

SSEN Distribution

# CLIMATE RESILIENCE STRATEGY

Strategic Update and Progress Report 2023



Scottish & Southern  
Electricity Networks

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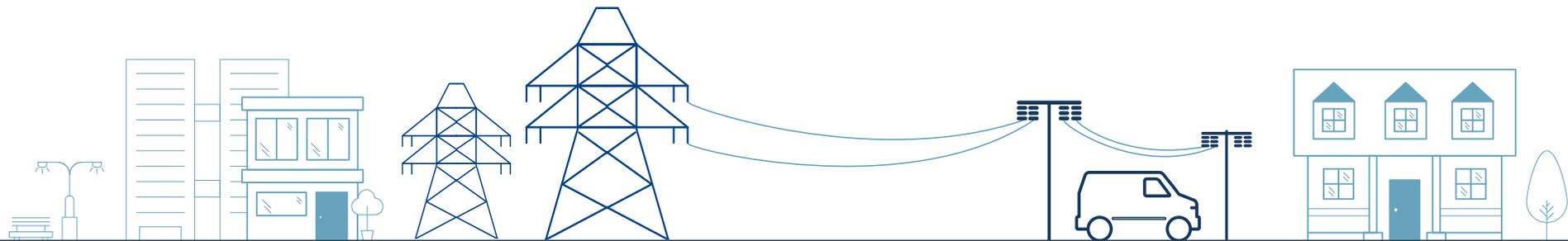
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# INTRODUCTION

## Executive summary

Electricity networks, in common with all civil engineering infrastructure, will be affected by the physical, societal, and financial impacts posed by climate change. Recent extreme events illustrate the extent of this potential exposure, demonstrated in recent storms such as Storm Arwen that caused over 1,000 points of damage on our overhead line network and affected over 100,000 homes, in our Northern licence area. Subsequent events, such as Storms Malik, Otto and Eunice have also posed new risks to our business. In the UK, an increase in the frequency of heatwaves has already been felt, affecting electricity networks' assets such as substations, transformers, and switchgears. At the same time an increase in the use of air conditioning in offices and homes as well as a national transition to greener energy, will result in higher demand for electricity, adding strain to electricity networks across the country.

We operate in different regions of the UK, from densely populated urban regions on the southern coast of England to scarcely populated rural areas in the Scottish Highlands and Islands. In the coming decades, our commitment to our 3.9 million consumers for reliable energy delivery will be challenged by the adverse risks of climate change, such as an increase in flooding, extreme temperatures, drought, and wildfires. We are committed to understanding these challenges, to find sustainable solutions to tackle them, and to adapt to a changing climate thus ensuring our future resilience.

However, the path to Climate Resilience is detailed, complex, and multi-faceted which requires a risk management plan with many factors, variables, and uncertainties. Through our Climate Resilience Strategy (Appendix 2), climate change risks are studied, assessed, and prioritised, and the climatic difference between our northern and southern regions is investigated. Interdependencies of our operation with other stakeholders (such as telecoms, electricity transmission, water utilities, etc.) are understood to highlight the key vulnerabilities for both us and our stakeholders.

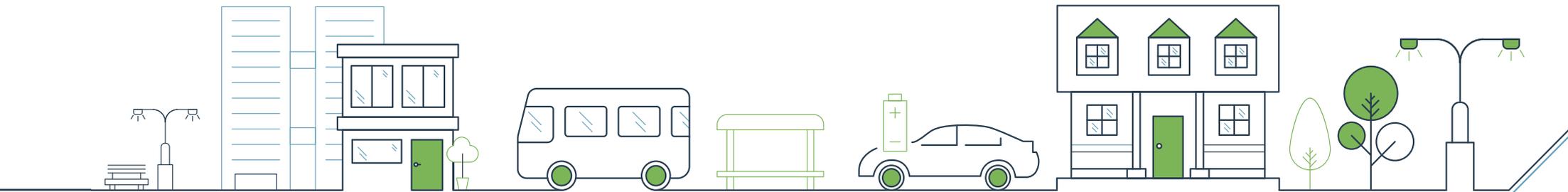
Throughout RIIO-ED1, we have worked to embed climate resilience into our operations by progressing our flood mitigation works, engaging with industry, and supporting our customers including those most vulnerable. We have also progressed a number of initiatives in line with our Adaptation Action Plan and Implementation and Improvement Plan to forge ahead with our Climate Resilience Strategy before we entered RIIO-ED2 in April 2023.

**For progress to date on our identified adaptation actions as part of our Climate Resilience Strategy, please see Appendix 1.**



*During RIIO-ED1 we made significant progress in improving our understanding of climate adaptation and have shown our commitment to ensuring the future resilience of our network by embedding climate adaptation into business as usual and supporting our stakeholders along the way. We look forward to continuing this work into RIIO-ED2, and beyond, to ensure we stand up to the changing climate around us.*

**Shirley Robertson**  
SSEN's Head of Strategic  
Planning and Sustainability



# WHO WE ARE

We are the electricity Distribution Network Operator (DNO) responsible for delivering power to 3.9 million homes and businesses across central southern England and the north of Scotland. We serve some of the most diverse and unique geographies across the UK, and keep customers and communities connected whilst developing the flexible electricity network vital to achieving net zero.

Our network serves some of the UK's most remote communities and also some of the most densely populated. Our two networks cover the greatest land mass of any of the UK's DNOs, covering 72 local authority areas and 75,000km<sup>2</sup> of extremely diverse terrain.

## OUR DISTRIBUTION NETWORK AT A GLANCE

Over **3.9million** homes and businesses

More than **888,000** customers on our Priority Services Register

Over **128,000km** of overhead lines and underground cables

Over **460km** of subsea cables powering our island communities

Over **4,100** employees across the country

*Figures as of October 2023*



# PURPOSE OF THIS UPDATE

The purpose of this Strategic Update and Progress Report is to outline updates to the original Climate Resilience Strategy, published as part of our RII0-ED2 business plan (Appendix 2), following learnings we took from the 2022-2023 storm season and other considerations since we published our plan. It also aims to provide stakeholders with a transparent account of our progress to date against our Climate Resilience Strategy actions.

This update also considers changes to the UK legislative landscape. Every five years, the UK Government produces an assessment of the risks and opportunities posed by climate change and reports on how the UK will adapt to them in its National Adaptation Programme publication. This year, the UK Government published its Third National Adaptation Programme (NAP3) which sets out the work that the UK Government and its partners are doing to protect the natural environment, homes, businesses, and public services from the impacts of climate change for the 2023-2028 period.

