Climate Resilience Strategy

December 2024

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Climate Resilience Strategy

Executive summary

1 We are fully committed to understanding the impacts of climate change on our business and providing transparent information on how we are managing climate-related risks.

2 In RIIO-GD3 we aim to be resilient to physical, financial, climate and cyber shocks in a changing world. In order to achieve the delivery of this outcome, we are committed to the following:

- **We will introduce a measure for climate resilience and establish a standard baseline from which we will monitor our progress.**

3 Our commitment to introduce a measure for climate resilience and establish a standard baseline will help us monitor our progress and understand if the interventions we make are contributing towards making us a more resilient business.

4 This Climate Resilience Strategy sets out our approach and commitments to ensure our network and property assets are resilient to the changing climate in the short to medium term over GD3 and beyond and should be read in conjunction with our Network Asset Management Strategy (SGN-GD3-SD-06) as well as all supporting Engineering Justification Papers (EJPs) and Cost Benefit Analysis (CBA) within Section E of this document.

5 We are already seeing the impact of climate change on our network assets. In our Scotland network we have experienced over 100 events of what we call pipeline washouts. This is where parts of our pipeline near rivers and under river crossings have been washed away due to heavy rainfall and river erosion. Pipelines exposed in this way present a safety hazard as well as potential disruption to customers if the pipeline were to break and leak gas. We have included case studies of recent weather events which have caused significant impact to our networks in this document, including the costs of remediation.

6 This strategy signposts other material we have prepared to report on climate-related impacts and climate-related risks relevant to our business. Such documents include reporting in line with Taskforce for Climate-related Financial Disclosures (TCFD) and reporting under the Adaptation Reporting Power (ARP).

7 Through ARP3, submitted to DEFRA in December 2021, we identified 22 climate-related risks. These risks have been reviewed to ensure they are still relevant and provide a comprehensive view of the challenges we are facing when we look towards RIIO-3 and beyond.

8 Based on our experience to date, and other analysis as described further below, our current assessment is that the key climate-related risks to our networks are:

- **Risk due to precipitation:** Flood risk of above ground assets and risk to underground pipelines from river erosion and flow; and erosion at river crossings. This is the climate risk we have seen the most evidence of to date. While we can carry out some proactive work (see increased surveys at river crossings), it is hard to predict when and where heavy rainfall, flash flooding and similar events will occur and there is a need for a re-opener to deal with any pipeline washouts.
- **Risk due to extreme high temperatures/drought:** This can cause ground movement due to drought conditions and dry ground (potentially). This is an emerging risk and something which we are working to understand better. The impact would mainly be on areas which have not been part of our mains replacement programme (where old metallic mains are replaced with poly-ethylene pipe, or PE pipe) or where we do not have PE pipe, i.e. our larger diameter pipe network.

9 Due to the uncertainty around these types of events, it is hard to predict when and where heavy rainfall, flash flooding, or risks due to extreme temperature, and similar events will occur. These are barriers to making viable business case for climate resilience projects, other than those identified within the strategy. We would propose that there is a Climate Resilience Reopener introduced within GD3 that should be used to mitigate against any risk that could become apparent within GD3 period.

10 We have challenged ourselves on workload and costs to ensure that we deliver value for money within GD3. We have ensured that there is an appropriate balance between allowances and uncertainty mechanisms to build a clear level of transparency and cost confidences. A climate resilience Reopener would support this approach while allowing GDNs to continue to mitigate against any risk to maintaining safety and resilience of the network through identifying any new risks and associated workloads through a Reopener process.

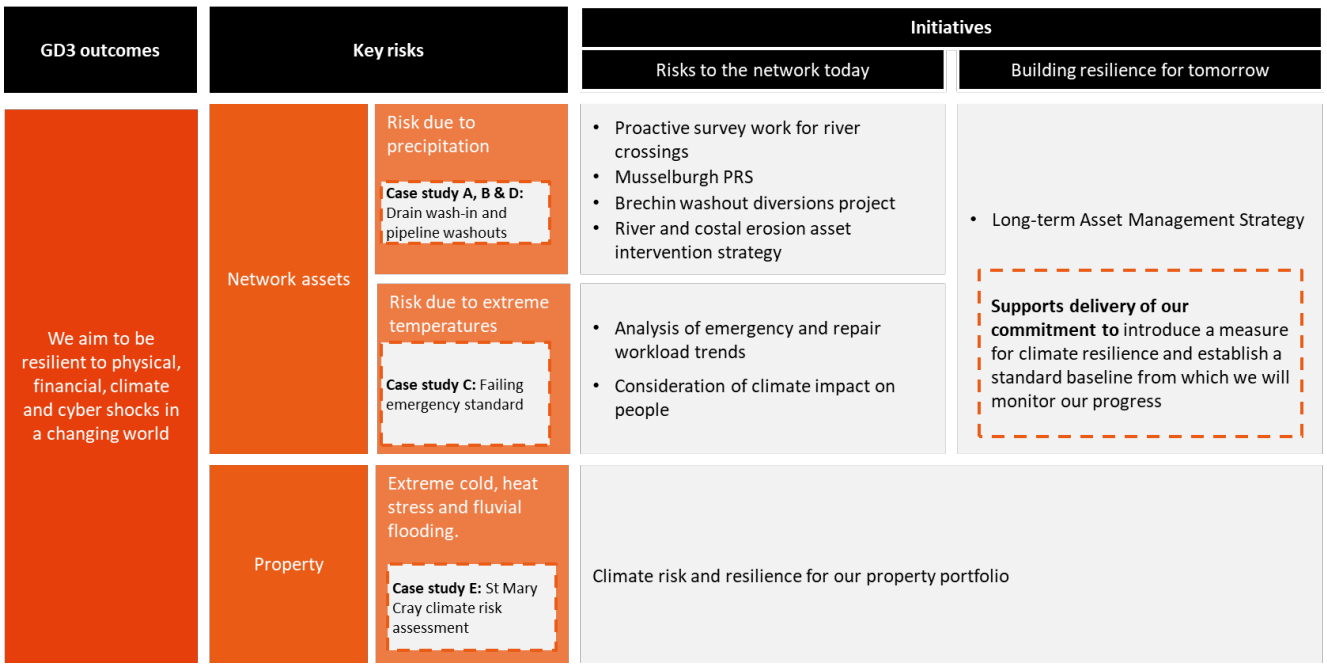
11 This strategy goes some way towards describing how we can be proactive to help prevent incidents which arise due to these key climate-related risks, for example additional survey work related to flood risk and erosion at river crossings. We commit to improve our knowledge and make further analysis. Specifically, we are committing to develop a long-term Asset Management Strategy which considers climate change risk and introduces a measure for climate resilience. This will establish a standard baseline from which we will improve over the course of GD3 and beyond. We will work collaboratively with other GDNs and DNOs through the Climate Change Adaptation & Resilience Working Group, at Energy Network Association, to derive suitable metrics and KPIs for monitoring and managing climate resilience.

12 We have also assessed the impacts of climate change on our property assets, and we provide an outline of our findings and proposals to ensure depots will remain operational in RIIO-3 and beyond.

13 Climate change will also impact our employees, in particular our frontline staff, and in this strategy, we consider what changes we can make to ensure they can cope with extreme weather events.

14 Figure 1 shows the framework for our climate resilience strategy and provides an overview of the key risks and case studies, and how these support the proposed initiatives to address the climate-related risks we are already seeing evidence of today and how we will build resilience for the future.

Figure 1: Framework for our climate resilience strategy



Source: SGN analysis

Introduction

15 This document outlines our Climate Resilience Strategy for our Southern and Scotland networks, in alignment with Ofgem requirements. It is part of our RIIO-GD3 business plan submission and supports our investment plan for the 2026 to 2031 period.

16 Our network is part of the UK's critical national infrastructure, keeping six million people in Scotland and Southern England safe and warm, and ensuring delivery of energy to large and small businesses connected to our network. Like all infrastructure operators, the changing climate is impacting our network and, over time this could make it more challenging to deliver our service to the high standards our customers expect, unless measures are taken to adapt and ensure resilience.

17 We are playing an active role in decarbonising the UK to help slow down the rate of climate change, however, we are already experiencing its impacts and will continue to do so. This strategy sets out how we are proactively addressing the impacts of climate change on our network and ensures we will act in a proportionate and timely way so we can continue to deliver our critical service to a high standard regardless of the future climate we operate in. This includes responding in an efficient way to climate-related incidents when they happen. How extreme climate events will impact our networks can be unpredictable and while we aspire to be proactive and prevent incidents, this is far from always possible to do, and we need to ensure a safe network under all circumstances.

18 In this document we set out our approach to assessing and managing climate-related risks and projecting its future impacts:

- **Section A:** The impact climate change is having on our business and the action we have taken so far to mitigate, address and adapt to its effects. An overview of the climate-related risks we face as we look ahead to GD3 and beyond. This section also includes case studies of a recent weather events;
- **Section B:** The work we have started and what we are committing to do over the remainder of RIIO-2 and into RIIO-3 to ensure our Scotland and Southern networks remain safe and resilient to a changing climate. This includes short to medium term projects: an increased programme of river crossing surveys to reduce the impacts of flooding and river erosion; work to address flooding of Musselburgh Pressure Reduction Station (PRS); a diversion project at Brechin to address a pipeline washout; proposed works to deal with assets subject to river and coastal erosions; how analysis of repair and workload trends with weather driven impacts inform our repex workloads; and our considerations to ensure our people remain safe during extreme climate events. It also includes a long-term project to develop a long-term Asset Management Strategy. This is our strategy for ensuring our network assets are resilient to the changing climate and we are adapting to climate change in a timely and appropriate manner.
- **Section C:** How we intend to ensure our buildings and land remain climate resilient, through investment in climate adaptation for our property portfolio.
- **Section D:** Risks and uncertainties we face and how we will manage them.
- **Section E:** Summary of the engineering justification papers (EJPs), and cost benefit analysis assessments (CBAs) associated with the Climate Resilience Strategy.

