reactive and proactive actions within the RIIO-GT3 period. On the reactive front, where our asset capabilities have been tested already by climate change, giving us evidence of its adverse impact on the operation of our asset base, we have proposed Climate Change Adaptation (CCA) driven essential investment in physical asset enhancements and protection.

2.0.5. Secondly, we have noted separately the investments that are driven primarily by other investment drivers (such as Asset Health) but have CCA as a secondary driver.

2.0.6. Thirdly, we have recognised and noted other non-CCA driven investments that deliver the benefit of enhancing our network's future climate resilience.

2.0.7. And finally, we have included within our plan, provision for climate change impact assessment studies across our critical sites, aiming at comprehensive site-specific quantification of risks posed by the specific hazards of flooding and temperature extremes. These studies will be in addition to our mandated (Environment Agency permitted Compressor Stations) site-specific climate risk assessments as they will be more bespoke and exhaustive.

2.0.8. We have developed and assessed our investment plans against the seven climate hazards that we have considered within (our most recent) Adaptation Reporting Power 3 (ARP3) report1, as potentially the most impactful for our gas transmission business. As part of the discussions within Energy Networks Association's (ENA) Climate Change Resilience Working Group (CCRWG), we have added an 8th hazard to our list of considerations, which we will be including within the upcoming ARP4 submission. Through the ENA, we have also been able to discuss and receive guidance from Ofgem on these hazards and their potential impacts.

2.0.9. We agree that significant effort is required by us and the wider energy sector to embed climate resilience within our Asset Management System (AMS) by having its clear line of sight cascaded down from our corporate priorities to the decision-making processes within operational and capital asset management planning and work delivery.

2.0.10. We firmly believe that the development of the climate resilience metrics (through our on-going collaboration with ENA and other key stakeholders) will be a fundamental step toward building a data-driven approach for consistently quantifying and maximising consumer benefit and for clarifying what resilience thresholds we should operate within.

2.0.11. We commit to working with our stakeholders to undertake scenario planning to identify the possible impacts of climate change, using the UKCP18 climate projections. This on-going work will allow us to develop adaptation pathways to appropriately plan for current and future decision points across our assets' lifecycles.

2.0.12. We have developed this strategy to set out robust guiding principles that underpin our holistic (short, medium and long term) approach to ensuring our gas transmission business is resilient to the impacts of climate change. Within

[1] https://www.nationalgrid.com/electricity-transmission/document/143211/download

the scope of this document, we focus on the resilience of our existing methane network and discuss the justification of the reactive and proactive measures we plan to undertake to counter the effects of current and future climate change impacts on our operations, during RIIO-GT3 and beyond.

2.0.13. In the longer term, proactively adapting to the effects of climate change will require us to adjust our own operations and build resilient infrastructure and contingency plans to better cope with weather-related threats and potential shifts in external behaviours that could unintentionally threaten our assets. During RIIO-GT3, we aim to gain better data-driven insights into the potential impacts of climate change on our network resilience through the proposed surveys and studies mentioned above, enabling us to build targeted, efficient, and well justified adaptation.

Figure 1: Our Climate Resilience Approach

2.0.14. We believe that investing in measures to mitigate the impact of climate hazards on our assets and network will ensure our continued capability to deliver sustainable value for our customers and stakeholders.

2.0.15. Our approach toward the development of a data-driven long-term climate resilience approach follows the Plan-Do-Check-Act (PDCA) continuous improvement principles where our current plans focus on the delivery of essential shorter-term investments and data gathering and analysis to develop a longer-term strategic direction.

2.0.16. We have also ensured that this strategy addresses and complies with Ofgem's requirements for our CRS, as stated within their business plan guidance (July 2024).

3 Asset Management Line of Sight

3.0.1. Our Climate Resilience Strategy is aligned to our business priorities and stakeholders' expectations. Our AMS includes a specific Asset Management Objective (AMO) related to Network Resilience (AMO6) of which Climate Resilience is an integral component (along with network resilience).

3.0.2. Full description of the line of sight within our AMS is included in NGT_A08_Network Asset Management Strategy_RIIO_GT3.

3.0.3. We have made a Business Plan Commitment (BPC) on ensuring we enable adequate climate resilience for the critical national infrastructure we operate. This commitment is shown in Figure 2, along with its line of sight to its relevant AMO, Ofgem's regulatory outcome and our business priority.

Figure 2: Line of Sight for the Climate Resilience Business Plan Commitment

4 Climate Change Hazards

4.0.1. When we were part of National Grid Group, ARUP was commissioned in 2020 to conduct a group-wide scenario-based assessment of physical climate change risks to the group assets. This study, delivered in 2021, has been used to inform our Climate-related Financial Disclosure (CFD) submissions2 from financial year 2021/22 onwards.

4.0.2. In our first full year as National Gas, we undertook a gap analysis on our previous disclosures against the CFD guidance to assess risks and opportunities that could impact our gas transmission business in the future. We conducted an initial qualitative analysis of rapid decarbonisation scenario (2 degrees rise) to assess our energy transition risks and a comprehensive quantitative assessment (via the ENA) for the slow decarbonisation scenario (4 degrees rise) to assess physical climate risks.

4.0.3. In addition to the ARUP study, in 2020, ENA, on behalf of its members, commissioned the Met Office to review UK Climate Projections (UKCP18) data to better understand the potential impact of climate change on energy infrastructure assets. The insights from this report also helped us in assessing the current risks to our network and inform future mitigation and/or management plans.

4.0.4. The group requested that only the highest Representative Concentration Pathways (RCP8.5) was used, to provide a worst-case scenario and timeframes out towards the end of the century. The rationale behind this decision was that the networks should plan for a worst-case scenario, since globally temperatures are already well on their way to reaching 2 degrees warming and that for the gas transmission system which is inherently resilient and has experienced limited impact from climate change to date, the greatest insight and value to be gained was in assessing the climate hazards associated with a RCP8.5 or 4-degree scenario only.

4.0.5. We consider that a qualitative assessment of the impact of a 2-degree scenario was undertaken in the decision to initiate only a 4 degree 'worst case' quantitative assessment on the highest priority hazards, as identified in section 4.0.9. A 2-degree scenario posed a low risk to National Gas assets across all climate hazards.

4.0.6. Based on the RCP8.5 scenario, hazards were identified by the ENA Climate Change Adaptation Group which included ourselves, the respective Gas Distribution Networks (GDNs) and the electricity Distribution Network Operators (DNOs).

4.0.7. Our ARP3 hazards and their risk assessment (derived from the ENA commissioned Met Office review) only considered RCP 8.5 of a 4.3-degrees rise in global mean surface temperatures. ARP3 guidance by Department for Environment, Food and Rural Affairs (DEFRA) did not mandate the assessment to include the other three scenarios (i.e., RCP2.6 | 1.6 °C rise, RCP4.5 | 2.4 °C rise and RCP6.0 | 2.8 °C rise). The qualitative 2-degree assessment mentioned previously allows us to gauge our energy transition risks but not the risks to physical assets from climate change. Therefore, a quantitative risk assessment for the 2 degrees scenario (that could be utilised for refining this strategy) is currently not available.

4.0.8. We recognise that Defra's ARP4 reporting guidance recommends previously reporting organisations to now include the minimum set of climate scenarios which are set for new reporting organisations, namely 2 and 4 degrees. In our ARP4 report, we will provide an update to our action plan and update our risk assessment and matrix which was previously based on a 4-degree warming scenario (worst case) only. In addition, we will document our qualitative 2-degree scenario analysis within our ARP4 report due for submission at the end of 2024. In line with our discussion with Ofgem as part of the SQ process (SQ Reference NationalGas013) on section 5.14 of Ofgem's business plan guidance (July 2024), which requires us to signpost to our climate change hazard and risk assessment at 2 and 4 degrees, we agree to submit the information on our 2 degrees qualitative assessment as part of our second annual reporting submission.