Alongside this, the UK Government also published its strategy towards the fourth round of climate adaptation reporting (ARP4). The strategy realigned reporting to better inform future statutory UK Climate Change Risk Assessments and National Adaptation Programmes. We have sought to update our Climate Resilience Strategy and associated outputs to reflect these changes.

Therefore, this strategy is intended to provide a holistic overview of, and clear rationale for, our actions that will ensure the future resilience of our business and provide actual benefits to customers. It also provides an update of wider resilience work taken to date and demonstrates how stakeholders will help to shape this going forward e.g. through continued engagement on our strategy and focus areas, as well as their role in specific climate resilience initiatives at a local level such as utilising our 'Powering Communities to Net Zero' fund.



# THE CLIMATE CHANGE CHALLENGE

## Introduction

Climate change poses several physical and non-physical risks to all manner of businesses; however, some of these risks have been much more present in recent years for civil engineering infrastructure such as our own electricity distribution network. Storms Arwen, Malik, Otto, and Eunice, amongst others, all posed new challenges to our network and the increase in extreme weather events demands a focus on climate change adaptation.

## The impact of climate change on our business

We operate in two distinct geographic regions: Northern Scotland and Central Southern England. These two regions differ in many ways including their geographic characteristics, current climates conditions, and their projected climatic changes.

Our Climate Resilience Strategy (Appendix 2) utilised the climate projections from the UK Climate Projects 2018 (UKCP18), provided by the Met Office and approved by the UK Government, to estimate future weather patterns in both of our licence areas.

## CLIMATE CHANGE PROJECTIONS IN SCOTLAND

In general, Northern Scotland is expected to experience warmer and wetter winters, with more intense rainfall events; and hotter, drier summers, with greater extremes. Average temperatures are projected to increase across all seasons. Intense rainfall events are expected to increase whilst there will generally be reduced frost and snowfall. Sea levels are predicted to rise gradually which will see more frequent and harsher storms on the coast.

## CLIMATE CHANGE PROJECTIONS IN ENGLAND

Our licence area in Central Southern England (including the cities of Reading, Basingstoke, Guildford, Southampton and all or part of Oxfordshire, Berkshire, Surrey, Hampshire, and Wiltshire) is expected to get warmer with summer heatwaves becoming more frequent and intense. Summer rainfall is projected to decrease, while winter rainfall will increase. The intensity of rainy days, in all seasons, is set to increase.

**For more detail on the projections and associated impacts on our network for various types of physical risk, please see Section 2 of Appendix 2.**



# OUR APPROACH TO ADAPTATION

## Introduction

Our approach for effectively managing climate resilience and adaptation has been developed with guidance from principals within ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and Guidelines. Figure 1 below outlines our approach taken.

 <b>BASELINE</b>	Understanding our network, including its characteristics and operational management
 <b>ESTABLISH CLIMATE SCENARIOS</b>	Establishing probable climate projections based upon the latest research
 <b>ASSESSMENT OF IMPACTS</b>	Assessing risks and opportunities comprehensively, covering systemic direct and indirect impacts
 <b>DEVELOPMENT OF ADAPTATION PATHWAYS</b>	Developing solutions for key risks and the assembly and implementation of an adaptation plan including pathways for decision making
 <b>MONITORING AND EVALUATION</b>	Assessing, informing and reviewing the adaptation plan and pathways to ensure resilience progress is evaluated
 <b>REPORTING AND COMMUNICATING</b>	Communicating progress to stakeholders and customers

Figure 1: Our Approach to Climate Adaptation

For more information, please see Section 3 of Appendix 2.



# CLIMATE CHANGE IMPACTS ON OUR BUSINESS

## Direct and indirect impacts

### DIRECT IMPACTS

As part of our involvement in the Energy Networks Association (ENA) working group on Climate Change Resilience, and utilising the UKCP18 projections, 15 potential direct impacts of climate change to our assets and operations were identified by the ENA and the Department for Environment, Food and Rural Affairs (DEFRA). These 15 risks, listed below, describe how temperature, drought, flooding, lightning, and wildfires can directly impact our overhead lines, underground cable systems, substations, network earthing systems, switchgear, and overall demand on our system.

- (AR1)** Overhead line conductors affected by temperature rise, reducing rating and ground clearance
- (AR2)** Overhead line structures affected by summer drought and consequent ground movement
- (AR3)** Overhead lines affected by interference from vegetation due to prolonged growing season
- (AR4)** Underground cable systems affected by increase in ground temperature, reducing ratings
- (AR5)** Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage
- (AR6)** Substation and network earthing systems adversely affected by summer drought conditions, reducing the effectiveness of the earthing systems
- (AR7)** Transformers affected by temperature rise, reducing rating
- (AR8)** Transformers affected by urban heat islands and concurrent air conditioning demand leading to overloading in summer months
- (AR9)** Switchgear affected by temperature rise, reducing rating
- (AR10)** Substations affected by river flooding due to increased winter rainfall
- (AR11)** Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter
- (AR12)** Substations affected by sea flooding due to increased sea levels and/or tidal surges
- (AR13)** Substations affected by floodwater waves from dam-bursts
- (AR14)** Overhead lines and transformers affected by increasing lightning activity
- (AR15)** Overhead lines and underground cables affected by extreme heat and fire/smoke damage



Figure 2: SSEN interdependencies

### INTERDEPENDENCIES

Our own stakeholders, and those relying on other systems, often depend upon the interconnections of services: if one system experiences service failure then this can often have cascading impacts on other systems.

Therefore, as well as the direct impacts from climate change on our network, we have identified a number of key areas of interdependency with our network. Recognising these interdependencies allows us to fully understand the impact that effective resilience of our operations can provide with the changing climate in our licence areas.

Figure 2 shows our identified interdependencies including other utilities and major infrastructure, our customers, and the local environment.

**For more information on our identified interdependencies and indirect impacts from climate change, please see Section 4.2 of Appendix 2.**

## Other impacts and opportunities

We have a number of pressing direct and indirect impacts imposing on our network that are associated with climate change in our licence areas. However, there are a range of other impacts that have been considered in the creation of our Climate Resilience Strategy, including wider economic and social impacts. There are also several opportunities that present themselves at the same time.

### ECONOMIC IMPACTS

There may be several significant changes that the local and global economy may see as a result of climate change in the coming years, given the risk to infrastructure and the increasing demand for electricity. Some of these changes include the need to enhance existing infrastructure, which in turn sees increased demand on global supply chains and the risks and opportunities associated with supporting the low carbon economy as climate change mitigation becomes more paramount. Additionally, given that electricity demand is projected to raise three-fold by 2050, the approach to financing the electricity network sector by Ofgem and the Department for Energy Security and Net Zero (DESNZ), with input from the industry, will be critical to ensuring long-term resilience.