19 This Strategy is aligned with our Climate-related Financial Disclosures in alignment with TCFD (Taskforce for Climate-related Financial Disclosures) as presented in our Annual Report 2024[1] and our 3rd Round Climate Change Adaptation Report[2] (ARP3). We are currently preparing our ARP Round 4

[1] This is available on our website: https://www.sgn.co.uk/sites/default/files/media-entities/documents/2024-07/SGNAnnualReport2024.pdf
[2] This is available on our website: https://www.sgn.co.uk/sites/default/files/media-entities/documents/2022-01/SGN-ARP3-1221_0.pdf

report which will be available on our website in December 2024. It cuts across several business areas, which are aligned and contribute to our overall GD3 plan.

20 Within our GD3 plan there are several funding requirements focused directly on addressing climate change impacts and others which have secondary benefits relating to climate change. These are summarised in the table below.

Table 1: Other Business Plan documents which relate to climate resilience and the additional funding requested

Document	Document	Funding requested GD3	Funding mechanism
River and coastal erosion asset intervention strategy	SGN-GD3-EJP-DST-008	£12.47m	Re-opener
Full site rebuild EJP (Musselburgh PRS)	SGN-GD3-EJP-LTS-002	£4.40m	Baseline
RIIO-GD3 Property Management	SGN-GD3-EJP-PRO-003	£0.42m	Baseline
Brechin washout diversions project	This document (starting on paragraph 40)	£3.78m	Baseline
Additional surveys at river crossings	This document section B	£6.45m	Baseline
Asset Management Strategy	SGN-GD3-SD-06	See Asset Management Strategy	Baseline

Source: SGN RIIO-3 Business Plan.

Outcomes and Commitments

21 Our Climate Resilience Strategy will support delivery of a number of our GD3 outcomes and associated commitments, that will contribute to us achieving Ofgem's secure and resilient supplies outcome. This is summarised below and detailed in Chapter 5 of our main business plan document.

- We are resilient to a range of external shocks and stresses:
  - **We will introduce a measure for climate resilience and establish a standard baseline from which we will monitor our progress.**

Customer and stakeholder insights

22 To read more about customer and stakeholder insights, please refer to the Stakeholder engagement and decision log (SGN-GD3-SD-12). The sources listed in the sections below reference documents in the decision log.

23 We have sought insight from specialist environmental stakeholders at two engagement events; one specialist roundtable event and one broad stakeholder event of which environmental impact was one of the topics discussed. Environmental stakeholders support us addressing the risks of climate change to our assets, with some believing it's essential and a high priority. This reiterates the importance of forward planning and long-term thinking.

24 Several stakeholders outline the benefits of a proactive approach, such as saving money, protecting the security of supply, and improving community relations. Furthermore, some stakeholders state the

importance of working in partnership with our supply chain, the local community, partner agencies and regulators to address and reduce the risks of climate change to our assets.

25 Our research and engagement activities showed that "Keeping the gas flowing" is a high priority in terms of importance which is ranked second by customers and third by stakeholders. It's seen as core to SGN's role. Customers and stakeholders believe SGN are currently doing a good job, based on their personal experience and the absence of bad press, and don't see a need for more investment. They're supportive of continuing the on-going programme of pipe replacement at current levels.

26 National stakeholders raise concerns about the resilience of the network in future, driven by the uncertainty around the future role of gas, geopolitical changes, and more extreme weather. [Source: 363.]

27 We received support from most customers and stakeholders for "Improving the climate resilience of SGN's assets", although this is considered lower impact and less urgent than reducing methane leaks. Stakeholders thought it made sense to prioritise sites at greatest risk of flooding. [Sources: 253, 317, 333.]

Section A Understanding the impact of climate change

Climate change – its impact so far

28 Our Southern England and Scotland networks already experience quite different climatic conditions, and we are already seeing variations in the effects of climate change on them, which we expect to increase over time. As part of ARP3 a Met Office study[3] was carried out focusing on significant extreme weather impacts due to the changing climate. The following paragraphs highlight the areas relevant to our geographically dispersed networks.

29 While average temperatures are increasing overall, Southern and Eastern England (which includes our Southern England network) are expected to show even higher temperature increases than the north. Therefore, risks in relation to extreme high temperatures, such as drought and wildfires, can be expected to be more prevalent in the south.

30 Further, data from the Met Office study shows there is significant variation in the amount of rainfall throughout the UK, with the driest areas in the Southeast and wettest areas in the west and the Highlands. Therefore, risks in relation to impacts due to severe drought would mainly impact our assets located in clay soils in the driest areas of the UK, such as London and the Southeast.

31 In the west of England and much of Scotland and Wales more prolonged rainfall will result in thresholds being exceeded more frequently, most often in autumn and winter. This is of relevance to our network in Scotland.

32 Over the last few years, we have experienced an unprecedented rise in washouts of our pipes that cross under rivers. This has been due to the exceptional level of rainfall in the UK, which has been attributed to climate change.

33 To date we have seen evidence of over 100 pipeline washouts in our Scotland network, in the distribution network (7 bar and below). The hazards associated with these are mainly exposed pipes and bank erosion, which can lead to exposed pipelines as time goes on.

[3] 3rd Round Climate Change Adaptation report (December 2021), available on our website: https://www.sgn.co.uk/sites/default/files/media-entities/documents/2022-01/SGN-ARP3-1221_0.pdf

34 Data projections suggest there will be significant increases in hourly precipitation extremes in the future. Whilst in the summer the frequency of wet days may decrease, when it does rain the average rainfall intensity will be greater. This in turn will impact on the frequency and severity of surface water flooding, which is considered an 'emerging risk' for us.

35 The data shows that sea levels continue to rise with projections indicating up to a 1m increase by 2100. This is also likely to be coupled with an increased frequency and/or intensity of storm surges. This is expected to have a direct impact on our assets located close to the coastline, for example, the northeast coast of Scotland and the south coast of England.

36 Projections of hotter, drier summers, as well as increases in summer hot spells, suggest fire risk in the UK will increase in future. This is particularly relevant where our assets are located in close proximity to moorland and in areas predicted to have the warmer future climates, such as the southeast coast of England. As an example, there was a moorland fire a few years ago near Netherhowculeugh offtake, a transmission site, and while there was no damage to our assets at the time the risk needs to be considered.

37 We are currently updating our Management Procedure for the inspection and maintenance of below ground pipelines and mains at river crossings and watercourses to develop a clear framework for river crossing risks and an approach to prevent, where possible, and reduce incidents where we experience pipeline washouts. In this document we also outline improved river surveys to prevent and/or reduce incidents of washouts.

Case study A: Risk due to precipitation: Drain wash-in – new and emerging risk

38 Heavier than normal rains have led to a potential new and emerging risk which we call a "wash-in". This has been added as a new and emerging risk in our climate risk register in Appendix 1.

39 This example is from Perth in Scotland. However, as the climate gets wetter, we are receiving more requests from landowners to repair blocked, broken or undersized field drains associated with our pipelines. Field drains can be easily blocked with the increased rainfall we have seen over the past few years. Also drains that would once easily drain a field are now becoming undersized with the increased volumes of water. As rainfall increases, we expect to have to repair more drains associated with our pipelines and mains.

40 We have an IP gas main running through a culvert under the M90 near Perth. The highway authority inspects the culverts on an annual basis and figure 2 show the culvert prior to storm Babet on 18th October 2023. Here the culvert is free flowing and free of any debris.

Figure 2: Gas culvert prior to Storm Babet, free flowing and free of debris

Source: Photo credit Highways Authority

41 Recently there has been an issue with flooding in the farmers field when there is a heavy rainfall. This flooding in the farmers field, where the entrance to the culvert is located, has on occasions has been spilling over onto the M90 motorway carriageway. The Highway Authority Scotland informed us that due to the severe weather condition resulting from last year's storms and floods during the winter of 2023, they are now experiencing washed in field debris to culverts and drains. Figure 3 shows the extent of the washed in materials in the culvert carrying the gas main under the M90 Perth. This show the gas main is completely submerged with debris blocking the free flow of water.

Figure 3: The same drain culvert filled with debris causing flooding

Source: SGN photo

Case study B: Risk due to precipitation: Pipeline washout, Angus in Scotland

42 This case study discusses the impact of a weather event on our assets in Brechin in 2023. Storm Babet brought exceptional rainfall to parts of eastern Scotland with 150 to 200mm falling in the wettest areas and the Met Office issued two red warnings for rain. For the county of Angus - inside this red warning area - 19 October 2023 was, by a wide margin, the wettest day on record since 1891.

43 During Storm Babet a 250mm intermediate pressure (IP) steel main was washed out near Brechin in Angus, in our Scotland network and the main was exposed for 40 metres. The pipeline is the sole feed to approximately 10,000 customers. The volume of farmland washed away was 145,000 m^3, which equates to 218,000 tonnes of soil. The entire area became a flood plain as is shown in figures 4 and 5.

Figure 4: Satellite photo of the impact from heavy rainfall during storm Babet which caused a pipeline washout near River South Esk, Brechin

Schematic 1 – River South Esk at Brechin in 2022.