[2] https://www.nationalgas.com/sites/default/files/documents/FY24%20NGT%20-%20Colour.pdf (CFD sections – page 31 onwards)

4.0.9. We have considered the seven highest priority hazards (in line with our ARP3 report3) and an additional eight hazard (to be included in our ARP4 report) in developing our investment plans. These hazard categories and a brief description of the risks assessed within these categories is described below. They are referenced by an ARG (ARG: ENA Climate Change Adaptation Sub-Group) or TCFD (TCFD: Risks considered by the TCFD Working Group Climate Modelling Project, but not considered in previous ARP Reports) prefix in consistency with the ARP3 report.

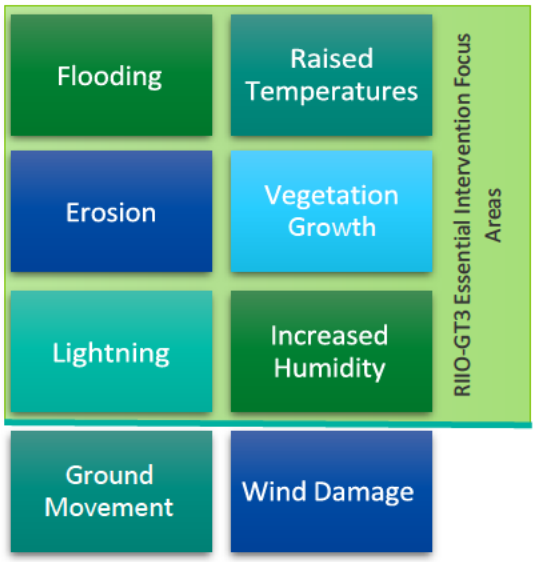


Figure 3: List of Climate Change Hazards Considered

4.1 Flooding

4.1.1. **ARG4: Flood risk of above ground assets.** There is an increasing risk of physical damage to assets located in flood plains (fluvial flooding) or to other assets from extreme and extended rainfall (pluvial flooding). We have already recorded evidence of flooding impacting our site operations (as per the example in section 10 of this paper, however, the risk considered here is for an increasing frequency of such incidents due to climate change. Whilst feeders and block valves can operate if submersed in water, electrical and electronic equipment may be susceptible to damage or may require isolating if flooding is anticipated. Loss of telemetry and communications has the potential to significantly impact site operation and the wider network. This will be exacerbated if flood defences are ineffective and/or plant relocation is not possible.

4.1.2. **ARG21: Saline contamination and increased corrosion rate of above and below ground assets from sea water.** There is a risk of gradual chemical damage to pipelines from increased tidal flooding, with potential for increased corrosion rates at any areas not fully protected by coatings.

4.2 Temperature Extremes

4.2.1. **ARG6b: Above ground assets affected by raised temperatures.** Gas network assets are manufactured to international standards and designed to operate within particular temperature parameters. Increasing temperature impacts all plant and equipment and may reduce their rating and asset performance, leading to reduced operating capacity. Higher temperatures within compressor cabs, may cause increased system tripping and subsequent plant

[3] https://www.nationalgrid.com/electricity-transmission/document/143211/download#:~:text=More%20importantly%2C%20the%20ARP3%20report,a%20consolidated%20Energy%20Industry%20response.&text=Outline%20the%20proposals%20and%20policies,introducing%20those%20proposals%20and%20policies

outages. Figure 4 shows that the global mean surface temperature has always been changing but a steep increase has been seen between 1980 to 2020. This makes it concerning and an important hazard to ensure resilience against.

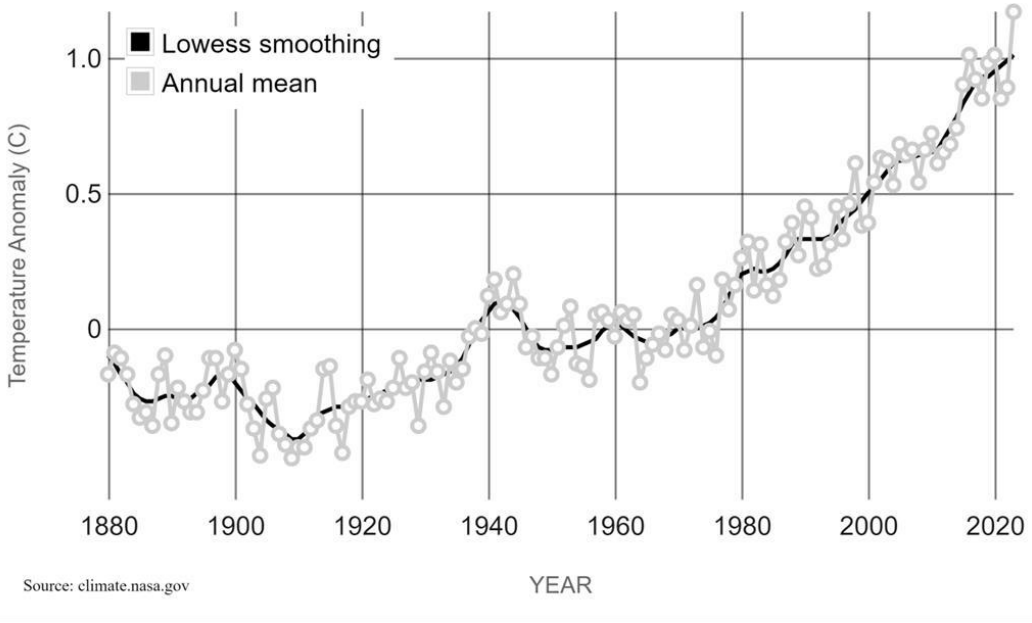


Figure 4: Change in Global Surface Temperature Compared to the Long-Term Average (source: climate.nasa.gov)

4.3 Erosion

4.3.1. **ARG10: Risk to underground pipelines from river erosion.** Pipelines can be exposed due to erosion of riverbed material and thereafter become susceptible to physical damage from external impact or from being unsupported. More frequent flooding and increased river and watercourse flows will increase the level of this risk.

4.3.2. **TCFD10b: Increased rate of loss of cover in areas with already low depth of cover (e.g., Fenland areas).** Increased temperatures and reductions in rainfall may result in shrinkage of clay and organic soils, resulting in reduced cover for pipelines. The shrinkage and the associated drying of soil also increases vulnerability to wind and water driven erosion, further compounding the issue. The resulting soil loss may make pipelines more prone to damage from third-party interference.

4.4 Vegetation Growth

4.4.1. **ARG15: Vegetation Growth.** Increases in both temperature and precipitation will lead to accelerated vegetation growth. Above ground assets will be impacted by any increased growth of trees, plants and invasive species adjacent to operational equipment. This will lead to increased levels of maintenance and reduced access issues including security threats where shrubs become climbing aids due to proximity to fence lines. Increased vegetation over the NTS pipelines will require more frequent clearance of the pipeline easement areas and areas around our sites.

4.5 Ground Movement

4.5.1. **ARG12: Ground movement due to drought conditions and dry ground.** Ground movement caused by drying and shrinkage may exert additional tensile forces on underground assets. Coupled with other issues, this could lead to mechanical damage and the potential fracture of pipelines leading to a gas release, fire and possible explosion.

4.6 Wind Damage

4.6.1. **ARG7: Wind damage to above ground assets from storm events.** Assets are subject to damage from extreme weather events including storms and high winds. Any increase in the frequency and severity of these events will mean a higher risk of infrastructure damage failure and an impact on support services.

4.7 Lightning

4.7.1. **ARG8: Extreme weather impacts from lightning.** The distribution of lightning is directly related to the Earth's climate, which is influenced by solar insolation. Also, increased storm frequency can lead to an increased lightning strike frequency. Research[4] indicates that global warming contributes to increased convective activity, leading to more thunderstorms and, consequently, more lightning strikes. Where lightning strikes exposed assets, this could cause physical damage and failure. This may lead to operational failure, loss of telecommunications equipment and a fire risk to gas venting stacks.

4.8 Additional Hazard | Increased Humidity

4.8.1. As the surface air temperatures rise due to global warming, the capacity of air to hold moisture increases, leading to gradually increasing ambient humidity levels, as highlighted by Figure 5: (sourced from Met Office press release | Sept, 2023)[5].

4.8.2. This hazard was not part of our ARP3 reporting, however, on the back of the recent Met Office study, we want to assess the impacts of increased air moisture on our assets which are exposed to the environment, specifically exposed site pipework and assets that interact with the moisture admitted by the air intake systems within compressor cabs.