### SOCIAL IMPACTS

The impacts of climate change on society as a whole are becoming more and more clear, as can be seen from extreme weather events in our licence areas to those around the globe. There must be a particular focus on those most vulnerable as well as the safety and wellbeing of our own staff.

We recognise that vulnerable customers such as the elderly or those on low-income are specifically prone to suffer more in climatic events that disrupt ordinary life. We are committed to engaging purposefully with our stakeholders and anticipating their needs, in order to continue to deliver positive outcomes for our customers and their communities.

### OPPORTUNITIES

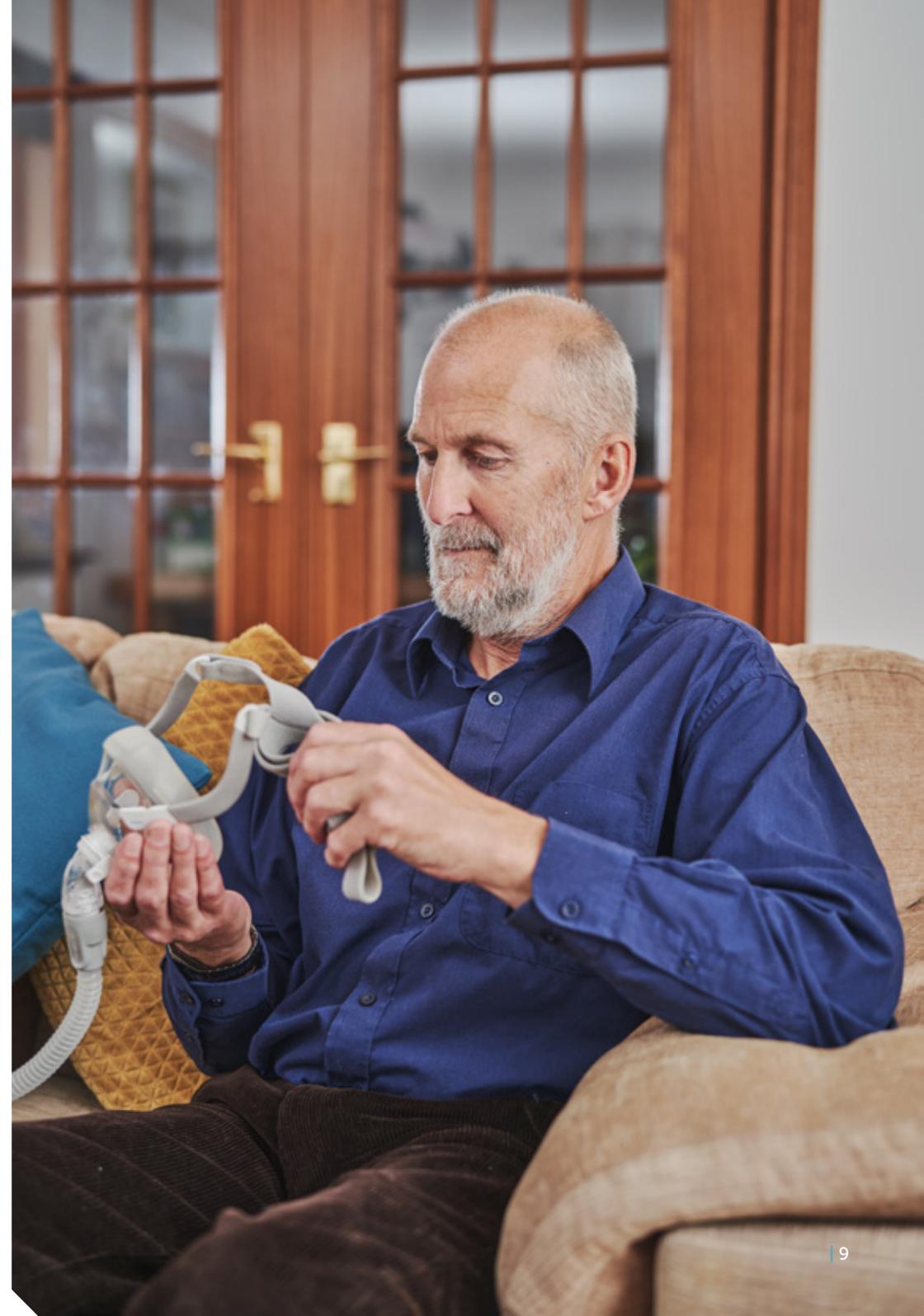
Whilst climate change projections largely pose risk to our operations and assets through both direct and indirect impacts, there are also some opportunities that can be realised.

In addition to the economic and social opportunities in supporting the net zero transition and providing continued support to our stakeholders, there are several opportunities in relation to direct impacts on our system.

With average temperatures being projected to increase across all seasons in Scotland, there are certain advantages that will lead to less risk in some areas and overall efficiencies. Examples of this include less loading of the system and less ice accretion on overhead lines, reducing the risk to structural integrity, due to warmer winter months. Additionally, reduced cold spells may result in easier maintenance due to better road and air access during the winter months for our operational teams.

There will also be a rise in technical knowledge that will be acquired whilst preparing for extreme climates which presents opportunities to our business and workforce.

**For more information on wider impacts and opportunities, please see Section 4.3 of Appendix 2.**



## Assessing climate risks

Risk is a product of impact and likelihood, and we have assessed the risks of climate change against the 15 risks to electricity networks, defined by DEFRA and the ENA, using the industry standard approach outlined in Table 1, below. These risks were assessed for each of our national areas to take account of the localised effects of climate change and understand the relative priorities across these areas.

		IMPACT				
		Limited	Minor	Moderate	Significant	Extreme
LIKELIHOOD	Almost Certain	5 / moderate	10 / major	15 / major	20 / severe	25 / severe
	Likely	4 / moderate	8 / moderate	12 / major	16 / major	20 / severe
	Possible	3 / minor	6 / moderate	9 / moderate	12 / major	15 / major
	Unlikely	2 / minor	4 / moderate	6 / moderate	8 / moderate	10 / major
	Very Unlikely	1 / minor	2 / minor	3 / minor	4 / moderate	5 / moderate

Table 1: Risk Assessment Matrix

For more information, please see Section 3.1 of Appendix 2.

## CLIMATE RISKS BETWEEN NOW AND 2050

Across our 15 direct climate change risks, a general trend of increased risk is seen as we move towards the year 2050. Risk ratings are assigned a score out of 20 based upon severity and probability. Our most severe risk, both at present and projected in 2050, is river, pluvial and sea flooding. Some risks are expected to reduce in severity and probability as we move towards 2050 with new technologies being increasingly introduced and adopted. Table 2 outlines these climate risks and their risk rating now and in 2050.