Schematic 2 – River South Esk at Brechin in 2024. Satellite imagery shows the impact of Storm Babet at the bend of the river where the riverbank protection (and foliage) has been washed away.

Source: SGN photos and presentation

Figure 5: Flood plain soil erosion and exposed Intermediate Pressure (IP) pipe fittings

Source: SGN photo

44 We had to make the pipe safe and re-protect it in that area. From what we could see from the landscape, to recover it with the surrounding earth would not have been enough should another flood occur. Due to the lay of the land, the water channelled into the area with enough force to propel full trees towards our pipe, creating a high risk of damage and potentially even rupturing our pipe. The remediation we undertook therefore was the best approach to protect our pipe whilst allowing the flood water to navigate through the area should a similar flood happen again.

45 For the remediation we took one ton gravel bags and covered the line securing these with rip rap boulders (commonly used for coastal defence). Then we installed 600mm drainage pipes to allow future flood water to pass through the remediation works. We covered this structure with further local gravel to give a final layer of protection. We invested £140,198 (CAPEX) to help protect our pipe from future floods. The long-term solution will be a diversion of this main; costs are included in the non-rechargeable diversions tab of the BPDT (CV6.06).

46 If the 250mm main had failed it would have resulted in the loss of supply to approximately 10,000 customers. This would have cost SGN approximately £14,000,000. Removing water from gas mains is a very hard and costly process. The reason it would be so costly is because any break under the flood would have caused the downstream system to flood.

47 Based on events in our Scotland network, analysis has been carried out for river crossings that fall within a storm path that have led to excessive river flows in our Southern network. Currently those sites are being surveyed and when complete these surveys will determine if remediation work is required.

Case study C: Risk due to extreme temperatures: Failing our emergency standard and building resilience

48 In the winter of 2022/23, we responded to controlled gas escapes within 2 hours for 96.6% of occurrences – below the 97% regulatory standard. This occurred for our Scotland network and in our lessons learned process, we identified a direct link between four days of extremely cold weather in December 2022 (12th – 15th December) and a corresponding spike in the number of calls we received and the associated workload. In addition, the cold weather spell was exaggerated by issues identified with the industry's national call centre which resulted in abnormally high levels of calls which increased the workload to a higher level than could have been forecast.

49 The spike in workloads was experienced during a period of significantly cold temperatures across the Scotland network, with recorded low temperatures of -15.7C in Aberdeenshire. Amber weather warnings were in place throughout the prolonged negative temperatures and the resultant unprecedented workload had a detrimental impact on our ability to maintain Standards of Service and recovery. The Met Office declared the cold spell to be one of the most significant since 2010 and as a result, the emergency call volumes increased to a much higher level than anticipated.

50 Our Scotland network recovered performance levels as soon as the harsh weather broke and continued through the year's remaining months. We developed remediation plans to ensure we would be better equipped and more resilient should such extreme cold weather events occur again. This included ensuring sufficient resource availability, maximising performance in the first half of the year to provide greater headroom should another occurrence like this happen and a review of processes and procedures to improve our responsiveness and resilience to extreme events such as those experienced in December 2022.

51 This case study shows that while extreme weather events create a risk to our business, they are not necessarily the sole reason for the impact but compounded with other events they create a much larger impact. It also shows that we have processes in place to learn from extreme events, including developing remediation plans to reduce, or if possible, eliminate impacts in the future.

Differences between our Scotland and Southern networks

52 Our dispersed networks face different climate-related risks and challenges to some extent. To date we have seen far more climate-related impacts affecting our Scotland network. Analysis of emergency and repair workload trends still shows how weather continues to be the biggest influencing factor for both networks. Further analysis of climate scenarios and the potential increased risks associated with an increasing likelihood of extreme weather events is required to fully assess the difference between our Scotland and Southern networks and the actions required to ensure safe and resilient networks in the long term. We commit to carry out such analysis and required modelling when considering our long-term Network Asset Management Strategy.

53 Our company-wide enterprise risk profile consists of 14 risks, of which one is climate change. The Board has overall accountability for risk management. Twice a year, the Board carries out a review of the full Enterprise Risk Register, makes decisions on how these should be managed and considers new or emerging risks. The Executive Committee owns and oversees the Enterprise Risk Management Framework. Each Enterprise Risk is assigned to one or more Executive Owner who is responsible for monitoring the exposure and nature of the risk, deciding how it should be managed and taking the necessary action to bring it back to the desired target level.

54 In our ARP3 we disclosed 22 climate-related risks identified through collaborative work between all Gas Distribution Networks and National Gas. These risks are functional risks managed at directorate level.

55 The 22 climate risks are the hazards identified using Met Office data from UKCP18 and cover scenarios of 2 and 4 degrees Celsius global temperature increase. Our ARP3 report is available on our website[4].

56 In summary, the ARP3 Met Office assessment concluded:

- many of the hazards identified are projected to increase due to future climate change, including, increased frequency of high temperature days, prolonged rainfall events, hourly rainfall extremes, sea level rise, extreme sea level events, increased risk of wildfire and increased extreme diurnal cycle events;
- the frequency of snow and ice days are expected to decrease; and
- with regards to societal response to climate change, the assessment considered that impacts of weather hazards on the energy network are likely to come in the form of an altered dependency between weather and both supply and demand, impacting forecast accuracy. And this in turn, is expected to increase the impact of the hazards on the sector.

57 Under a 2-degree Celsius global temperature increase scenario, the physical risk to our assets would be medium, presenting a similar or slightly higher risk than what we are experiencing today.

58 With a scenario where the global average temperatures would reach 4 degrees Celsius, we can expect high to very high physical risk to our network with increased acute and chronic severe risks including irreversible impacts like sea-level rise. This could jeopardise safety and security of supply for our customers.

59 In preparing this strategy, we held a workshop to review the risk narrative and actions associated with the 22 identified climate risks, based on among other factors our experience in dealing with pipeline washouts since the publication of ARP3 in December 2021. The workshop resulted in two updated tables, one for physical climate risks to our gas network, and one table with management risks. A full list of risks is shown in Appendix 1.

60 Based on our current assessment, **the key climate risks to SGN are**:

- **Risk due to precipitation:** Flood risk to above ground assets and risk to underground pipelines from river erosion and flow; and erosion at river crossings. This is the climate risk which we

[4] https://www.sgn.co.uk/sites/default/files/media-entities/documents/2022-01/SGN-ARP3-1221_0.pdf

have seen the highest evidence of to date, illustrated by case studies A, B and D in this document.

- **Risk due to extreme temperatures:**
    - In case of extreme high temperatures or drought: This can cause ground movement due to drought conditions and dry ground (potentially). This is an emerging risk and something which we are working to understand better. The impact would mainly be on areas which have not been part of our mains replacement programme (where old metallic mains are replaced with poly-ethylene pipe, or PE pipe) or where we do not have PE pipe, i.e. our larger diameter pipe network.
    - In case of extreme low temperatures: During prolonged cold spells when there is extra pressure on our networks to keep customers warm, a combination of compound events exacerbated by climate hazards can lead to challenges as highlighted in case study C, which in this specific case led to us failing our emergency standard.

61 Our understanding of climate-related risks is still evolving and as is shown in the Climate Resilience Strategy we are making commitments to improve this over the coming years and into the next price control.

Assessing our options for addressing climate change risks

62 In this Climate Resilience Strategy, we focus on:

- Interventions that manage risks in relation to climate risks we are seeing already; and
- Commitments to improve our understanding of medium to long-term climate-related risks and how these will evolve over time with increased climate change impact.

63 We commit to developing a decision-making framework to ensure we assess options and determine what the most appropriate course of action is for a particular climate-related event. For example, this would consider whether mitigation or adaptation is the best approach, what project to invest in, including consideration of nature-based solutions, and how we can improve our response to reduce the impact of an event in the future. Our commitment to introduce a measure for climate resilience and establish a standard baseline from which we will monitor our progress, will help us understand how the chosen investment is making us more resilient. Nature-based solutions, where relevant, can provide several benefits in addition to adapting to a changing climate, such as mitigation of climate change and improvement and enhancement of biodiversity and nature.

Section B Climate resilience strategy – network assets

64 In this section we discuss what interventions we are committing to carry out over the remainder of the RIIO-2 price control period and into RIIO-3. The purpose is to: address climate-related risks; carry out work to build our understanding of how these risks are changing in the medium to long term; and highlight the actions we must take to ensure we can maintain our networks, keeping customers safe and warm.

65 The strategy is organised as follows:

a) Addressing key risks to the network today:

Risk due to precipitation and risk due to extreme temperatures are identified as key risks to our network today. We propose interventions in the form of proactive survey work for river crossings, river and coastal erosion remediation works, pipeline repair work and to address the impact on our people.

This section also includes two specific projects we would like to carry out in RIIO-3, Musselburgh PRS and Brechin washout diversions project, which are both related to risk of precipitation and flooding.

b) Building resilience for tomorrow:

To develop a long-term Asset Management Strategy considering climate related risks and projection for how these may change over the longer term and what adaptation pathways we would therefore need to consider ensuring climate resilience.

Addressing key risks to the network today

Proactive survey work for river crossings

66 We have carried out a review of how we assess our under-river crossings. We currently inspect these crossings once every 10 years (and annually if a pipe is found to be exposed). We are proposing to change this in response to the emerging threats to our assets. This approach would enable us to be more proactive in understanding when a pipeline river crossing could become an issue so we can address the issue before it becomes a hazard.

67 To ensure our networks remain safe and resilient over time, we are proposing that every crossing would receive at least one survey per year for the foreseeable future, i.e. starting in GD3 and continuing beyond. This approach will be re-assessed as we prepare for the RIIO-4 Business Plan.