4.8.3. Our ARP3 report contains the detailed risk assessment related to the potential impact of these hazard on our assets. It concluded that one of the seven hazard categories it assessed, i.e., 'Raised Temperatures' posed a high risk while the other six categories posed a medium risk to our network.

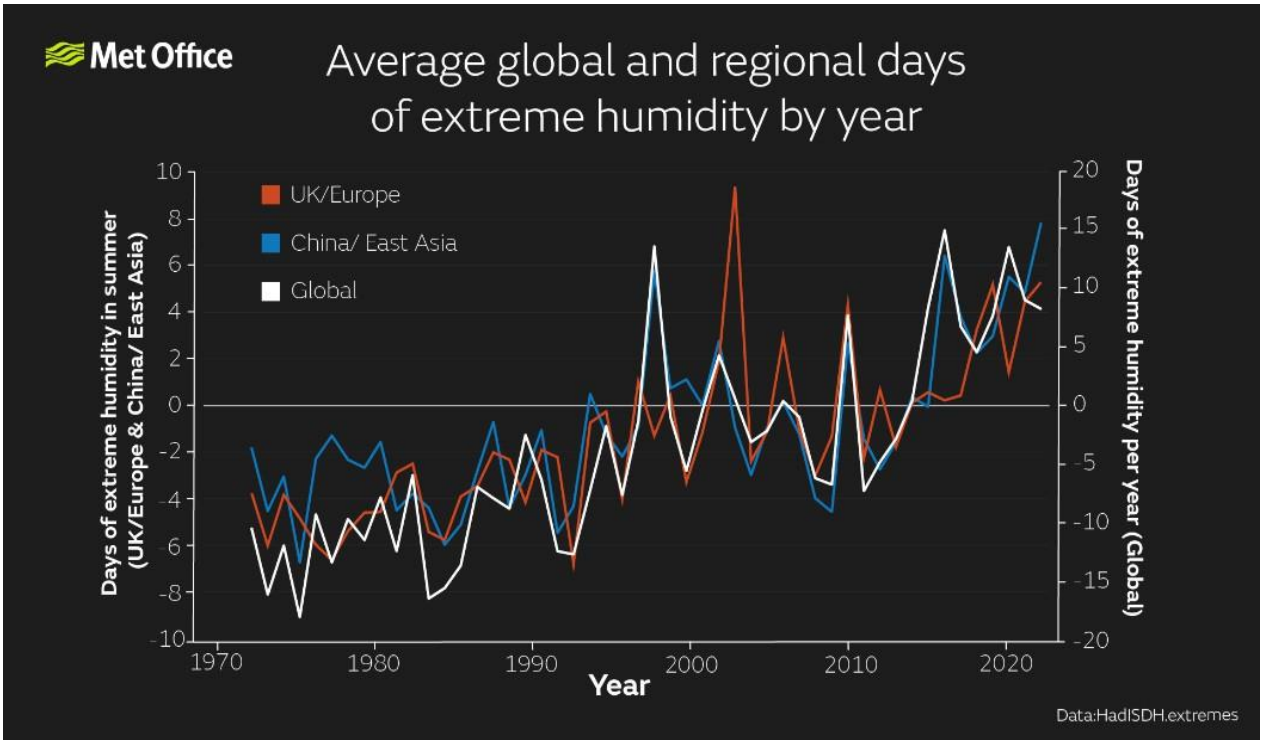


Figure 5: Met Office data on Increasing Days of Extreme Humidity

[4] Projected increase in lightning strikes in the United States due to global warming | Science

[5] New global dataset shines a light on humidity extremes - Met Office

5 Our Strategy for Tackling Climate Hazards

5.0.1. Within the development of our CRS and the subsequent asset management plans related to climate resilience, we have considered our response to the previously described climate change hazards within a framework that addresses the following six aspects: anticipate, resist, absorb, recover, adapt and transform. This is in line with the best practice identified within the National Infrastructure Commission's (NIC) 2020 report on the resilience of UK's critical national infrastructure[6].

5.0.2. This report concluded that to deliver resilient infrastructure, a framework for resilience is required that:

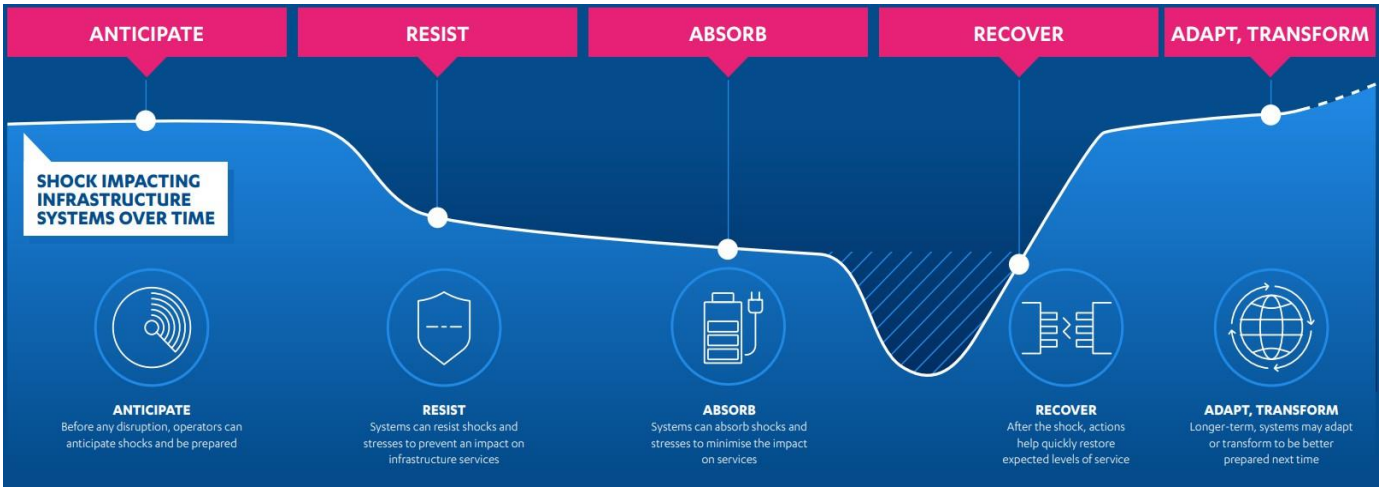


Figure 6: National Infrastructure Commission | Anticipate, React, Recover: Resilient Infrastructure System

- better anticipates future shocks and stresses by facing up to uncomfortable truths.
- improves actions to resist, absorb and recover from shocks and stresses by testing for vulnerabilities and addressing them.
- values resilience properly
- drives adaptation before it is too late.

5.0.3. We recognise that there is significant work needed to embed climate resilience within the energy sector and to fully anticipate and resist future shocks from climate change require us to better understand the potential impacts of climate change hazards on our network. A substantial barrier to making a long-term proactive strategy and plan is the current lack of climate resilience metrics and standards. These metrics will allow us to set quantifiable and realistic target thresholds for acceptable resilience levels and to better demonstrate consumer value in achieving, maintaining (and where justified) exceeding them. We are working closely with Ofgem and the ENA on the development of these metrics and look forward to contributing toward this shared ambition. We are committed to collaborating closely with our stakeholders, particularly the ENA Climate Change Resilience Working Group (CCRWG), to conduct scenario planning that identifies potential climate change risks and impacts based on UKCP18 projections. This will enable us to make informed decisions regarding current and future investments throughout the asset lifecycle. Furthermore, we are working to embed Climate Change Adaptation measures in accordance with the ISO 14090 framework, into our Environmental Management System (EMS). We are also collaborating with ENA and Ofgem to develop adaptation pathways so we can ensure their seamless integration into our EMS.

5.0.4. We cannot be purely reactive in dealing with the current and imminent climate change impact until the development of these metrics. Recent extreme weather events have already tested the resilience of our assets, providing justifiable evidence for several essential investments that we have proposed in our RIIO-GT3 investment plans. These investments include immediate and necessary action in improving our resilience against climate change hazards. The following sections describe our assessment of each of the (previously identified) 8 climate change hazards, our

[6] Anticipate-React-Recover-28-May-2020.pdf (nic.org.uk)

strategy toward tackling them through operational and capital work and the business plan justification for any necessary RIIO-GT3 investments within that area.