We are collaborating with the industry through the Energy Networks Associated Climate Change Resilience Working Group (ENA CCRWG) to align our approach to climate resilience to ensure the long-term physical resilience of our networks and to assess additional physical and transitional risks associated with climate change. Through continued active participation in this engagement, we plan to update our adaptation risk matrix to reflect learnings from recent extreme weather events and reflect any movements to critical thresholds based upon the latest research.

We plan to publish this update in the next strategic update in alignment with the next round of adaptation reporting, ARP4. We will continue to actively collaborate with industry via the ENA CCRWG, as well as work with the stakeholders identified in our Climate Resilience Strategy, to further develop our understanding of indirect and interdependent climate risks across the regions in which we operate.

Table 2 outlines these climate risks and their risk rating now and in 2050.

Adaptation Risk	Risk Rating in 2023	Risk Rating in 2050	Trend
(AR1) Overhead line conductors affected by temperature rise, reducing rating and ground clearance	9	12	⬆️
(AR2) Overhead line structures affected by summer drought and consequent ground movement	2	4	⬆️
(AR3) Overhead lines affected by interference from vegetation due to prolonged growing season	9	9	↔️
(AR4) Underground cable systems affected by increase in ground temperature, reducing ratings	10	10	↔️
(AR5) Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage	1	2	⬆️
(AR6) Substation and network earthing systems adversely affected by summer drought conditions, reducing the effectiveness of the earthing systems	6	6	↔️
(AR7) Transformers affected by temperature rise, reducing rating	6	4	⬇️
(AR8) Transformers affected by urban heat islands and concurrent air conditioning demand leading to overloading in summer months	4	4	↔️
(AR9) Switchgear affected by temperature rise, reducing rating	8	6	⬇️
(AR10) Substations affected by river flooding due to increased winter rainfall	20	20	↔️
(AR11) Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter	20	20	↔️
(AR12) Substations affected by sea flooding due to increased sea levels and/or tidal surges	20	20	↔️
(AR13) Substations affected by water flood wave from dam-bursts	5	5	↔️
(AR14) Overhead lines and transformers affected by increasing lightning activity	6	6	↔️
(AR15) Overhead lines and underground cables affected by extreme heat and fire/smoke damage	9	12	⬆️

Table 2: SSEN's Key Climate Change Risks between now and 2050

## Adaptation Pathways

An appropriate decision-making approach is needed to address the uncertainties in climate change projections to ensure long term resilience. We utilise the concept of 'Adaptation Pathways', as outlined in *ISO 14090:2019*, which allows us to take actions under the uncertainty that climate change poses our network in the future. This approach allows us to plan, prioritise and stagger investment in our adaptation options based on thresholds and trigger points to assess the decision required and incorporate flexibility into our adaptation plans.

**For more information, please see Section 3.2 of Appendix 2.**



# EMBEDDING RESILIENCE AS BUSINESS AS USUAL

## Flood mitigation

With 'substations affected by flooding' being our highest rated direct climate risk on our risk matrix, (Table 2), we are focussed on embedding flood resilience into our business-as-usual operations. Our work programme to improve flood mitigation at our sites is governed by allowances received from our regulator, Ofgem, that we predict to align with the ENA Engineering Technical Report 138. Therefore, over the RIIO-ED1 period, we have invested £16.63m on investigation works and flood mitigation measures across both of our licence areas.

As we enter RIIO-ED2, we are continuing a focus on flood mitigation works to ensure our resilience to the changing climate in both of our licence areas. Our RIIO-ED2 allowances for flood mitigation amount to £21.8m for the price control period. Amongst other investments, we plan to carry out flood risk assessments at the sites identified in our register of at-risk substations, which will inform appropriate mitigation measures for the site where necessary. We also plan to improve our relationship with local water authorities and companies, to increase our local knowledge of risks to our substations and enable a collaborative approach to flood mitigation.

## Industry engagement

### ENA CLIMATE CHANGE RESILIENCE WORKING GROUP

We actively participate in the ENA CCRWG. The ENA is the trade association representing the energy network companies in the UK and Ireland, of which SSEN is a member.

The ENA CCRWG has been established to ensure the long-term physical resilience of energy system networks against both direct and indirect impacts, and to assess the additional physical and transitional risks associated with climate change. This includes considering and responding to the latest available data or projections of climate change impacts across Great Britain, and identifying the ways in which climate change risks facing the networks may change as the years progress. In doing this we will also recognise the impact of increased demand on our networks as we move towards a net zero future.

Through this working group, we have contributed to industry collaboration workstreams and supported academic partnerships including the DESNZ 'Climate Services for a Net Zero Resilient World' (CS-N0W) project. We have also engaged with other UK Government agencies and academia through this working group, and we remain committed to supporting this work going forward.

### LESSONS LEARNT

Following the series of extreme weather events experienced during the winter of 2021/22, including Storm Arwen, we committed to review and investigate the actions and recommendations identified in internal reviews as well as reviews conducted by Scottish Government, DESNZ and Ofgem. Through these reviews, there were 137 actions and recommendations identified, all of which have been closed and completed through engagement with our stakeholders including the ENA and other DNOs where relevant.

Following these events, we actively worked to reduce the risk of outages on our network in the event of a storm by investing £1.2m into undergrounding overhead lines and replacing secondary substations. The undergrounding measures reduced the risk of trees falling on our lines causing outages and replacing the substations allows for mobile generation to be fitted to the town centres in an event of a storm where needed.

Additionally, we committed to working with the Met Office to expand and enhance research into future severe weather risks and planning assumptions for the electricity sector. A successful cross-industry workshop was held, and the Met Office has agreed to hold annual climate change workshops, in which we will continue to actively participate in.



**More information on our industry engagement, and how they have progressed our Climate Resilience Strategy to date, can be found in Appendix 1.**

## Fault forecasting

Our Data and Analytics team has built sophisticated models to simulate different future scenarios in order to identify the associated impacts to our network. These models will enable us to drive planning, intervention and investment decisions thus reducing risk from these impacts.

During RIIO-ED1, we have successfully undergone trials of our Weather-driven Fault Volume Forecasting model, which aims to understand and improve our response times to faults that may occur due to changes in the short-term weather forecasts. Understanding fault predictions allows for improved resource planning and deployment, with the ultimate benefit of reducing Customer Minutes Lost (the average number of minutes that a customer has their supply interrupted) and Customer Interruptions (the number of supply interruptions recorded as a percentage of customers connected in a year).