68 We have split our river crossings into three categories to enable an appropriate level of assessment to be carried out relative to the risk:

- crossings of 1 – 2 metres in width;
- crossings greater than 2 metres but less than 30 metres; and
- crossings over 30 metres.

69 Depending on the category of river crossing, a different survey approach would be adapted. We propose that every river crossing will have at least one Riverbank Survey each year, crossings greater than 2m but less than 30m will receive an additional Riverbed Survey and crossings over 30m will require an additional survey carried out by a specialist diver. All surveys will be carried out annually. This new scheme will enable a proactive approach to carrying out interventions to mitigate the risk of a pipe becoming exposed and reduce the risk to SGN's network and protect customers supplies.

Table 2: Number of river crossings across our Southern and Scotland network, sorted according to category.

Network	Riverbank survey only 1 or 2 metres	Riverbank and riverbed surveys Less than 30 metres	Riverbank, riverbed and diver Survey >30 metres
Southern	103	602	37
Scotland	119	272	42

Source: SGN analysis

70 The estimated costs of this essential additional work are displayed in the table below. All survey costs are CAPEX as we would engage contractors to carry out the required works. The riverbank and riverbed surveys are simple visual surveys requiring a 1–2-person team. The specialist diver survey cost is based on survey carried out on an existing project on the River Tay. All costs in 2023/24 prices.

Table 3: CAPEX for river crossing surveys per category and total

Network	Riverbank Surveys only/ Year	Riverbank and riverbed Surveys / Year	Riverbank, riverbed and Diver Surveys / Year	Total CAPEX / Year
Southern	£185,500	£301,000	£259,000	£745,500
Scotland	£108,250	£136,000	£294,000	£538,250

Source: SGN analysis. 2023/24 prices.

71 As a result of these preventative surveys, we will carry out restoration works to protect our below river crossings using natural engineering techniques that are environmentally friendly.

72 We propose creating environmental havens where remedial works are carried out, in collaboration with local authorities and the Environment Agency or the Scottish Environment Protection Agency. This could include planting natural flowers, establishing willow along riverbanks with bird and bat boxes, planting hawthorn hedges for nesting Passerines such as Finches and Reed Warblers etc. and installing "bug hotels". This would enhance the local environment and benefit each local ecosystem. It is also aligned with our ambition to improve biodiversity over and above our work on SGN-owned land, as per our Environmental Action Plan.

73 SGN requests funds of £1,283,750 per financial year to carry out surveys across both networks to fulfil its licenced safety obligations, protect its below-river crossings, stimulate the local ecosystem and ensure security of supply to keep customers safe and warm.

Musselburgh PRS

74 In the GD3 period we are proposing the full site rebuild of the current Musselburgh Pressure Reduction Station (PRS) at a new, strategically chosen location. The initiative is driven by the critical need to address integrity risks associated with the aging infrastructure, which houses non-compliant unnecessarily complex and unreliable equipment, which is situated on a flood plain, posing significant operational, safety and security of supply concerns.

75 The PRS is adjacent to the river Esk and is subject to frequent flooding events, exacerbating the risk of operational interruptions and catastrophic failures. These environmental challenges threaten the station's ability to maintain continuous and safe pressure regulation.

76 The recommended solution is a full site rebuild at a new location.

77 Relocating and rebuilding the PRS will mitigate the risks associated with flood disruptions, aging infrastructure, and unnecessarily complex and unreliable primary protective devices, ensuring consistent and reliable service to our customers.

78 Investing in this infrastructure will reduce maintenance costs and extend the asset's lifecycle, providing significant cost savings over time. Furthermore, a new, well-designed PRS will significantly reduce the risk of accidents and environmental hazards, safeguarding both employees and the community.

79 Rebuilding the Pressure Reduction Station at a new location is a strategic investment that addresses critical integrity risks, ensures regulatory compliance, and provides long-term operational and financial benefits. The proposed project is essential for maintaining the reliability and safety of the pressure regulation system, ultimately supporting SGNs commitment to reliably serve our customers.

80 This project forms part of our Full Site Rebuild program detailed in the Engineering Justification Paper SGN-GD3-EJP-LTS-002, with an estimated cost of £4.40m.

Brechin washout diversions project

81 In 2023 the path of Storm Babet as it crossed Scotland had a significant impact upon the River South Esk near the town of Brechin. The high rainfall from the storm increased the flow of the river to such an extent that it overwhelmed the existing riverbank protection measures. See case study B: pipeline washout.

82 The removal of the topsoil was so extensive that it exposed the fittings on an intermediate pressure (IP) pipe approximately 300m downstream from the breach of the riverbank. This exposed the pipe to any potential future flooding. This pipe is the sole supply to approximately 10,000 customers and as such had to be protected with temporary ground works until a long-term solution could be put in place.

83 The risk of future erosion and river damage is such that the long-term solution for this main would ideally be to divert away from its existing river crossing. However, the upstream roadway crossing the river is Brechin Bridge which has also been previously damaged by flooding and would not offer a suitable option for a permanent resolution. As such SGN propose to undertake a feasibility study in early GD3 to ascertain the optimal option for the long-term with a view to potentially establishing a permanent solution in late GD3. The estimated cost for diversion is £3.78m.

River and coastal erosion asset intervention strategy

84 Throughout GD2, we have experienced heightened volumes of climate issues relating to pipes or pipe-supporting structures that cross rivers. Riverbank erosion has removed supporting ground, exposing pipes to the force of the river itself, exposed pipes to potential damage from debris being washed down the river and exposed traditional pipe protection measures (cathodic protection schemes, protective coatings, protective barriers) to river conditions that could be beyond their design parameters. In addition, pipe bridges or similar supporting structures, are also being eroded or damaged by flood waters.

85 Without remediation, below-ground assets compromised by erosion events are at significant risk of failure. Should failure of such pipes occur, this could potentially result in significant loss of supply, costly emergency repairs and significant levels of gas venting to the atmosphere. This could also result in an environmental incident (water contamination and damage to trees and wildlife). While an incident could be controlled by the closure of both upstream and downstream valves, disruption, and loss of supply to a high number of end users would occur.

86 The associated cost of managing an incident, restoring customer supplies, providing alternative heating or accommodation as well as business claims for loss of income, highlights the potential cost of this emerging issue.

87 We continue to gather information relating to above and below-ground crossings through our survey programmes as per our existing management procedures (Management Procedure for the Inspection and Maintenance of Above Ground ≤7 Barg Pipe Crossings reference SGN/PM/Maint/14 and Management Procedure for the Inspection and Maintenance of Below Ground Pipelines and Mains at River Crossings and Watercourses Operating at Pressures of 7 Bar and Below, reference SGN/PM/Maint/15.) These surveys involve recording and gathering information relating to our main and the site conditions as part of our continuing efforts to monitor and manage this risk. We aim to proactively identify locations of suspected coastal or river erosion to work with relevant stakeholders to agree on preventative measures to protect our pipelines and the environment.

88 Our proposal involves remediating all known incidents of risk to existing river crossings associated with river or coastal erosion for below 7bar river crossings in Scotland and Southern, forecasting a requirement for 12 per year in Scotland and 7 per year in Southern, with a forecasted spend of

£12.47m over RIIO-GD3. Remediation works will be carried out over the RIIO-3 price control period and it is something we expect to continue beyond GD3 unless we make every river crossing (or coastal pipe) 100% protected, which is essentially impossible.

89 This proposal is not covered by Cost Benefit Analysis (CBA) as it is a compliance driven, forecast based workload. Due to our inability to predict when or where a failure may occur, this workload is uncertain. Forecasted volumes are an estimate based upon the volumes experienced through RIIO-GD2, however given the unpredictable nature of weather, the volumes experienced may be slightly greater or lower than the forecast. SGN are requesting a re-opener mechanism to reclaim the costs associated with interventions in RIIO-GD3.

90 Table 6 below details the forecasted annual spend to facilitate this programme of works in RIIO-GD3, in 23/24 prices. The forecasted volumes are evenly distributed across each year of RIIO-GD3 however within this there is an offset in volume between Scotland and Southern. Scotland has a higher forecasted volume than Southern based on historical data. Whilst volumes have been forecast based on data experienced throughout RIIO-GD2, this is a new proposal and not a continued programme from RIIO-GD2.

Table 4: Volume of interventions and forecasted spend for Southern and Scotland networks for below 7bar river crossings remediation works

Year	GD3
Volume of Interventions (Scotland)	60
Volume of Interventions (Southern)	35
Forecasted spend total (£m)	£12.47m

Source: SGN analysis

Case Study D: Risk due to precipitation: Pipeline washout Dighty Burn, St Monifeith

91 In 2019, as part of a survey in accordance with our Management Procedure on Inspection and Maintenance of Above Ground ≤7 Barg Pipe Crossings, it was identified that approximately 50 metres of the riverbank on the River Dighty in Monifieth, Scotland had been washed away – exposing approximately 3m of an intermediate pressure (IP) pipe crossing the river, shown in figure 6.

Figure 6: Exposed section of IP pipe crossing River Dighty

Source: SGN photo

92 Due to scheduling issues in early 2020 caused by the Covid-19 pandemic, work to remediate the issue could not be undertaken until 2022. In the intervening period the effect of the river on the exposed section of pipe was to strip approximately a 3m section of the protective coating.

93 The IP pipe is part of SGN Grid 13 Perth Dundee IP/MP system. Failure of this pipe would result in the loss of gas to approximately 25,000 customers.