5.0.5. More information about our strategy for responding to climate related risks can be found in our Annual Report [7].

[7] FY24 NGT Annual Report (nationalgas.com)

6 Summary of RIIO-GT3 CCA Investments with Phasing

6.0.1. Our RIIO-GT3 AMP includes the following three categories of investments related to climate resilience. Where additional climate resilience measures have caused an increase toward a project cost, only the additional cost for these measures has been counted here:

Category 1: Climate Resilience is the Primary Driver	Category 2: Climate Resilience is the Secondary Driver	Category 3: Climate Change Impact Studies
These are investments which were primarily driven by the climate resilience driver and include essential asset enhancements or protection measures.	These are investments that are driven primarily by other investment drivers (such as Asset Health) but have CCA as a secondary investment driver.	This category includes investments into comprehensive studies on critical sites for quantification of risks posed by the specific hazards of flooding and temperature extremes and suggest appropriate and targeted adaptation measures where necessary.

Figure 7: Investment Categories Related to Climate Resilience

6.0.2. Proposed cost within each of these categories is as follows, as extracted from our Business Plan and the relevant EJPs:

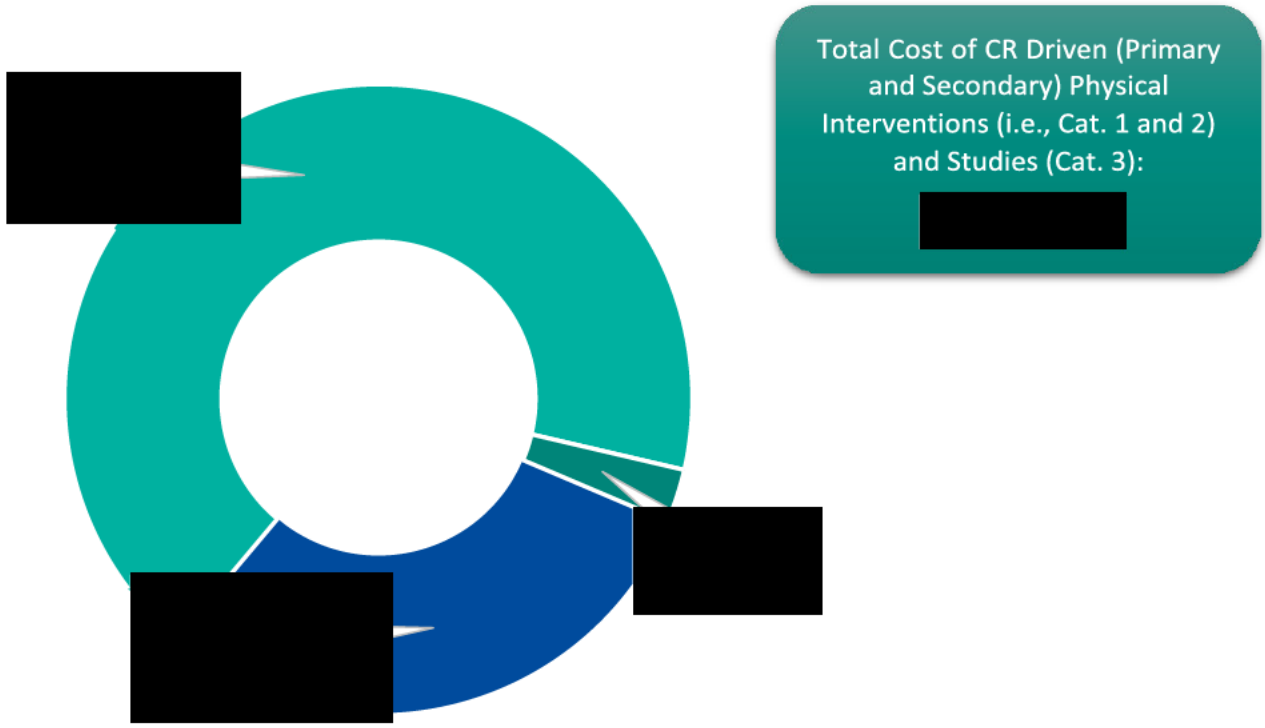


Figure 8: Cost Breakdown of CR-Related Investment Categories

6.1 Flooding

ARG4: Flood risk of above ground assets.

6.1.1. This is potentially the most significant risk posed by climate change on our network. This risk is associated with ingress of water from various sources of flooding that would impact on the operation of site assets. Flooding is often associated with either consistent rainfall over several days or heavy torrential rainfall in a short span of time (causing flash flooding).

6.1.2. There are several potential consequences associated with flooding, some of them are explained below:

- Damage to electrical and control circuits caused by flooding could put the site out of use causing a security of supply risk.
- There is a risk of damage to the compressor units if the lubrication pumps and control circuits fail due to flooding. Although the gas would continue to flow through the station, via the non-return valve between the suction and discharge headers, the loss of compression capability could have significant impact on the wider network operation and security of supply depending upon the availability of other units at the time. If the lubrication pumps failed whilst the turbine was running, the unit could be damaged which would make it unavailable for a longer period, increasing the network impact.
- Flooding of the control room could result in damage to vital control equipment putting the station out of use for a considerable period.
- In instances where sites have been flooded, physical access to the site could be lost thus affecting routine and emergency operational activities.
- Flooding or extreme weather conditions with increased precipitation will accelerate the deterioration of enclosures, resulting in poorer temperature control and moisture ingress, which will increase degradation of the enclosed assets.

6.1.3. The following are some examples of where Flooding has impacted our assets:

- In late 2017 at [redacted], flooding resulted in damage to the drainage and sewerage system and gas venting systems. Damaged pumps, instrumentation assets and switches had to be replaced to restore operations.
- Between 2017 and 2023 there have been nine recorded incidents at [redacted] of pits flooding and drains being blocked resulting in the repeated need to flush and clear them.
- In 2013, flooding at [redacted] caused severe damage to low-lying electrical assets, details of the recovery project are described in Section 6.1.6 to 6.1.11 within this document.

6.1.4. Table 1 below describes the CCA investments related to flood risk on sites, their associated categories and the proposed volume and cost for each investment line:

Table 1: CCA Investments Related to Flood Risk

Investment Category	Investment Title	Investment Description	Volume (# of Sites)	Proposed RIIO-GT3 Cost (23/24 price base)	Associated EJP
Category 1: Climate Resilience is the Primary Driver	Flood Risk – Temporary Drainage Facilities	This investment involves the installation and utilisation of temporary drainage facilities for flood mitigation. For the RIIO-GT3 plan specifically, we will be developing an emergency flooding plan that involves the purchase of high-volume mobile water pumps and associated suction and delivery hoses. These are to be maintained at each identified site to assist / back-up the existing drainage system if assets such as the oil interceptor pits are overwhelmed by storm water or has blockage. Pumps will also be used to draw storm water away from the critical assets on site. In extreme emergency situations water will be pumped direct to watercourses outside the impacted site. This is an essential investment as the purchased assets can be used on other sites as and when required.	[redacted]	[redacted]	NGT_EJP19_Civils_RIIO-GT3 (Chapters 3, 6, 8, 9 and 12)
Category 3: Climate Change Impact Studies	Flood Risk - Studies to Develop Permanent	Studies to develop permanent mitigation measures - The purpose of this investment is to assess the impacts of flooding and develop permanent mitigation measures for flood risk management across impacted sites on the NTS.	[redacted]	[redacted]	NGT_EJP19_Civils_RIIO-GT3 (Chapters 3, 6, 8, 9 and 12)

Investment Category	Investment Title	Investment Description	Volume (# of Sites)	Proposed RIIO-GT3 Cost (23/24 price base)	Associated EJP
	Mitigation Measures	With projected high rainfall events, sites on the NTS will be at higher risk of flooding than they currently are, resulting in damage to assets and compromising safety of personnel. The forecast is for the studies to be completed in RIIO-3. Suitable sites have been selected to undertake the studies at.*			

*A desktop study, 'Gas Transmission Flood Risk Assessment Report' was carried out in 2016 using data provided by the Environment Agency (EA), Scottish Environmental Protection Agency (SEPA) and National Resources Wales (NRW) to assess the flood risk due to coastal, fluvial (river) and pluvial (surface) flooding. This data was then geospatially laid over the location of all our NTS sites to identify all sites with a flood risk of greater than 1 in 1000 years (taking into account the presence of flood defence schemes by local authorities). Sites for these studies have been selected based on this analysis, combined with an analysis of site criticality.