Moving forward into RIIO-ED2, we plan to create a more advanced fault prediction model with longer-term fault volume forecasting capability. This model will aim to improve our understanding of the root causes of faults with more certainty, considering both weather and non-weather-related faults in alignment with the ENA Engineering Technical Report 132. The benefits of this longer-term forecasting include supporting improve resource planning and deployment driving interventions and driving network improvement and investment planning by resolving underlying root causes.

We are committed to progressing and improving this work in order to drive longer term planning of the network thus aiding the future resilience of our network.

## Climate-related disclosures

Climate disclosures provide a channel to elevate climate challenges, informing decisions and driving change to deliver a net zero economy. SSE plc has structured its climate-related disclosures against the Taskforce on Climate-related Financial Disclosures (TCFD) recommendations since 2018. As part of SSE plc, key risks and opportunities associated with our distribution network are considered as part of these group-wide climate disclosures.

SSE's Net Zero Transition Plan sets out the key actions we will take to drive progress towards its net zero ambitions, and the interim Science-based Targets aligned to a 1.5°C pathway, with input from all the SSE business units. The plan also features cross-cutting actions to recognise the key role that climate adaptation and resilience will play in the transition to net zero. We contribute significantly to these actions, given our role as the DNO in our licence areas across the UK and we will continue to contribute to these outputs throughout RIIO-ED2 and beyond.

Climate-related disclosures are presented in SSE's Annual Report, Sustainability Report, and CDP disclosures. Additionally, SSE's annual Net Zero Transition Report provides a summary and navigational tool which shareholders receive for vote each year. At a group level, we also respond to CDP's Climate Change programme annually and were once again part of the A-list in 2022, receiving an 'A' award.

We also input into SSE's climate risk and resilience reviews ensuring that key risks and opportunities posed to our network are considered. We will continue to contribute to these outputs throughout RIIO-ED2 and beyond.

**For more information, please see SSE's Annual Report and Net Zero Transition Plan.**



## Supporting our customers

Throughout RIIO-ED1 we expanded our fuel poverty activities, widened our partnership network, drove forward the Priority Services Register (PSR), and worked to ensure our services were inclusive and accessible. At the end of 2022/23, we had 853,416 PSR households registered in our licence areas. We also supported 14,744 households, through direct enabling support or critical advice services, and provided point-of-crisis support, removing immediate pressure points, to 1,448 households.

Figure 3 shows our 2022/23 highlights in more detail.

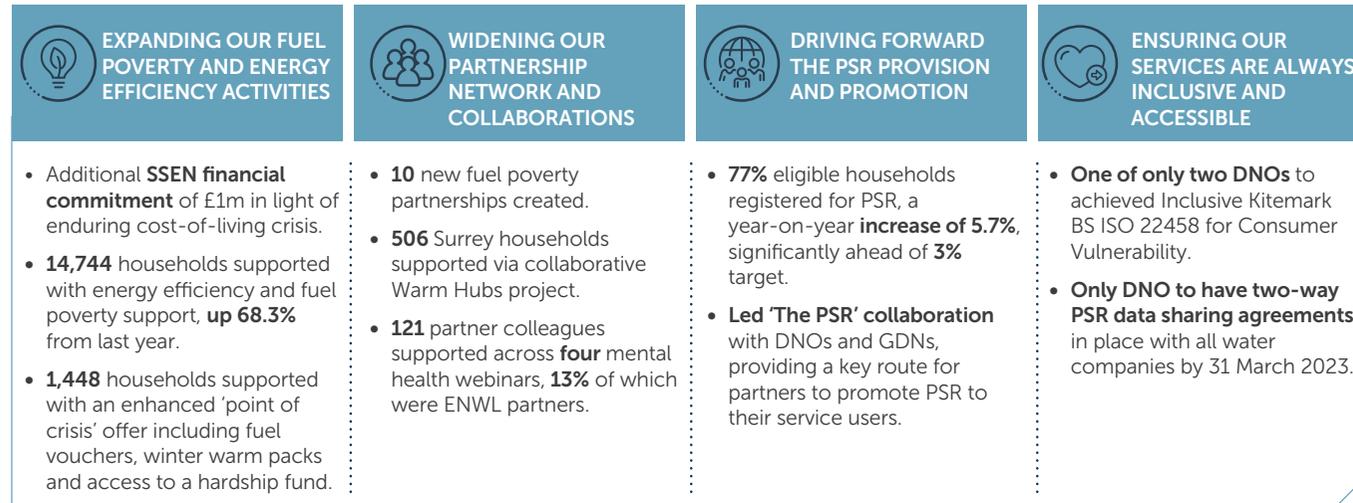


Figure 3: SSEN 2022/23 Customer Highlights

## RESILIENCE FUNDING

Over the past eight years, during RIIO-ED1, the Resilient Communities Fund (RCF) has supported community groups and charities across our electricity distribution network areas in central southern England and the north of Scotland. In that time, the fund has demonstrated the value in helping communities to build resilience for emergency events and protect the welfare of vulnerable community members. As we see increased effects of climate change in our local licence areas, such as more frequent extreme weather and storm events, this support has proved to be increasingly useful for our communities.

Since 2015, the RCF has awarded £4.7m to 680 not-for-profit community groups and charities. 2023/24 represents the final year of the RCF following the conclusion of RIIO-ED1. Commencing in RIIO-ED2, the new 'Powering Communities to Net Zero' fund will be available to support low-carbon technology accessibility initiatives for those in vulnerable situations as well as community-led environmental and resilience schemes.

**For more information on our work to support our customers, please see our 2022/23 Stakeholder Engagement and Consumer Vulnerability Submission.**



# ADAPTATION ACTIONS

## Introduction

We are committed to ensuring climate change risks are managed from the identification and implementation of adaptation measures to the ongoing review and monitoring through our internal risk processes. Policy documents, codes of practice and progress reports will be updated to consider the impact of climate change on the business. A deep understanding of climate change risk will play an important part in business planning. With our Adaptation Action Plan, consideration is given to the actions that should be taken to either reduce the likelihood of occurrence or reduce the severity of impact in a timely manner.

## Our adaptation actions

Following the conclusion of RIIO-ED1, and the work undertaken to date against our original Adaptation Action Plan, we have updated both the plan and our Implementation and Improvement Plan.

Table 3, below, outlines our updated adaptation risk actions for each of our 15 identified potential direct impacts of climate change on our network. A result of our adaptation pathways approach, the below Action Plan addresses the technical aspects of ensuring our business stands up to the changing climate around us.