94 Multiple remediation options for the pipe were considered, including replacing the pipeline, however due to the topography this was ultimately deemed impractical. It was decided the best course of action was to build a temporary water break to facilitate repairs to the protective coating of the pipe. The integrity of the pipe was then protected by rock dumping to re-establish the riverbed, figure 7.

Figure 7: Stages of rock dumping to remediate washout.

Source: SGN photos

95 Following engagement with the river authorities, the riverbank was re-established and reinforced to provide long-term protection for the pipeline without disrupting the natural course of the river, figure 8.

Figure 8: Reinforcement of riverbank.

Source: SGN photos

Analysis of emergency and repair workload trends

96 Whilst there is clear evidence the REPEX program has reduced the number of repairs required significantly over the last 10 years, particularly through the Tier 1 mandatory programme, weather continues to be the biggest influencing factor on monthly volumes. Low temperatures are a key contributor to more repairs in the colder months, and extremes of hot and cold temperatures drive

localised peaks in repair works. We have carried out analysis, with the support of an external expert, and the outcomes fed into our repair workloads and forecasts for RIIO-3.

97 In GD3 we expect to see a reduction in repairs to Tier 1 mains, while works to Tier 2 and Tier 3 mains are projected to increase. This has increased investment requirements significantly in recent years and is expected to remain in GD3. To understand the trends and inform our future forecasts we commissioned a specialist data analyst to independently assess the factors that impact repair workload and assess how they will change in the future (SGN-GD3-ECR-02). Key factors identified include the rate of replacement, rate of mains deterioration and the temperature through seasonal variances.

98 The seasonal volume pattern of both Publicly Reported Escapes (PREs) and repairs continue to be driven by variations in weather, with lower temperatures typically resulting in higher PRE and repair volumes. In addition, there is clear evidence of extreme cold and hot weather events driving localised increases in PREs and repairs. This is determined as an influencing factor within our recent external analysis.

99 The fluctuation of temperature and the seasonal variances being experienced and forecasted to get worse will have an impact on both our PRE and repair volumes going forward.

100 Within RIIO-GD3 it is anticipated through the SSMD, there will be opportunities to progress with further analysis of the impact that climate will have on PREs and repair volumes going forward through the use of the Network Innovation Allowance and in particular the impact that this will have on our resilience strategy.

101 We are also supporting other innovation projects through development of both Digital Platform for Leakage Analysis (DPLA) and Advanced Methane Detection (AMD) and are progressing with these initiatives through the use of uncertainty mechanisms. More details of the initiatives and the mechanism proposed can be found in the EAP (SGN-GD3-SD-01) as well as chapters 6 and 8 of the main business plan.

102 It is expected that when complete, the outputs and recommendations from DPLA and AMD will further support our Climate Resilience Strategy within GD3 and beyond.

Consideration of climate change impact on people

103 With increasing extreme weather events, including prolonged periods of hot weather, we commit to researching this further and will engage with the other GDNs, utility companies with experience of countries with hot weather and wider industry, including the HSE, to ensure our workforce remain safe. We have controls and guidance in place and will review these to ensure advice and communication to our employees stay relevant. This work and potential future interventions as described below, is ongoing continuous work which we are performing to ensure our workforce remain safe.

104 Exposure to higher temperatures with more frequent periods of heat may result in greater heat stress, potentially leading to more cases of heat-related illnesses such as heat stroke, heat exhaustion, increased susceptibility to chemical exposure, and fatigue.

105 Interventions could be:

- periodic heat-risk assessments to identify the groups most vulnerable to spiking temperatures, including the aging workforce, pregnant people and employees with disabilities;
- the implementation of specific heat-related health and wellbeing initiatives, which may include training workshops on heat-stress management or fitness and nutrition plans to help workers adapt to the changing climate;
- heat-resistant working environments including sustainable building infrastructure with better air conditioning systems; and

- working with manufacturers to develop suitable personal protective equipment (PPE), as wearing PPE in warm/hot environments increases the risk of heat stress.

Building resilience for tomorrow

106 In RIIO-GD3 we aim to be resilient to physical, financial, climate and cyber shocks in a changing world. To achieve the delivery of this outcome, we are committed to the following:

- **We will introduce a measure for climate resilience and establish a standard baseline from which we will monitor our progress**.

107 In support of this commitment, we will develop a long-term Asset Management Strategy up to 2050. Through this process we will consider climate risks over the long term, and how these could impact our network assets on a detailed level. It will allow us to assess options and determine what the most appropriate course of action is for a particular climate-related event. For example, this would consider whether mitigation or adaptation is the best approach, what project to invest in, including consideration of nature-based solutions, and how we can improve our response to reduce the impact of an event in the future. Part of the work will also be to identify suitable KPIs to measure the network's ability to withstand and recover from climate-related disruptions. By establishing a baseline, we can monitor our progress on how we are improving resilience.

108 We will also continue to work collaboratively with other GDNs and DNOs through the Climate Change Adaptation & Resilience Working Group, at the Energy Network Association, to ensure that the metrics and KPIs for monitoring and managing climate resilience are aligned, and to adopt an industry wide approach to these challenges.

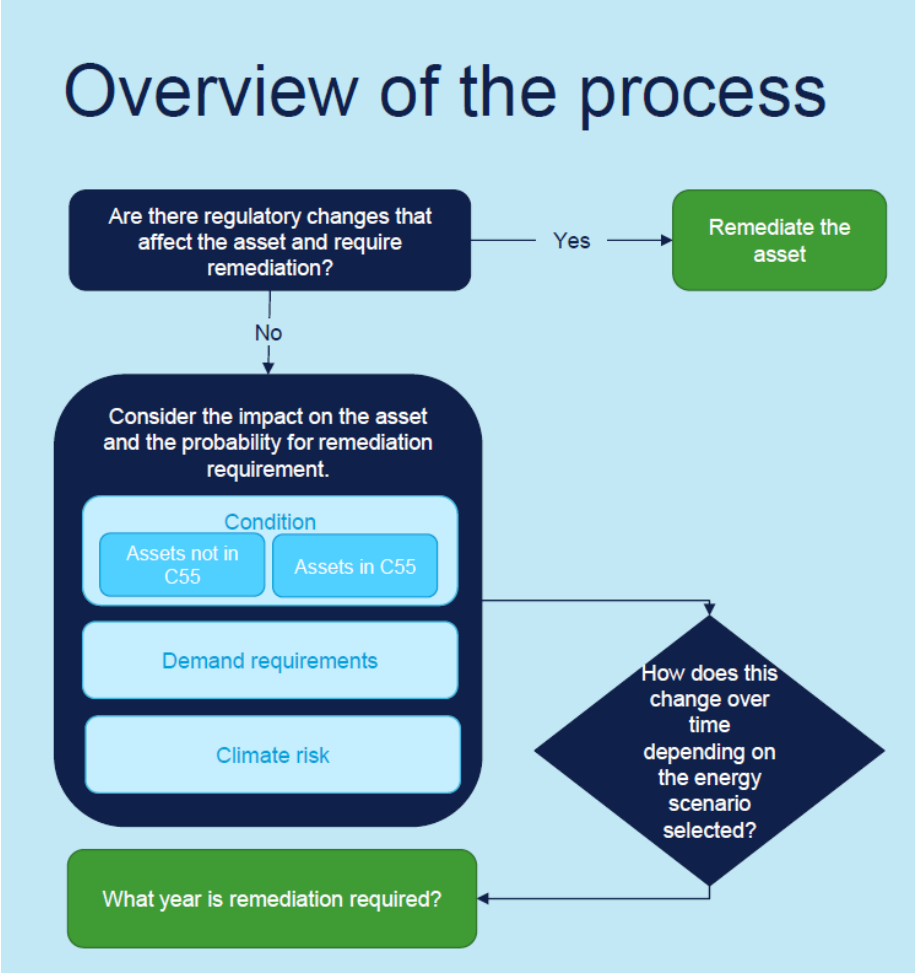
Development of a long-term Asset Management Strategy

109 This strategy will provide understanding on how remediation works may be affected depending on (but not exclusive to): future energy scenarios, changes to future demand, climate change and regulatory changes.

110 We have already started this work, working with an external expert, and have concluded phase 1, methodology, of this project. We expect to have a first cut of the plan in the early part of RIIO-3. However, it's important to note that plan would be live and iterative responding to updated threat / climate data as we progress.

111 The process to determine when the asset requires remediation is shown in Figure 9. Assets are first considered for remediation based on the condition assessment through our model (called C55). From the assets part of C55 we have a reasonable understanding of the health of the asset, and for assets not included in this model, a condition-based health calculation will be carried out dependent on population characteristics (e.g. age of asset, location of asset), failure data, inspection data, maintenance data, and survey data. These assets will then be given an asset health score on the same scale to those seen in C55. Thereafter future demand requirements will be considered, linked to the different energy scenarios to be developed between ourselves and the external expert depending on the amount of gas required to be provided by SGN to customers. Climate risk is the other key factor contributing to the process. Here we will use a tool to determine the impact of climate change over time on the SGN assets.