ARG21: Saline contamination and increased corrosion rate of above and below ground assets from sea water.

6.1.5. Saline atmospheric moisture can accelerate corrosion for exposed site pipework not fully protected by coatings. Our on-going site coating programme caters for this hazard, in line with our internal corrosion-defects' management process. Similarly, for our below ground pipework, our primary protection (pipeline coatings) and second protection (cathodic protection system), along with other pipeline inspection and maintenance activities deal with this hazard. These investments are covered in other areas of our business plan submission.

Real-life Event | Recovery from Site Flooding at [redacted]

6.1.6. [redacted] which lies near to the banks of the [redacted] was subjected to a tidal surge, which flooded the site to a depth of 600mm, disrupting telecommunications and inundating the security equipment. The site was remotely inoperable and invisible to Gas Network Control Centre (GNCC, now NCC) until the waters subsided and repairs could be affected.

[redacted]

6.1.7. A capital project was raised to rectify the damage caused by the floodings on our electrical, security and telemetry assets. This was completed in March 2017. The total cost of the recovery from the flooding event for this site was [redacted]

[redacted]

6.1.8. Damage caused by the flooding is shown in pictures below. There was a loss of the 24v supply to the Remote Telemetry Unit (RTU) unit due to earth leakage. [redacted]

6.1.9. Within the Electrical and Instrumentations (E&I) kiosk, the flood water damaged the following electrical pieces of equipment:

- gang switched socket outlet
- Switched spur for heater
- Heater
- 110V Transformer

6.1.10. Within the RTU cabinet, the flood water damaged the following [redacted]:

- [redacted]
- [redacted]
- [redacted]

Figure 11: Internal and External Flood Damage, Flood-water Height in Most Places was between 0.6 to 0.8m

6.1.11. Table 2 shows the breakdown of expenditure by project subtasks, relating to the [redacted] flooding recovery project.

Table 2: Breakdown of Expenditure (all costs treated as capital expenditure)

Categories	Grand Total
Conceptual	£71,446
Direct Orders	£100,389
Drawings	£9,877
Feasibility	£182,823
GTAM Remediation Works	£317,343
Works Delivery (Contractors)	£1,462,199
PWS External Services	£1,320
PWS MWC	£39,767
PWS NG Project Team Costs	£2,060
PWS Project Services	£15,516
System Operator (SO) Costs	£289,000
Grand Total	£2,491,739

6.2 Temperature Extremes

ARG6b: Above ground assets affected by raised temperatures.

6.2.1. This hazard primarily affects our Compressors and Site assets as explained below. Also, the following passages describe the associated adaptation interventions proposed for RIIO-GT3. Detail of the optioneering and cost development for these interventions is available in the Compressors and Sites Engineering Justification Papers (EJPs) summarised in Table 3.

6.2.2. Temperature fluctuations result in compressor related trips and operational failures. The consequences can be localised or wider system failures which can affect our ability to compress gas and in turn affect the security of supply in the network.

6.2.3. The main risks posed by temperature to our compressor assets are associated with ventilation, cooling and heating of the compressor unit and ancillary equipment. High temperatures can cause gas generators (which drive some of our compressors) to trip, leading to loss of function of the unit until temperatures fall. Low temperatures can impact the function of ancillary plant and equipment leading to unavailability of the compressor unit until remedial action is taken. For example, air intakes can become blocked with ice requiring manual removal. Valve stems can become frozen preventing the unit from starting (these can be thawed by manual irrigation with hot water).

6.2.4. For our compressors to work satisfactorily in high or low temperatures, extra modification is required for operational reliability. For example, extra ventilation and oil coolers are installed if operating in higher temperature to ensure that Compressor Enclosure Cabs do not overheat and go outside the 'Dangerous Substances and Explosive Atmospheres Regulations' (DSEAR) rating of the electrical equipment in the cab. On the other hand, some units struggle to start in cold weather with super chilling, these units require extra heating to improve start reliability but generally once started will produce their own heat and will thereafter run satisfactorily.

6.2.5. Extremely elevated temperatures can also reduce life of batteries and transformers, and frequent temperature variations accelerate degradation of above ground pipework coatings. We do not, however, understand the severity of these impacts or how many sites may be affected. There is a need to develop better understanding of these phenomena, identify any high-risk sites which are affected and develop mitigation measures as required.

6.2.6. The following is an example of where Temperature has impacted our assets:

- At [redacted], the compressor units have tripped due to elevated temperature. Notable incidents occurred in 2020 and 2021. Through RIIO-T2 we have implemented ventilation upgrades to mitigate increase in temperatures and we are monitoring the impact of this intervention to inform future interventions across the NTS. The number of days per year with temperatures higher than 28°C in [redacted]) have doubled[8] from 4-6 days to 8-12 days since [redacted] It is likely that the increase in temperature since these units were commissioned has contributed to these trip events (our proposed detailed impact assessment studies in RIIO-GT3 will help us better understand the correlation between failure modes and likelihood and the ambient temperatures).

6.2.7. Table 3 below summarises the CCA investments within the area of Compressors in line with our Climate Resilience Strategy, their associated categories from Category 1 to 3 (as described earlier in this chapter) and the proposed cost for each investment. Apart from the climate change impact assessment studies in table below, the remaining investments are not Climate Change Adaptation (CCA) driven. They are primarily driven by the Asset Health (Legislation and Policy). However, they deliver climate resilience benefits.

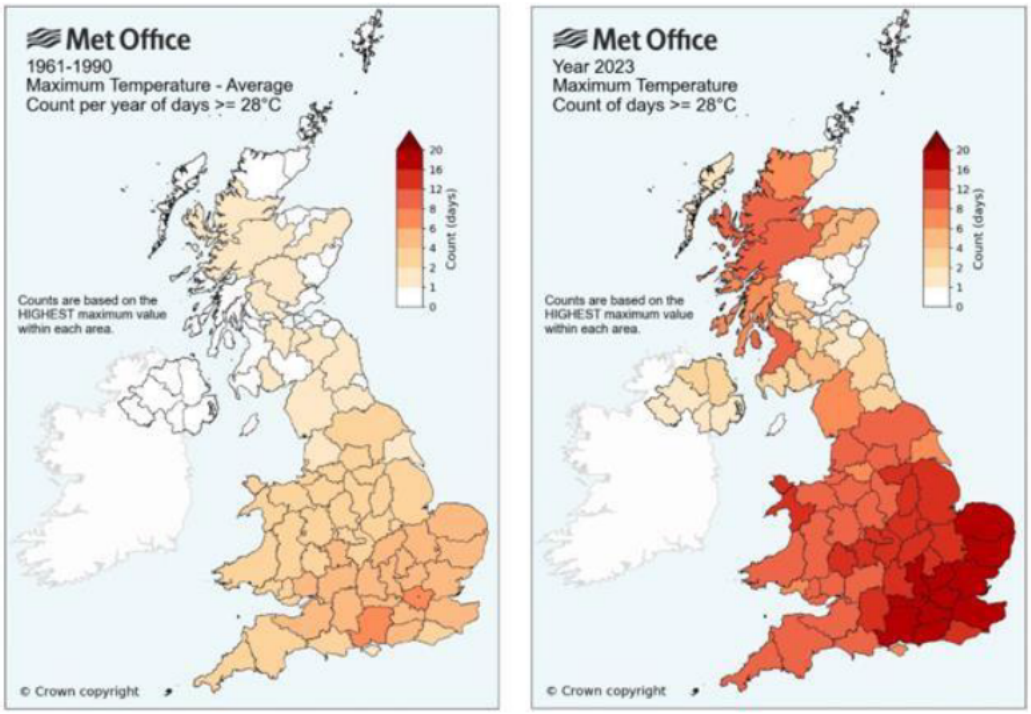


Figure 12: Average count of the number of days per year in which the highest maximum temperature within each county of the UK has exceeded 28°C – indicating a 'hot' day – covering the periods 1961-1990, 1991-2020, 2014-2023 and actual counts for year 2023. The scale extends to 20 days. Counts are based on 1km resolution gridded climate data from the HadUK-Grid dataset.