As we continue to drive our sustainability ambitions, the Action Plan will primarily target improvements in our current processes thus recognising the great work carried out to date and our existing defined processes, as well as avoiding unnecessary costs to our customers. We will review these actions on an annual basis.

Adaptation Risk	Action(s)	2050 Risk	Mitigated Risk	Change to Risk
(AR1) Overhead line conductors affected by temperature rise, reducing rating and ground clearance	<ul style="list-style-type: none"> <li>Review and update design standards for overhead lines, where necessary, to specify the upsizing of capacity to meet future load demands and projected higher temperatures.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	12	9	↓
(AR2) Overhead line structures affected by summer drought and consequent ground movement	<ul style="list-style-type: none"> <li>Undertake a technical review of the impact of summer droughts on ground shrinkage, and the destabilisation of the foundations of single structures and towers, to ascertain the real risk of this occurring and any mitigation required.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	4	4	↔
(AR3) Overhead lines affected by interference from vegetation due to prolonged growing season	<ul style="list-style-type: none"> <li>Explore the use of LiDAR to aid in the management of trees, allowing a better understanding of circuit resilience.</li> <li>Increase the tree cutting cycle frequency from four to three years in SEPD to account for more favourable weather conditions for vegetation growth.</li> <li>Commence project to determine if a tree resilient overhead line can be achieved, to ensure that a line can remain live and safe despite falling trees, using covered conductor and smart technology to detect when a tree has fallen on the line.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	9	6	↓
(AR4) Underground cable systems affected by increase in ground temperature, reducing ratings	<ul style="list-style-type: none"> <li>Investigate and determine the effects of increase in ground temperature on our underground cable systems.</li> <li>Verify the thermal models currently being used for distribution cables.</li> <li>Consider the effects of the changes to cyclic loading to low voltage levels.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	10	8	↓
(AR5) Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage	<ul style="list-style-type: none"> <li>Review and update design standards for the use of ducted systems and joints at high voltage in urban environments, where required, to mitigate the impacts of ground movement.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	2	2	↔

Adaptation Risk	Action(s)	2050 Risk	Mitigated Risk	Change to Risk
(AR6) Substation and network earthing systems adversely affected by summer drought conditions, reducing the effectiveness of the earthing systems	<ul style="list-style-type: none"> <li>Investigate a risk-based approach to inspect and monitor changes in the conditions of network earthing systems.</li> </ul>	6	6	↔
(AR7) Transformers affected by temperature rise, reducing rating	<ul style="list-style-type: none"> <li>Where transformers have radiators, investigate the need for increasing the size of the radiators or the use of water cooling to comply with excess heat and to reduce temperature.</li> <li>Explore the installation of temperature monitors for monitoring conditions in our substations and current primary substations where applicable.</li> </ul>	4	2	↓
(AR8) Transformers affected by urban heat islands and concurrent air conditioning demand leading to overloading in summer months	<ul style="list-style-type: none"> <li>Where transformers have radiators, investigate the need for increasing the size of the radiators or the use of water cooling to comply with excess heat and to reduce temperature.</li> <li>Explore the installation of temperature monitors for monitoring conditions in our substations and current primary substations where applicable.</li> </ul>	4	2	↓
(AR9) Switchgear affected by temperature rise, reducing rating	<ul style="list-style-type: none"> <li>Embed new design standard with the provision for suitable environmental conditions (e.g. increased ventilation, air-con and dehumidification) that will function in line with projected changes to the climate in our regions.</li> <li>Consider the provision for ventilation/air-conditioning in current substations.</li> </ul>	6	2	↓
(AR10) Substations affected by river flooding due to increased winter rainfall	<ul style="list-style-type: none"> <li>Assess the risk and resilience of critical substations affected by pluvial flooding and, where required, develop a local flood mitigation plan.</li> <li>Build and invest in flood mitigation measures for critical substations affected by pluvial flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in line with the ENA Engineering Technical Report 138 which applies to Grid and Primary sites.</li> <li>Investigate automating the management of flooding data and review the Environment Agency and Scottish Environment Protection Agency flood maps as and when they are updated.</li> <li>Work across industries to improve local knowledge of risks to our substations and enable a collaborative approach to flood mitigation.</li> </ul>	20	20	↔
(AR11) Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter	<ul style="list-style-type: none"> <li>Assess the risk and resilience of critical substations affected by pluvial flooding and, where required, develop a local flood mitigation plan.</li> <li>Build and invest in flood mitigation measures for critical substations affected by pluvial flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in line with the ENA Engineering Technical Report 138 which applies to Grid and Primary sites.</li> <li>Investigate automating the management of flooding data and review the Environment Agency and Scottish Environment Protection Agency flood maps as and when they are updated.</li> <li>Work across industries to improve local knowledge of risks to our substations and enable a collaborative approach to flood mitigation.</li> </ul>	20	20	↔
(AR12) Substations affected by sea flooding due to increased sea levels and/or tidal surges	<ul style="list-style-type: none"> <li>Assess the risk and resilience of critical substations affected by pluvial flooding and, where required, develop a local flood mitigation plan.</li> <li>Build and invest in flood mitigation measures for critical substations affected by pluvial flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in line with the ENA Engineering Technical Report 138 which applies to Grid and Primary sites.</li> <li>Investigate automating the management of flooding data and review the Environment Agency and Scottish Environment Protection Agency flood maps as and when they are updated.</li> <li>Work across industries to improve local knowledge of risks to our substations and enable a collaborative approach to flood mitigation.</li> </ul>	20	20	↔

Adaptation Risk	Action(s)	2050 Risk	Mitigated Risk	Change to Risk
(AR13) Substations affected by water flood wave from dam-bursts	<ul style="list-style-type: none"> <li>Continue to monitor the current position regarding dam-bursts and develop and implement a mitigation plan where necessary.</li> </ul>	5	5	↔
(AR14) Overhead lines and transformers affected by increasing lightning activity	<ul style="list-style-type: none"> <li>Continue with the current strategy to use class 2 surge arresters and investigate the latest technology and research where applicable.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	6	6	↔
(AR15) Overhead lines and underground cables affected by extreme heat and fire/smoke damage	<ul style="list-style-type: none"> <li>Explore wildfire risk areas and develop and implement a mitigation plan where necessary.</li> <li>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions.</li> </ul>	9	12	↓