Figure 9 The step-by-step process of determining whether an asset requires remediation and how climate risk is considered as part of this process

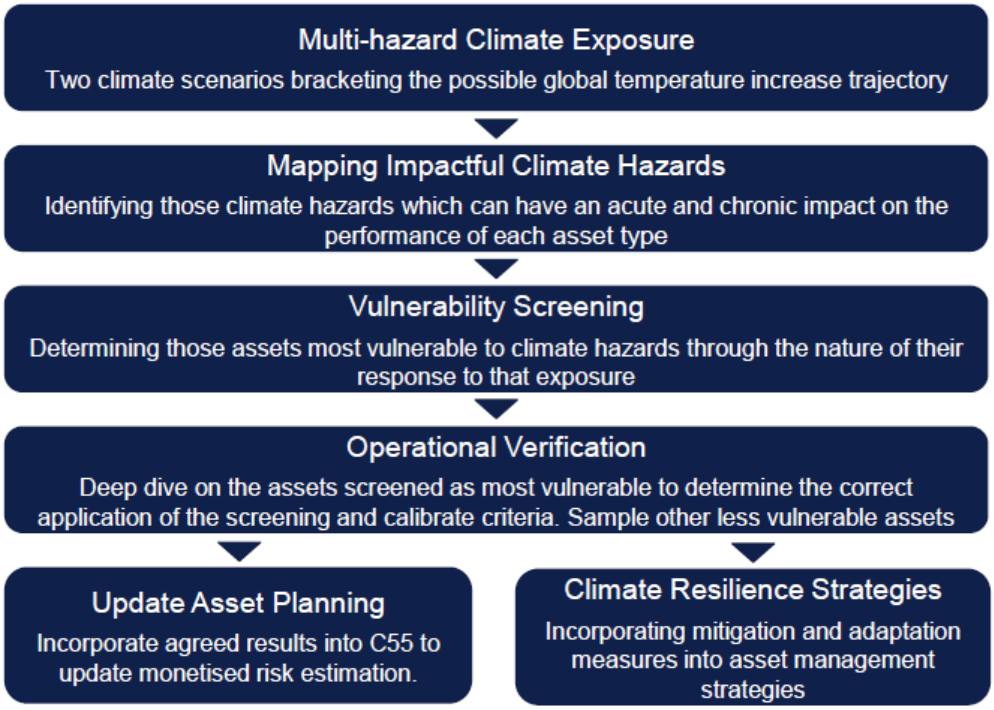


Source: SGN asset management plan – Phase 1, Methodology and initial draft outputs

112 The gas demand required over time greatly depends on the scenario selected to occur in the gas industry. For example, should the UK government determine that hydrogen will be a part of the UK's energy future, the gas demand would look different to the scenario where the UK government determine that hydrogen will not be a part of the UK's energy future. We will develop and define scenarios, assess the impacts these have on the network, determine asset management pathways and define asset management strategies to tackle the different scenarios.

113 The changing climate causes a constraint to the methodology described above. In collaboration with the external expert, we will use a climate risk tool to review and interrogate the physical impacts on the asset due to climate change. The tool allows us to combine climate science, data analytics, and operational expertise to understand overall climate impact on assets. The exposure to climate hazards is the foundation of the assessment, but it is only when the likely asset response is determined that this allows decision-making to occur. In determining options for improving network resilience, asset vulnerability to climate change has to be factored with asset criticality and existing control options (such as redundancy). The climate resilience methodology is shown in figure 10.

Figure 10: Climate resilience methodology applied to assess the remediation requirement of an asset



Source: Source: SGN asset management plan – Phase 1, Methodology and initial draft outputs

114 Climate science is by its nature uncertain particularly as projections get further into the future. Scenario uncertainty (the variation between the outputs between scenarios) is addressed by bracketing the results between two input scenarios representing optimistic and pessimistic outcomes. These are:

(i) SSP1-2.6 is a sustainable development pathway with low challenges to mitigation and adaptation, assuming rapid economic growth, low population growth, and an emphasis on renewable energy technologies. It typically leads to a 2°C warming scenario.

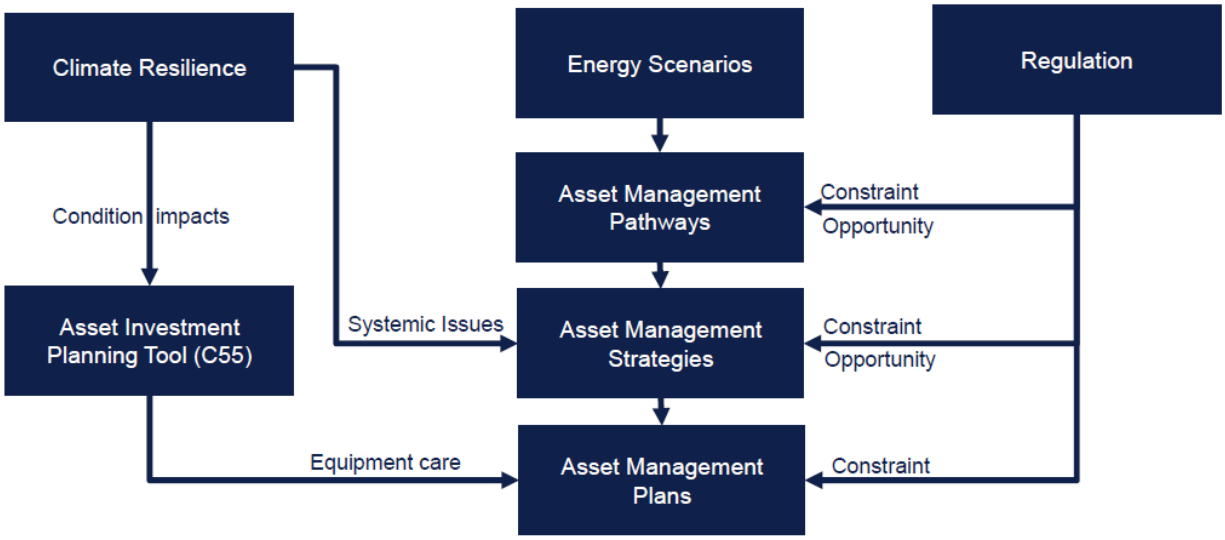
(ii) SSP5-8.5 is a fossil-fuel-intensive scenario with high challenges to mitigation and adaptation, assuming rapid population growth, high fossil fuel use, and limited climate policies. It typically leads to a 4°C or higher warming scenario.

115 The timeframe considered is through to 2050 with an intermediate milestone of 2030.

116 Further analysis of climate exposure and mapping climate hazards will be conducted to understand the material impact to the deterioration of the asset, before identifying those assets most vulnerable to climate hazards. Usage and operational verification will be carried out before reaching the desired out puts of updated asset planning to be incorporated into the C55 model, and climate resilience strategies with mitigation and adaptation measures. The results of the climate risk and vulnerability assessment will be used to identify common measures to mitigate the acute effects of climate events and adapt equipment to the chronic impacts. This will in turn make the network more resilient. This could include changing equipment specifications, reconfiguring equipment layout or updating operational processes. These would be incorporated into Asset Management Strategies as appropriate. Regulations provide an additional constraint to the methodology but also potential opportunity for future proofing networks. Regulations change due to multiple reasons, for example, to reduce environmental impact, increase efficiency and increase safety in the industry. Regulatory changes may mean that the assets in SGN's portfolio require attention prior to their natural end of asset life due to degradation alone. In these instances, these assets will be flagged in the model for remediation.

117 The three aspects of future energy scenarios, climate resilience and regulation changes combine to deliver a set of outcomes that permit development of asset management plans that reflect strategic network enhancement objectives as well as meeting tactical equipment care requirements, addressing systemic climate change impacts and regulatory requirements as well.

Figure 11: The three aspects of energy scenarios, climate resilience impact and regulation all impact on the future asset management pathways, strategies and plans that we will develop



Source: Source: SGN asset management plan – Phase 1, Methodology and initial draft outputs

118 For clarity:

- Asset management pathways means understanding the impact on the network from each of the UK energy scenarios, each scenario is associated with a different pathway;
- Asset management strategies are how SGN meet their net zero targets based on the impact on the network from the energy scenarios (e.g. area X may be transitioned to hydrogen, whilst area Y is being transitioned to electricity and therefore SGN's network will be decommissioned); and
- Asset management plans are a list of assets that require investment and the associated predicted year of investment required, (which can be used for regulatory planning), depending on the pathway and strategy determined.

119 This approach will enable us to develop adaptation pathways to take into account all key climate risks in the medium to long term.

120 The development of a long-term strategy will also involve consideration of applicable standards and methodology for climate adaptation and climate resilience.

Section C Climate resilience strategy - property assets

Climate risk and resilience for our property portfolio

Introduction

121 In RIIO-2 we received baseline funding for climate change adaptation surveys. This assessment has been carried out up to 2080, utilising current climate projection data (UKCP18). It is aligned with the

UK Green Building Council (UKGBC) Framework for Measuring and Reporting Climate-related Physical Risks to Built Assets, which is industry accepted guidance for assessing physical climate risk at asset level.

122 The assessment findings will allow adaptation measures to be prioritised, kept under review and where appropriate, action taken to align with existing plans for maintenance, repair, and refurbishment.

123 There were several unforeseen developments that happened during GD2; navigating these uncertainties requires proactive planning, risk assessment, and flexibility to adapt to changing conditions in the property management landscape. One of the uncertainties we have encountered is climate-related risks: natural disasters (like extreme precipitation, flooding, heat stress etc) can cause damage to properties, leading to significant repair costs and potential liability issues. We aim to remain resilient in a changing climate, and therefore we will implement proportionate adaptation measures against the identified climate risks at our occupied buildings such as 'soft' flood defence systems.

Case study E: St Mary Cray climate risk assessment

124 The St Mary Cray site consists of a small office and a warehouse. The site is located at the bottom of a hill, situated at 40m above sea level. The area surrounding the site is mostly hardstanding, with very limited vegetation on site. There has been reports of small-scale surface water flooding, especially in the car park and warehouse. Being located at the bottom of a hill, runoff water floods the car park, limiting access to parking spaces. The roof is poorly maintained and there is evidence of damp and leaking throughout the building. Windows are doubled glazed but cannot be opened across the building. There is air conditioning in the office rooms and no previous reports of overheating have been made.