Table 3: Climate Resilience Investments Related to Compressors and Sites.

Investment Category	Investment Title	Investment Description	Volume (# of Sites)	Proposed RIIO-GT3 Cost (23/24 price base)	Associated EJP
Category 2: Climate Resilience Secondary Driver (Primary Driver = Asset Health Risk Management)	Enhancements to [redacted]	These compressor units are impacted by elevated temperature. Based on their age and current asset health state the proposed intervention is to replace the air oil cooler [redacted]	[redacted]	[redacted]	NGT_EJP27_St Fergus: Rotating Machinery_RIIO-GT3(Chapters 4 and 10).
Category 2: Climate Resilience Secondary	[redacted]	This investment focuses on improving the asset health of the converter cooling system at St Fergus	[redacted]	[redacted]	NGT_EJP27_St Fergus: Rotating

8 https://www.metoffice.gov.uk/about-us/news-and-media/media-centre/weather-and-climate-news/2024/temperature-extremes-and-records-most-affected-by-uks-changing-climate

Investment Category	Investment Title	Investment Description	Volume (# of Sites)	Proposed RIIO-GT3 Cost (23/24 price base)	Associated EJP
Driver (Primary Driver = Asset Health Legislation & Policy)	Cooling System Repair	site by replacing damaged components which are affecting the overall performance of the system.			Machinery_RIIO-GT3(Chapters 4 and 10).
Category 3: Climate Change Impact Studies	[redacted]	These [redacted] are impacted by high temperature. Previous interventions to mitigate high temperature impacts have been completed on [redacted]. This study aims to determine the effectiveness of the [redacted] to better understand how the impacts of increases in temperature can be effectively mitigated.	5	[redacted]	NGT_EJP04_Rotating Machinery_RIIO-GT3 (Chapter 4 and 9)
Category 3: Climate Change Impact Studies	Compressors Temperature Risk Studies to Develop Permanent Mitigation Measures	These are assets impacted by extreme temperatures. Studies are required to fully understand the temperature variation risks posed to compressor units and their ancillary equipment.	[redacted]	[redacted]	NGT_EJP13_Compressor Fleet – Network Investments and Zone 1 (Scotland)_RIIO-GT3(Chapters 9 and 10)
Category 3: Climate Change Impact Studies	Temperature Risks Study: Above Ground Pipework Coatings	The purpose of this investment is to assess the impacts of temperature extremes and develop permanent mitigation measures for temperature risk management across impacted sites on the NTS. With extreme high temperatures and frequent fluctuations in temperatures (from extreme high to extreme low and vice-versa), pipework coatings can degrade and crack due to the expansion and contraction of the pipework. The forecast is for the studies to be completed in RIIO-GT3. Suitable sites are being sought to use as case studies.	[redacted]	[redacted]	NGT_EJP01_Site Assets - Asbestos, Stabbings and Redundant Assets_RIIO-GT3 (Chapters 2, 3, 7 and 9)
Category 3: Climate Change Impact Studies	Temperature Risks Study: Batteries	The purpose of this investment is to assess the impacts of temperature extremes on batteries to develop permanent mitigation measures. With global warming, batteries on the NTS will be operating at higher temperatures than they currently do. The consequential higher energy usage and overheating will reduce their life expectancy. The forecast is for the studies to be completed in RIIO-GT3. Suitable sites are being sought to use as case studies.	[redacted]	[redacted]	NGT_EJP01_Site Assets - Asbestos, Stabbings and Redundant Assets_RIIO-GT3 (Chapters 2, 3, 7 and 9)
Category 3: Climate Change Impact Studies	Temperature Risks Study: Transformers	Like batteries, this investment assesses the impacts of temperature extremes on transformers and explores long-term / permanent mitigation measures. With global warming, transformers on the NTS will be operating at higher temperatures than they currently do now. The consequential higher energy usage and overheating will reduce their life expectancy. The forecast is for the studies to be completed in RIIO-GT3. Suitable sites are being sought to use as case studies.	[redacted]	[redacted]	NGT_EJP01_Site Assets - Asbestos, Stabbings and Redundant Assets_RIIO-GT3 (Chapters 2, 3, 7 and 9)

6.3 Erosion

ARG10: Risk to underground pipelines from river erosion.

6.3.1. There are over 600 points at which below ground pipelines cross a watercourse including rivers, streams and ditches. Of these, six are considered as major river crossings, which lie [redacted] IGEM TD/1 [9] highlights the increased susceptibility for pipelines crossing busy navigable watercourses to damage from shipping (as a result of direct collision or grounding or damage caused by anchors or trawl boards).

[9] IGEM TD/1 Edition 6, Steel Pipelines for High Pressure Gas Transmission

6.3.2. The investment related to the risks within this area is described in Table 4, which is primarily driven by the Asset Health (Legislation and Policy) and by climate change adaptation as a secondary driver:

Table 4: River erosion related pipeline investments

Investment Category	Investment Title	Investment Description	Volume (# of Crossings)	Proposed RIIO-GT3 Costs (23/24 price base)	Associated EJP
Category 2: Climate Resilience Secondary Driver (Primary Driver = Asset Health Legislation & Policy)	Watercourse Crossings Defect Resolution	Remediation of crossing issues such as shallow depth of cover due to natural erosion, or bank collapse.	[redacted]	[redacted]	NGT_EJP26_Pipeline Protection_RIIO-GT3 (Chapters 4, 5, 9, 11, 12, 13 and 14)

TCFD10b: Increased rate of loss of level in areas with already low depth of cover (e.g., Fenland areas).

6.3.3. We have an existing on-going campaign to ensure continued resolution of any Reduced Depth of Cover (RDoC) over our NTS pipelines. This intervention area is primarily driven by the Asset Health (Legislation & Policy) driver with CR as the secondary driver, as described in Table 5.

Table 5: Pipeline reduced depth of cover investments.

Investment Category	Investment Title	Investment Description	Volume (# of Locations)	Proposed RIIO-GT3 Costs (23/24 price base)	Associated EJP
Category 2: Climate Resilience Secondary Driver (Primary Driver = Asset Health Legislation & Policy)	RDoC Defect Resolution / Topsoil Importation	Topsoil importation to resolve depth of cover defect. It is understood that any future increased frequency of rainfall will increase soil erosion, reducing depth of cover, therefore resolving RDoC defects actively will ensure we keep up with any accelerated impacts. This investment will deliver climate resilience to mitigate this effect from high rainfall.	[redacted]	[redacted]	NGT_EJP26_Pipeline Protection_RIIO-GT3 (Chapters 4, 5, 9, 11, and 12)

6.4 Vegetation Growth

ARG15: Vegetation Growth.

6.4.1. Due to the increasingly favourable growing conditions predicted for the UK[10] (including higher temperatures, higher rainfall frequency and increase Carbon dioxide levels in the atmosphere) caused by climate change; the growth of vegetation is projected to increase further. Increased vegetation over our Pipelines (within the pipeline easement areas) can inhibit the delivery of mandatory legislative above ground/aerial inspections, reduce our ability to access our assets for routine or emergency maintenance activities and increase the risk of third-party interference due to lack of visibility of pipeline marker posts.

6.4.2. Table 6 describes the CCA investment related to vegetation growth pipeline easement areas and the proposed volume and cost for this investment:

Table 6: Pipeline vegetation growth investments

Investment Category	Investment Title	Investment Description	Volume (km)	Proposed RIIO-GT3 Costs (23/24 price base)	Associated EJP
Category 2: Climate Resilience Secondary Driver (Primary Driver =	Easement Reinstatement Campaign	Vegetation clearance of areas of the NTS that now have dense vegetation on them, including minor hedge, bracken, young trees.	[redacted]	[redacted]	NGT_EJP17_Pipeline _RIIO-GT3 (Chapter 6, 8 and 9)

[10] https://www.forestresearch.gov.uk/research/climate-change-impacts/climate-change-impacts-and-adaptation-in-englands-woodlands/#:~:text=Warmer%20growing%20seasons%20and%20rising,west%20of%20England%20may%20result.