Table 3: Updated SSEN Adaptation Action Plan to Direct Climate Risks

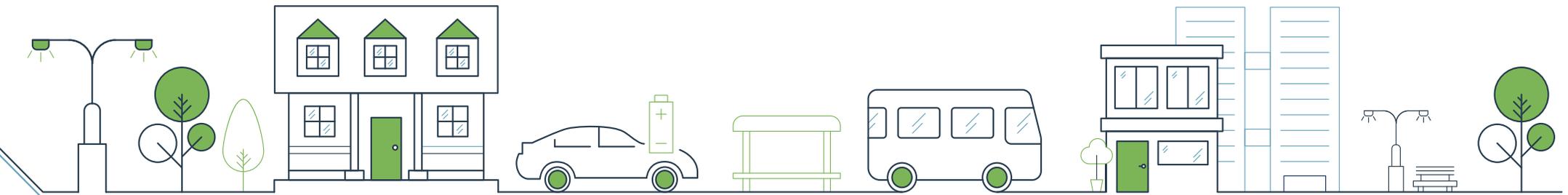


Table 4, below, outlines our updated Implementation and Improvement Plan to demonstrate progress against our Climate Resilience Strategy and improve our approach to climate change adaptation throughout R100-ED2 and beyond. We will review these actions on an annual basis.

Area	Action	Timescale
<b>Assessing Climate Change Risks</b>	Investigate the effects of climate change across our 7 different regions.	2024
	Identify the critical thresholds that will cause our distribution systems to suffer an intolerable shift in performance and undertake threshold analysis. Monitor the proximity and likelihood of exceeding defined climate thresholds.	2024
	Further investigate and analyse our interdependencies to develop a better understanding of the impacts of climate change on our business.	2024
	Investigate additional scenarios and timeframes, which could include an assessment of our risks to climate change at the end of the century and to different climate model scenarios.	2025
	Review and update our climate risk and resilience assessment in conjunction with the ENA CCRWG, including any additional direct climate impacts and risks identified through historical learnings and further research e.g. Wind.	2024
	Identify the climate risks associated with our low-income and vulnerable customers/communities, and work together to manage these risks.	2024
<b>Adaptation Planning</b>	Collaborate with stakeholders to develop an Adaptation Plan for the indirect and interdependent climate risks assessed, as well as other risks associated with climate change.	2025
	Further develop our Adaptation Pathways approach to prioritise our climate change adaptation actions utilising threshold analysis and based upon a multi-criteria 6 capitals approach.	2024
	Continue to embed climate risk and resilience into business as usual (strategic, tactical, operational decision making and investment governance) by establishing clear roles, responsibilities, and leadership within SSEN.	2024
<b>Monitoring and Evaluation</b>	Update policy documents, codes of practice and progress reports to consider the impact of climate change. Develop a specific Climate Resilience Policy.	2024
	Review and update our Adaptation Action Plan and our Implementation and Improvement Plan, including any updates from our climate risk and resilience assessment.	2024
<b>Reporting and Communication</b>	Update customers and the public on action taken to improve our resilience to climate change via our website and newsletter.	Annually
	Actively participate in the ENA Climate Change Resilience Group with other DNOs, collaborating with industry and experts (e.g. supporting the DESNZ CS-NOW programme and any other relevant academic projects or partnerships).	Quarterly
	Deliver climate resilience related reporting including: An Annual Progress Report to Ofgem, highlighting the progress we have made against our Adaptation Plan and Implementation and Improvement Plan; UK Government reporting such as Adaptation Reporting Power and National Adaptation Programme for the fourth round; Contributing to SSE's level reporting including TCFD.	Annually

Table 4: Updated SSEN Implementation and Improvement Plan

**For more information, please see Section 5 of Appendix 2. Our priorities for indirect impacts are summarised in the above sections and Section 4.2 of Appendix 2.**

## Progress to date

**For progress on our Adaptation Action Plan and our Implementation and Improvement Plan to date, please see Appendix 1.**

**More detail and context for each of the actions can be found in Section 5 of Appendix 2.**

# CONCLUSION

Resilience is detailed, complex, and multi-faceted. It requires a risk management plan that considers many factors, variables, and uncertainties. Through our Climate Resilience Strategy, we have demonstrated a commitment to managing the impacts that climate change poses to our business.

During RIIO-ED1, we made significant progress in embedding climate resilience into our operations. Since the RIIO-ED2 business plan submission, we have invested £16.63m into flood mitigation measures at our substations, continued our active engagement with key stakeholders, learned from extreme weather events which affected our network, and progressed our own modelling work to drive network planning and investment decisions.

We have also proven our commitment to our customers and stakeholders by expanding our fuel poverty activities, widening our partnership network, driving forward the PSR provision, and working to ensure our services are inclusive and accessible. At the end of 2022/23, we had 853,416 Priority Services Registered households in our licence areas. We also supported 14,744 households, through direct enabling support or critical advice services, and provided point-of-crisis support, removing immediate pressure points, to 1,448 households. Over the course of RIIO-ED1, our Resilient Communities Fund has awarded £4.7m to 680 not-for-profit community groups and charities and we are committed to continuing to support our communities through RIIO-ED2 with our 'Powering Communities to Net Zero' fund.

We have also progressed our Adaptation Action Plan and our Implementation and Improvement Plan as per Appendix 1.

Although our approach to climate change resilience and adaptation must evolve given the nature of the climate change challenge, we see climate change mitigation, adaptation, and disaster prevention as best reflecting our enduring commitment to our consumers. We look forward to continuing this work into RIIO-ED2, and beyond, to ensure we stand up to the changing climate around us and ensure the future resilience of our network.



# APPENDIX 1

## Adaptation actions progress to date

Table 5 and 6, below, outline progress to date against each of our adaptation actions, from our Adaptation Action Plan and Implementation and Improvement Plan both originally set out in our Climate Resilience Strategy (Appendix 2).