125 The St Mary Cray site has been assessed against ten physical climate risks as part of our climate change adaptation surveys, as shown in figure 12. The results highlight a high risk of extreme cold in the short term, as well as a moderate risk of pluvial flooding and extreme precipitation. The assessment shares recommended adaptation measures to be implemented and estimated costs. The assessment helps us to identify actions to take in the near term (RIIO-3) and in the medium to long term beyond the price control period.

Figure 12: St Mary Cray climate risk register assesing the location against the physical climate risks

		Heat Stress	Extreme Cold	Storm and Wind Event	Extreme Precipitation	Fluvial Flooding	Pluvial Flooding	Drought	Wildfire	Subsidence	Coastal Erosion
SHORT TERM	RCP 2.6	Very low risk	High risk	Low risk	Moderate risk	Low risk	Moderate risk	Very low risk	Very low risk	Very low risk	Very low risk
	RCP 4.5	Very low risk	Moderate risk		Moderate risk	Low risk	Moderate risk	Very low risk	Very low risk	Very low risk	Very low risk
	RCP 8.5	Very low risk	Moderate risk		Moderate risk	Low risk	Moderate risk	Very low risk	Very low risk	Very low risk	Very low risk
MID TERM	RCP 2.6	Very low risk	Moderate risk	Low risk	Moderate risk	Low risk	Moderate risk	Very low risk	Very low risk	Very low risk	Very low risk
	RCP 4.5	Very low risk	Moderate/Low risk		Moderate risk	Low risk	Moderate risk	Very low risk	Very low risk	Very low risk	Very low risk
	RCP 8.5	Very low risk	Moderate/Low risk		Moderate risk	Low risk	Moderate risk	Very low risk	Low risk	Very low risk	Very low risk
LONG TERM	RCP 2.6	Very low risk	Moderate/Low risk	Moderate/Low risk	Moderate risk	Low risk	Moderate risk	Very low risk	Low risk	Very low risk	Very low risk
	RCP 4.5	Very low risk	Moderate/Low risk		Moderate risk	Low risk	Moderate risk	Low risk	Low risk	Very low risk	Very low risk
	RCP 8.5	Very low risk	Low risk		Moderate risk	Moderate/Low risk	Moderate risk	Low risk	Moderate/Low risk	Very low risk	Very low risk

Source: SGN Climate risk and resilience, Climate change risk and adaptation planning portfolio. Main report

Climate-related risks to our property portfolio

126 Our sites in the UK are expected to experience an increase in summer and winter temperatures, reduced summer rainfall and increased winter rainfall which in some way will affect all assets across our portfolio.

127 Flooding is the most prevalent risk to assets across all time frames and climate scenarios. This includes both pluvial and fluvial flood sources, which both see increases in risk ratings as we move towards 2080.

128 During the short term, from now and up to 2030, our sites in England and Scotland see an average of 1.3 and 1.7 climate risks per site respectively. Key risks up to 2030 include extreme cold, heat stress and fluvial flooding.

129 During the mid-term, from 2030 until 2050, our sites see a similar average of climate risks per site as during the short term. The risk of extreme cold decreases, whilst the risk of heat stress and fluvial flooding increase.

130 The long term, beyond 2050 up to 2080, sees an average of 2.9 and 2.5 climate risks per site in England and Scotland respectively, over double the risk exposure compared to the mid-term. By 2080, new climate risks are observed at sites, along with the continual risk of heat stress and a notable increase in the risk of pluvial flooding.

131 Wherever possible, passive design measures or nature-based solutions have been prioritised in committed actions.

How we address the risks to our properties

132 Details of the climate adaptation approach we are taking, which is based on the climate change adaptation surveys carried out for our property portfolio, are available in the Property Management EJP (SGN-GD3-EJP-PRO-003). Over RIIO-3 our proposals amount to a total of £0.42m to implement proportionate mitigation measures against the identified climate risks (heat stress, extreme cold, flooding, extreme precipitation etc) at our occupied buildings. These risks are the highest risks over the short term up to 2031.

133 Adapting our property portfolio will continue beyond RIIO-3, tackling risks which are estimated to become prevalent in the medium term and longer terms.

Section D Risk and uncertainty

134 Climate change and extreme weather events are happening already. The impact on our assets is unpredictable as we have limited knowledge of how and where extreme weather events will hit us over the RIIO-3 price control period and beyond. We commit to model this and develop climate adaptation scenario pathways to identify suitable mitigation interventions. These may be CAPEX project interventions, closer monitoring for assets at high risk and the development of contingency plans for weather events that are expected to become more frequent.

135 While we can model and aim to be proactive in our approach, these challenges and impacts are also unpredictable to some extent, and we therefore propose a climate-resilience re-opener.

136 We have also noted an increase in approaches from the Environment Agency to work collaboratively to develop various nature-based solutions to develop climate resilience. This is due to the fact we have assets in the areas they are exploring. We want to respond positively to such requests but would need to charge for any associated workload, to divert pipelines for example. A reopener could allow for nature-based adaptation and climate change resilience schemes to be paid for rather than passing the cost on to the regulator.

137 We are proposing a climate change resilience reopener to put forward pre-emptive works to stop assets being affected by the results of climate change. For example, in GD2 we have utilised the Diversions reopener to provide allowances for this type of uncertain activity whereby a diversion is required to mitigate against the risk, thus enabling the recovery of costs post-event.

138 The Climate Resilience Re-opener should include all climate related works that will allow us to mitigate against these types of risks as well as ensuring the right type of intervention is deployed to allow us to maintain a safe and resilient network. This could include weather related erosion events that impact on our assets and require a range of interventions that can include restoring cover, diverting assets or rebuilding sites. In GD3 we have included the cost of known activities only. It is important that this reopener is introduced to cover the costs of future events that are not known to us or have a greater level of uncertainty.

Section E Engineering Justifications Papers and Cost benefit Analysis

139 The Climate Change Resilience Strategy is supported with engineering justification papers (EJPs) and cost benefit analysis assessments (CBAs) as detailed in the table below. These documents support our RIIO-GD3 submission with detailed engineering justifications and costs for investment detailed in this document.

140 No other financial assessment tools were used aside from CBAs and EJPs.

Table 5: EJPs and CBAs

Name / Project	Cost	NPV (at 16 years)	EJP Reference	CBA Reference
River and coastal erosion asset intervention strategy	£12.47m (re-opener)	N/A – no CBA	SGN-GD3-EJP-DST-008	N/A
Full site rebuild EJP (Musselburgh PRS)	£4.40m	£101.59m (for full site rebuild CBA, not Musselburgh specific)	SGN-GD3-EJP-LTS-002	SGN-GD3-CBA-LTS-SCO-002
Reinforcement General EJP (Brechin washout diversions project)	£3.78m	N/A – no CBA	SGN-GD3-EJP-DST-005	N/A
RIIO-GD3 Property Management	£0.42m	£6.29m (for property management CBA, not climate resilience specific)	SGN-GD3-EJP-PRO-003	SGN-GD3-CBA-PRO-003

Conclusion

141 This strategy summarises the impacts of climate change we see evidence of across our Scotland and Southern England networks today and what actions and interventions we can take to proactively manage the impacts in RIIO-3.

142 We are also making commitments to improve our knowledge and understanding of how long-term climate-related risks will impact our networks in the medium to long term and use this to develop an Asset Management Strategy up to 2050. We also commit to work collaboratively with other GDNs, DNOs and the wider industry to improve our climate resilience for our network assets.

Appendix 1 Climate risk register

This appendix shows the 22 climate-related risks as identified in the ARP3 (see section A Climate risk assessment). The climate risks are organised in categories of climate risk:

- temperature;
- precipitation;
- temperature & precipitation;
- other; and
- management risks.

Table 6: Physical climate risks to the network

Risk Code	Risk	Description	Mitigation Progress
ARG6	Above ground assets affected by raised temperatures	Gas equipment is inherently resilient and designed to operate at high temperatures as network assets are manufactured to international standards. Where temperatures increase above designated temperature parameters, the impact to network controls should be minimal.	We do not consider this as a general mechanical issue. In the past we have put air conditioning units in to manage temperatures and will continue to do so if required. IT equipment and instrumentation may need additional protection.
ARG8	Extreme weather impacts from lightning	Increased storm frequency creates more risk from lightning. Where lightning strikes exposed assets, it can cause physical damage and possible operational failure, loss of telecommunications equipment, and a fire risk to gas venting stacks.	We are actively working on this and ensuring we have sufficient lighting protection system. We are also carrying out Risk Assessments for new sites which takes this into consideration.
ARG12	Ground movement due to drought conditions and dry ground	Ground movement caused by drying and shrinkage will exert tensile forces on underground assets, especially to more vulnerable joints and connections, with cast iron mains presenting the highest risk. This could lead to mechanical damage and the potential fracture of pipelines leading to a serious risk of gas release or explosion. Any loss of ground cover above pipes could also increase the risk of third-party strikes.	The gas mains replacement programme and growth in PE pipe installation are reducing risks from ground movement arising from drought conditions. Ongoing work to understand reasons behind existing repair numbers is being carried out.
ARG4	Flood risk of above ground assets	Assets in flood plains (fluvial) or otherwise are physically vulnerable to extreme and extended rainfall (pluvial). Ancillary instrumentation and communication equipment are notably the most vulnerable, despite governors and pressure-reducing equipment being resilient and capable of operating when submerged in water.	This is included in our risk registers. We have also carried out analysis that show breakdown of our assets in different flood zones, using EA and SEPA flood mapping and shape files.