Asset Health Legislation & Policy)					
Category 2: Climate Resilience Secondary Driver (Primary Driver = Asset Health Legislation & Policy)	Easement Reinstatement Campaign (Tree Clearance)	Tree clearance of areas that have dense vegetation on them, including bracken, trees and woodlands.	[redacted]	[redacted]	NGT_EJP17_Pipeline _RIIO-GT3 (Chapter 6, 8 and 9)

6.5 Ground Movement

ARG12: Ground movement due to drought conditions and dry ground.

6.5.1. We are not proposing any essential investments for this area. At present, there is no significant reason to believe that gas leaks because of ground movement exist under current conditions. Routine helicopter surveying, line walking with depth finding and pigging runs (which can detect imperfections in the pipelines) are undertaken on the NTS at regular intervals. The robust construction and engineering of the NTS provides it with a good level of resilience to this hazard.

6.6 Wind Damage

ARG7: Wind damage to above ground assets from storm events.

6.6.1. We are not proposing any essential investments for this area. This hazard is does not impact our buried pipelines assets, and as for our sites, they are kept free of trees through maintenance contracts, minimising the possibility of trees falling on and consequently damaging our above ground assets.

6.7 Lightning

ARG8: Extreme weather impacts from lightning.

6.7.1. We have on-going campaigns for the refurbishment of our current Earthing and Lightning Protection systems, primarily driven by the Asset Health (Legislation & Policy) investment driver, however, they play a role in building resilience against this impact of climate change. Table 7 describes the investment and proposed volume and cost for this.

Table 7: BAU investments for Lightning protection

Investment Category	Investment Title	Investment Description	Volume (# of units)	Proposed RIIO-GT3 Costs (23/24 prices)	Associated EJP
Category 2: Climate Resilience Secondary Driver (Primary Driver = Asset Health Legislation & Policy)	Refurbishment of Earthing and Lightning Protection (Large Sites and Small Sites)	Refurbishment of Earthing & Lightning Protection system involves replacement of individual components of the Earthing & Lightning Protection System (Offtake, Block Valve) based on the assessment of the installation against the current standards.	[redacted]	[redacted]	NGT_EJP12_Electrical Infrastructure : Site Lighting, Earthing and Lightning Protection_RIIO-GT3(Chapters 5, 7 and 9)

6.8 Additional Hazard | Increased Humidity

New (to be included in ARP4): Accelerated corrosion induced by increased humidity.

6.8.1. One significant impact of increased humidity is the potential for elevated corrosion of exposed above-ground assets. Our ongoing coating program is designed to address corrosion issues. However, if we observe that corrosion growth is exceeding current levels, we may need to consider targeted risk-based adjustments to the survey frequencies.

6.8.2. In a specific example related to corrosion, an investigation at Carnforth revealed that moisture in the compressor cabs contributed to corrosion. As a result, all air intake replacements are now required to be equipped with dehumidifiers. These installations are aimed at mitigating the effects of moisture in the air and providing climate

resilience benefits against humidity. An assessment comparing costs for air intakes with integral dehumidifiers to those without indicates that [redacted] for the investment line in Table 8 can be directly attributed to climate resilience.

Table 8: Compressor cab air-intake dehumidification investments

Investment Category	Investment Title	Investment Description	Volume (# of units)	Proposed RIIO-GT3 Costs (23/24 prices)	Associated EJP
Category 1: Climate Resilience is the Primary Driver	Compressor Cabs: Air Intake Dehumidifiers	Air Intake Replacement and upgrading to a dehumidified Filter House System for units specified within Cabs EJP document. The costs for dehumidifier units has been calculated based on analysis of average unit costs of installation of Air Intake systems with and without dehumidifier units.	[redacted]	[redacted]	NGT_EJP03_Cabs_RIIO-GT3 (Chapters 4 and 8)

7 Interdependencies

7.0.1. Interdependencies between different industry sectors is a major source of risk for the energy network, with failures from one sector potentially causing adverse impacts across to the others. Telecommunications, electricity network and road transport are potentially the most important sources of risk to our operational resilience. Telecommunications channels (including satellite and broadband connectivity) are vital for automated and remotely controlled equipment, and for communication with personnel in the field. Telecommunications failure has the potential to have an increasing impact in the future with greater reliance on interconnected smart systems. Risk of transport disruption could mean our inability to access our sites and assets when needed (e.g., access to pipeline valve assets to isolate supply in an emergency).

7.0.2. Intensifying climate risks as well as a deeper interconnectivity (resulting in increased interdependency) of industrial sectors requires a strong focus in terms of broader risk assessment and modelling. Centralised policy making and an integrated approach is required to ensure consumers' funded investments can be allocated efficiently and targeted correctly based on risk.

7.0.3. An example of a proposed initiative in this area is a SIF innovation project by the name of CReDO+. It is looking to explore the interdependencies between various sectors and assess failure modes and interconnected risks to assets and service and National Gas has volunteered to be part of this important project. Our participation in CReDo+ will allow us to better understand the interdependency of the NTS on other critical national infrastructure owners and operators.

8 Incorporating Stakeholders' Feedback

8.0.1. We have incorporated the views of our key stakeholders into our approach. During September 2024, we held a customer and stakeholder workshop to discuss our proposed approach within this CRS and gained valuable actionable feedback from it. The workshop was attended by representatives of Ofgem, DESNZ, gas and electricity transmission and distribution network operators, and industry and academia experts on this subject. Some salient learnings from this session are as follows:

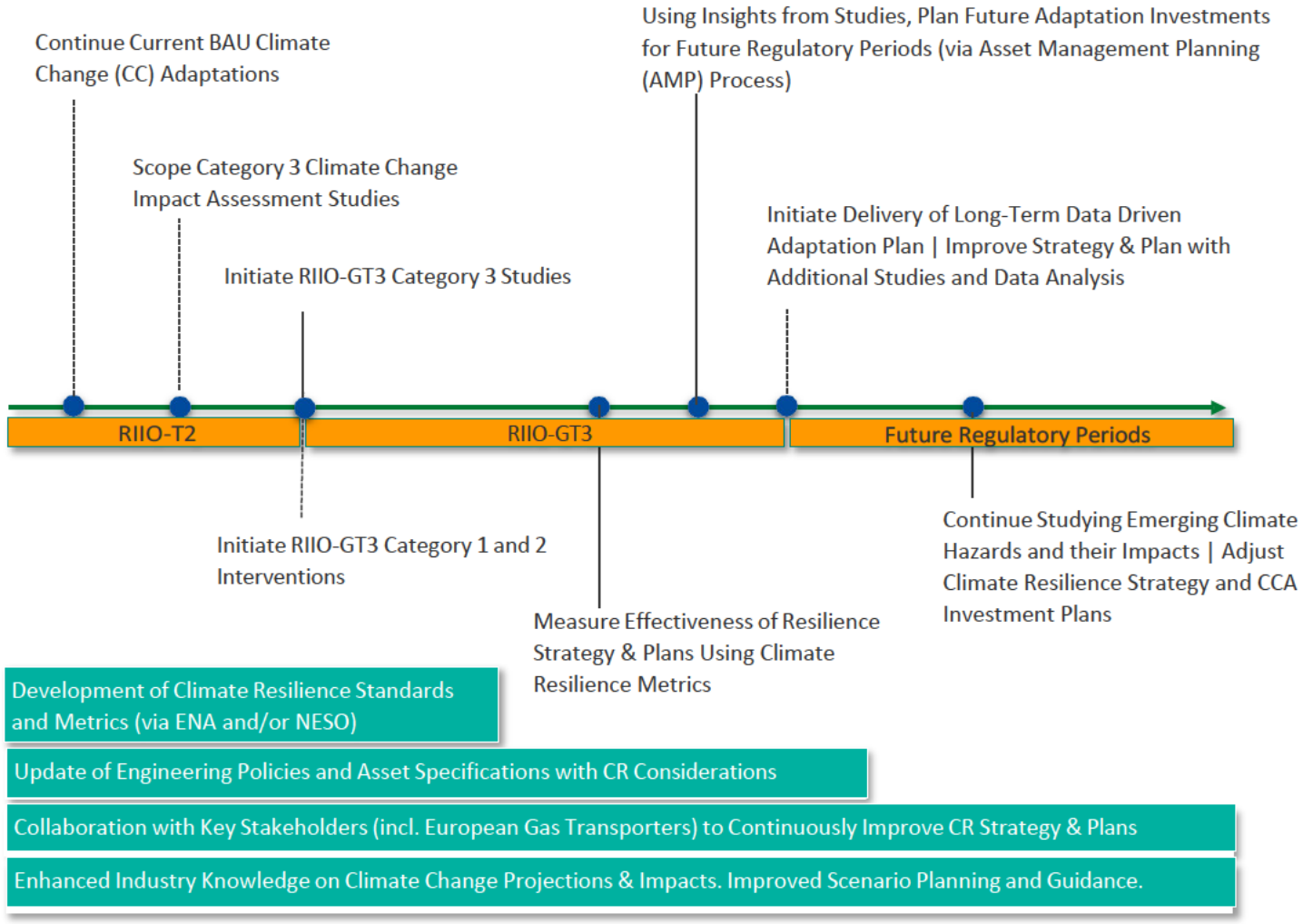
- Attendees agreed on the need to collect more data related to the potential impact of climate hazards on our assets and operations; this will enable the development of better-informed long term investment planning. Attendees shared similar issues with gaps and lack of granularity in climate change projections, as well as limitations in internal historic data attributing faults and defects to the direct or indirect impact of climate hazards.
- Splitting investments into "essential/tactical" and "strategic" was deemed to be a sensible approach.
- Attendees noted that National Gas could be collaborating more with foreign Gas Transmission System Operations (TSOs) on future climate resilience strategy and analysing asset management best practices.
- There was also a recognition that our engineering standards, policies, procedures and the specifications for new and replacement assets needs to clearly incorporate climate resilience.