ARG5	Flood risk of above ground assets from catastrophic dam failure	Extreme precipitation can lead to dam overload and failure. Where assets are located far enough away from dams, the impact of water inundation from a dam burst is no different from "standard" pluvial, fluvial or tidal flooding, and flooding impacts can be considered similar. Where assets are close enough to dams to be impacted by the full force of a breach, the damage would be substantial. Plant and equipment would not only be impacted by water ingress but are likely to be physically damaged or washed away by the force of water.	We have analysed the length of mains pipelines, number of district governors, TRS's (transmission reductions stations) and Pressure Reduction Stations within flood reservoirs. This is used to acquire a greater understanding if and where we would have any assets at particular high risk, and the maps and shape files are a useful tool when any upgrades or other works are being planned.
ARG9	Asset impact from snow/ice falls and accumulation	The risk to above ground assets is expected to gradually decrease due to less frequent snow events. However, a risk remains of physical damage from excessive snow or ice falls, for example, increased loading on building roofs.	We do not consider this a big issue for our network assets, there is no or little risk to damage because of snow/ ice falls. It is much more of an issue from an accessing sites perspective and as such dealt with in relevant BCM Plans.
ARG10	Risk to underground pipelines from river erosion and flow	Increased precipitation results in flooding and stronger watercourse flows. This hydraulic action can abrade pipeline coatings if they are exposed. Additionally, hydraulic motion can move pipes, causing bending stress from lack of support.	Pipelines can be exposed and are then susceptible to physical damage (scouring and erosion of pipeline coatings). More frequent flooding and increased river and watercourse flows will increase this level of risk. We have clear evidence of this happening across our Scotland network. To allow a clear framework for river crossing risk and approach we are currently updating our Management Procedure for the inspection and maintenance of below ground pipelines and mains at river crossings and watercourses (Maint15). Consideration of extended surveys to be proactive in preventing river erosions at river crossings.
ARG11	Ground contamination and transport of materials from flooding of contaminated sites	Flooding of contaminated sites, especially sites like floodplains, can transport leeched materials via ground water. This can expect increased damage mitigation costs like remediation and inspection, additionally, risking more regulatory and enforcement action.	Part of well documented process in SGN. No gap identified and no current actions identified. Well managed risk.
ARG22	Ground water flooding of below ground assets leading to water ingress to pipes	Despite the inherent resilience of pipelines, more frequent and prolonged flooding will increase the risk of physical damage and the likelihood of water ingress leading to	We are already experiencing and dealing with the consequences of ground water flooding.

		operational and supply issues. Flooding may also cause a governor (installed below ground) to go to fault conditions that could lead to over-pressurisation of the network.	
ARG13	Vulnerability of critical IT systems managed by third parties from extreme weather events	This represents an interdependency with other service suppliers and there is a risk of the loss of critical IT systems and functionality, especially if there is insufficient flood protection or cooling of third-party data centres and/or these cannot be relocated. Any loss of capacity could lead to the need for manual intervention and reduced network control.	Climate change/ extreme weather events are included in our IT risk registers, referencing IT supply chain and IT resilience.
ARG15	Vegetation Growth	Increases in temperature and precipitation will lead to increased vegetation growth. Above ground assets will be impacted by any increased growth of trees adjacent to operational equipment, leading to increased maintenance and reduced accessibility. Similar issues may be encountered with the accelerated growth of plants or invasive species. Any change in the numbers or seasons of nesting birds and protected species will need to be registered on habitat surveys and could potentially restrict work activities.	We have existing procedures around site husbandry to deal with vegetation.
ARG7	Damage to above ground assets from storm events	Damage to above ground assets from storm events assets are subject to damage from extreme storms and high winds, and therefore any increase in the frequency and severity of these events will mean a higher risk of infrastructure damage and failure, with communication equipment being the most vulnerable assets.	We have existing procedures dealing with site husbandry on sites (to remove any potential vegetation that could damage assets in a storm). In addition, when we are experiencing extreme weather events, we hold back work as required to ensure the safety of our people. Our property assets have been assessed from risk of storm events.
ARG14	Asset damage if no wildfire risk assessment or remediation measures	Increased temperatures and reduced precipitation increase the occurrence of wildfires, posing a significant risk to above ground assets that are located in susceptible areas (e.g., open heathland, grassland, forested areas). Underground pipeline damage is more probable when vegetation clearance within 3m of site boundaries is not performed. There is also an interdependent risk from any impact on other utility assets in the electrical system.	Around all above ground installations there are hard surfaced areas and sites are being managed from a vegetation perspective Currently the risk of wildfires to our assets are not specifically considered in our risk registers.

ARG20	Tidal flooding of above ground assets	Regardless of the source the impact of flooding on above ground assets is the same. There is a risk of physical damage to assets, although governors and pressure reducing equipment are resilient and capable of operating when submerged in water. This will be exacerbated if flood defences are ineffective and/or plant relocation is not possible.	The risk of flooding to assets are considered in our risk registers. We have surveyed our assets using Coastal Flood Boundary Datasets from EA and DEFRA, and SEPA flood risk maps for Scotland.
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, which will affect asset integrity and could lead to water ingress and gas release. Ingress of saline groundwater may also impact the buoyancy of pipes and cause structural issues.	There is a possibility that our distribution network could be impacted but we have yet to undertake any analysis to quantify this. We have a number of assets near shoreline.
New & emerging risk	Culvert and field drain wash-ins	We are receiving more requests from landowners to repair blocked, broken or undersized field drains associated with our pipelines. Field drains can be easily blocked with the increased rainfall we have seen over the past few years. Also drains that would once easily drain a field are now becoming undersized with the increased volumes of water. As rainfall increases, we expect to have to repair more drains associated with our pipelines and mains.	This is a new and emerging risk which we will evaluate and address as part of ARP4.

Source: SGN analysis

Table 7: Management risks for climate change

Risk Code	Risk	Description	Mitigation Progress
ARG1	Lack of climate change management procedure.	The requirements for climate change management need to be specified to ensure the necessary procedures and actions are integrated into the organisation's environmental management system. This leads to a greater understanding of the potential impact of climate change and improves the overall environmental culture within the business.	Climate change management procedures and actions are integrated in our environmental management system (EMS). Our EMS aspects register acknowledges climate change risks. Our EMS is externally certified to ISO14001:2015. Our risk register considers lack of procedures and tools. To allow a clear framework for river crossing risk and approach we are currently updating our Management Procedure for the inspection and maintenance of below ground pipelines and mains at river crossings and watercourses (Maint15)

ARG2	Lack of specific policies and procedures governing risk assessment process on climate change	A robust climate risk assessment process is required for all major network investment decisions. Climate change needs to be considered at the planning stage prior to the installation of new/replacement gas and electricity infrastructure. This will result in a greater level of asset data and information and increased asset integrity.	Our risk register considers lack of procedures and tools. Our template for investment decisions includes environmental considerations. Flooding is a key risk which is being considered for future location of assets. However, other climate risks are not considered to the same extent. We will develop adaptation pathways to take into account all key climate risks in the medium to long term which will help inform our risk score and confidence rating across the climate risk register.
ARG3	Risk and action owners not identified at senior leadership team level	Asset climate risks need to be afforded the same status as other risks to assets including security, safety, and other environmental impacts. Accountability is then required at senior management level and responsibilities included within existing business risk processes.	'Climate change' is one of 14 enterprise risks in SGN. Strategic oversight is provided by our Stakeholder & ESG Board Committee. The risk owner is our Chief of Staff.
ARG16	Wildlife impacts	The effects of climate change could lead to impacts on wildlife due to changes in environments, habitats, and behaviours. This could lead to restricted access to assets from changed nesting habits, prolonged nesting seasons, changes to species migration, subsidence from digging etc.	This is considered in our risk register. We also have procedures and provide guidance to deal with nesting birds and similar wildlife impacts.
ARG17	Supply chain impacts	Business Continuity Management (BCM) plans could be affected due to severe travel difficulties resulting from extreme weather events. This can result in reduced capability and support from supply chain businesses and impact on the continued operation and maintenance of the networks. The adoption of new technology and equipment will assist in the ability of the workforce to work remotely and continue to manage network assets.	With regards to services from our supply chain, this is considered as part of our Business Continuity Management Plans. We recognise there is a risk of supply chain impacts due to climate change and have yet to develop an adaptation response
ARG18	Precipitation - BCM plans affected due to severe travel difficulties resulting from extreme weather events	Business Continuity Management plans could be affected due to extreme weather events. There may be an impact on organisational capability and staff resources and the continued operation and maintenance of the networks.	Risk to travel and associated operational difficulties due to weather events are covered in our BCM Plans. The COVID pandemic has tested the arrangements and systems in place which have proven to be effective.

ARG19	Knock on effect on GDN operations from variable electricity supply due to impact on DNOs	One of the potential interdependencies within the sector is the knock-on effect on gas network operations from a variable electricity supply. Any initial climate impact on the electricity networks, as set out in the electricity network risks, may result in electricity supply interruptions leading to an impact on asset operations and gas supplies to customers.	This risk requires a utility response and collaboration and is noted as an interdependency. To ensure resilience across our property portfolio we have one depot per sub-region with additional power supply. CNI assets (large offtakes etc) have alternative power supply, such as an onsite generator (13 sites). Gas control & OCC has alternative power supply

Source: SGN analysis