8.0.2. Based on this feedback, we will be ensuring immediate action in the following two areas:

- We will be putting increased focus on an initiative to review/update on our policies, procedures, engineering standards, data attributes and asset specifications. We have a responsibility as an asset management function to ensure that new and replacement assets are resilient to climate change.
- We will be continuing the on-going work to externally benchmark our strategy and plans with international network operators, as they may experience climate-related hazards sooner and face similar or additional climate-related challenges. Outputs of this engagement will help shape our future strategy submissions.

9 Summary

9.0.1. The following timeline summarises our planned approach for embedding climate resilience in business strategies, standards and investments in RIIO-GT3 and future regulatory periods. We will continue to revise and review this approach in light of better data insights, improved climate hazards' projections and climate risk assessments, our own studies and collaboration with key stakeholders in the UK and on a global stage. We remain firm in our ambition to protect our network and continue to provide reliable service to our customer and consumers.



Compliance with Ofgem's BP Guidance Requirements

This chapter sign posts Ofgem's BP CRS requirements and expectation to sections within this document and / or within our wider BP submission, demonstrating our compliance with them as summarised in Table 9.

Table 9: Demonstration of Compliance with Ofgem's BP Guidance

BP Guidance Section Ref.	Ofgem's BP Strategy Expectations	Our Response
5.8	Business plans should include a dedicated Climate Resilience Strategy (CRS).	This document is our dedicated CRS.
5.9	One Climate Resilience Strategy should be produced per network company.	Requirement satisfied.
5.10	Companies should set out their planned approach and timeline for embedding climate resilience work.	Included in Chapter 9
5.11	CRS should also signpost to any other submitted documents which relate to climate resilience, such as load strategies explaining their influence on your business case if requesting additional funding for climate resilience.	Investment tables in Chapter 6 Signpost Relevant EJPs No additional funding requested
5.12	CRS should also signpost to any other material relating to climate resilience, such as climate related financial disclosures and ARP reporting.	Climate related financial disclosure referenced 4.0.1 ARP3 report referenced in 4.0.8
5.13	CRS should outline any other climate resilience work network companies are undertaking or planning to undertake, identifying the steps that they expect to take over the course of RIIO-GT3 and beyond.	Summary of planned approach for RIIO-GT3 and beyond included in Chapter 9 Essential RIIO-GT3 investments identified in Chapter 6 CReDO+ SIF project information in Chapter 7
5.14	Network companies should signpost to their relevant climate change hazards and risk assessment at 2 and 4 degrees as outlined by their most up to date ARP reporting.	Referenced in 4.0.6, 4.0.7 and 4.0.8. Requirement not currently met. Will be met either by submission or as part of second annual reporting submission. Ofgem's response reference NationalGas013: Should National Gas not meet this requirement as part of their Business Plan submission, it will be required to submit this information at the latest, as part of their second annual reporting submission.
5.15	Network companies should outline a breakdown of expenditure (Capex and Opex), relating to a weather event or compound event which has occurred in the last 10 years and has been caused by or exacerbated by climate hazards or risks which caused loss of supply or other detrimental impacts, submitting any supporting evidence, including but not limited to: identifying the costs of response and recovery; and how this information is being used for future decision-making.	Referenced in Chapter 6 (6.1.6 to 6.1.11):
5.16	This event or events does not need to be attributed to anthropogenic climate change. Ofgem is seeking this information to better understand potential future costs as the effects of climate change intensify.	Statement Acknowledged
5.17	(a) Each CRS should outline the key categories identified in the Business Plan Data Template (BPDT) memo table for climate resilience and provide context as to why this category is affected by climate resilience: (b) through current activities and workstreams. (c) through new climate resilience projects. (d) the plan for investment until the end of the RIIO-3 price control period.	BPDT Table 11.5 part of submission
5.18	Companies should also complete the climate resilience memo table within the BPDT submitting estimates of spend associated with climate resilience. Each category should link to a climate hazard and explanation as to how it affects resilience to the hazard, and how this investment is weighed up against other options, for example, recovery versus protection.	BPDT Table 11.5 part of submission

5.19	Explain any alternative financial assessment tools outside of CBAs and EJPs used for climate resilience justification, such as social return on investment.	No alternative tools used.
5.20	Each network company should explain any barriers to making a viable business case for climate resilience projects. If possible, network companies should outline how they might use the Resilience Reopener to mitigate these issues.	Barriers Referenced in 5.0.3 We do not plan to use the Resilience Reopener for mitigation of these issues.
5.21	Table summarising the expectations for Climate Resilience Strategies.	Table below

Table 10 summarises Ofgem's expectations for the Climate Resilience Strategies along with how we have fulfilled them:

Table 10: Ofgem CRS Expectations and Our Responses

	Ofgem's CRS Expectations	Our Response
1	Signpost to other documents in the business plan submission which relate to climate resilience	Other submitted documents which relate to climate resilience include the EAP and compressors, sites and pipelines EJPs
2	Signpost to any other material related to climate resilience	ARP report is signposted in chapter 4, it is related to climate resilience
3	Outline any other current or planned climate resilience work	Planned climate resilience work outlined in Chapter 6 and an overall timeline of activities included in Chapter 9
4	Signpost to relevant climate change hazards	Climate change hazards outlined in chapter 4
5	Outline the costs of a recent weather event (or compound event) which cause loss of supply of other detrimental impact	Cost of a recent weather event highlighted in chapter 6 (6.1.6 to 6.1.11)
6	Outline the key categories from the BPDT, the plan for investment throughout RIIO-3, and complete the climate resilience memo table	Plan for essential investments outlined in Chapter 6. Table 11.5 climate resilience memo table included with submission
7	Explain any alternative financial assessment tools outside of CBAs and EJPs used for climate resilience justification	NARMs is the only Decision Support Tool used for investment decision making
8	Explain any barriers to making a viable business case for climate resilience projects, and how the Resilience Reopener might be used to mitigate these issues.	Barriers referenced in 5.0.3 Limited data and a lack of attribution of potential climate change hazard on defects and faults is a barrier to making a viable business case. Lack of Climate Resilience Metrics and Standards inhibit our ability to quantify benefits of adaptation interventions and compare options. We do not plan to use the Resilience Reopener for climate change mitigation works.