Area	Action	Progress to Date
Assessing Climate Change Risks	<b>Investigate the effects of climate change across our 7 different regions</b>	We actively collaborate with industry and academia through committed participation in the ENA CCRWG. Through this, we engage with the UK and Scottish Governments, the wider industry and academia to inform our approach to climate change resilience. When compiling our Climate Resilience Strategy, we investigated the effects of climate change across our regions by utilising the UKCP18 models. We will further investigate and monitor the effects of climate change across our 7 different regions through the ENA CCRWG, and by utilising any updates to the UKCP models, over the coming years to ensure our plans take account of the latest information and best practice.
	<b>Identify the critical thresholds that will cause our distribution systems to suffer an intolerable shift in performance, and undertake threshold analysis</b>	Through our RIIO-ED2 Climate Resilience Strategy and Environmental Action Plan, we have committed to undertake initiatives to mitigate, and adapt to, the effect of climate change on our network assets. Through continued active participation with industry and academics via the ENA CCRWG, we will look to continually monitor these critical thresholds. In the near term, we plan to update our adaptation risk matrix to reflect learnings from recent extreme weather events. This update will consider movements to the critical thresholds based upon the latest research. We will continue to monitor the impacts of climate change to our network to ensure that our policies and procedures reflect the associated risks so that our network is fit for purpose through RIIO-ED2 and beyond.
	<b>Establish clear responsibilities, roles and leadership within SSEN to own and drive our climate resilience strategy</b>	We have established a Strategic Planning and Sustainability Team within our business to ensure that clear responsibilities, roles and leadership are in place to drive our climate resilience strategy forward to ensure that our network is fit for purpose through RIIO-ED2 and beyond. We have also created an Environment, Social and Governance Subcommittee to focus decision making and governance for wider sustainability considerations including climate risk and resilience.
	<b>Further investigate and analyse our interdependencies to develop a better understanding of the impacts of climate change on our business</b>	Through our RIIO-ED2 Climate Resilience Strategy, we have identified a number of interdependencies that impact our operations, and those that we have an impact on. These include our customers, other utilities and major infrastructure, and the local environment. We will continue to actively collaborate with industry via the ENA CCRWG, as well as working with the stakeholders identified in our Climate Resilience Strategy, to further develop our understanding of interdependencies across the regions in which we operate.
	<b>Investigate additional scenarios and timeframes, which could include an assessment of our risks to climate change at the end of the century and to different climate model scenarios</b>	We will continue to investigate additional scenarios and timeframes through industry/academic collaboration via the ENA CCRWG as the latest research is published. We will continue to support the DESNZ's Climate Services for a Net Zero Resilient World project and other academic partnerships as they arise. Following Storm Arwen in late 2021, we committed to working with the Met Office to expand and enhance research into future severe weather risks and planning assumptions for the electricity sector. A successful cross-industry workshop was held, and the Met Office has agreed to hold annual climate change workshops in which we will continue to actively participate.
	<b>Investigate additional direct climate impacts and risks, such as coastal erosion</b>	We will continue to develop our approach to additional direct physical climate change risks through active collaboration with industry and academia via the ENA CCRWG and through proactive measures such as our internal modelling work. In early 2023, we presented a case to investigate nature-based solutions as options to combat substation flooding as an innovation opportunity at the ENA Energy Innovation Basecamp with positive interest to date. Additionally, as part of our RIIO-ED2 business plan, we secured funding to deliver our 'Life Below Water' Customer Value Proposition (CVP). This CVP will restore approximately 17ha of seagrass across our licence areas, delivering biodiversity, carbon sequestration and community benefits as well as having the potential to deliver protection from coastal erosion. We will provide updates on these initiatives in our next strategic update report.
Adaptation Planning	<b>Establish clear responsibilities, roles and leadership within SSEN to own and drive our climate resilience strategy</b>	We have established a Strategic Planning and Sustainability Team within our business to ensure that clear responsibilities, roles and leadership are in place to drive our climate resilience strategy forward to ensure that our network is fit for purpose through RIIO-ED2 and beyond. We have also created an Environment, Social and Governance Subcommittee to focus decision making and governance for wider sustainability considerations including climate risk and resilience.
	<b>Collaborate with stakeholders to develop an Adaptation plan for the indirect and interdependent climate risks assessed</b>	Through our RIIO-ED2 Climate Resilience Strategy, we have identified a number of interdependencies that impact our operations, and those that we have an impact on. These include our customers, other utilities and major infrastructure, and the local environment. We will continue to actively collaborate with industry via the ENA CCRWG, as well as working with the stakeholders identified in our Climate Resilience Strategy, to further develop our understanding of indirect and interdependent climate risks across the regions in which we operate.

Adaptation Planning

**Develop an Adaptation Plan for other risks associated with climate change**

Our Adaptation Pathways will be updated in the next strategic update in late 2024 to align with the next round of adaptation reporting, ARP4.

**Further Develop Adaptation Pathways to prioritise our climate change adaptation actions**

Our Adaptation Pathways will be updated in the next strategic update in late 2024 to align with the next round of adaptation reporting, ARP4.

**Investigate the use of making future climate adaptation decisions based upon a multi-criteria “six capitals” approach**

We will continue to develop our approach in this area and aim to test the multi-criteria in our decision-making process in relation to adaptation decisions over the coming reporting period.

**Embed climate risk and resilience into business as usual strategic, tactical, and operational decision making and investment governance**

Climate risk and resilience is considered as part of our business as usual strategic, tactical, and operational decision making and investment governance. We have established a Strategic Planning and Sustainability team within our business to ensure that climate risk and resilience is considered within our asset strategy and governance processes. We have also created an Environment, Social and Governance Subcommittee to focus decision making and governance for wider sustainability considerations including climate risk and resilience.

During RIIO-ED1, significant investments into flood mitigation were made to ensure the resilience of the substations on our network. Across RIIO-ED1, a total of £16.63m was invested into investigation works and flood mitigation measures across both of our licence areas. We also progressed innovation projects such as Informed Lightning Protection, which trialled the use of surge arresters to protect circuits against lightning strikes, with 450 surge arresters installed during RIIO-ED1. All of this work is to be continued into RIIO-ED2, with flood mitigation being securely embedded as business as usual.

As well as this, our Data and Analytics team has created fault-forecasting models to enable more informed and precise resource allocation and network improvement. These have been in place for a number of years and are under constant development.

Additionally, following Storm Arwen and in conjunction with other DNOs, we have further embedded climate resilience into business as usual through several initiatives including: investing £1.2m into risk mitigation measures, clarifying roles and responsibilities between us and our resilience partners; enhancing non-digital communications during prolonged outage events; and stress testing our telephony and IT infrastructure.

Reporting and Communication

**Develop a climate resilience policy**

We are part of SSE plc and we have a shared Climate Change Policy, outlining SSE’s approach to implementing actions that mitigate and adapt to the impacts of climate change, and also ensure that climate-related risks and opportunities are integrated into both strategic and operational decision making. We adhere to the requirements of this policy, and will ensure that the SSEN Distribution continues to meet these requirements over the coming reporting period.

**Submit an annual progress report to Ofgem, highlighting the progress we have made against our adaptation plan and improvement implementation plan.**

Our Climate Resilience Strategy is available on our website and our first progress report is due to be published in October 2023.

**Actively participate in the Climate Change Resilience Group established in early 2021 with other ENA members**

We actively participate in the ENA CCRWG and will continue to do so over the coming reporting period to ensure the long-term physical resilience of our network and to assess the additional physical and transitional risks associated with climate change.

**Support BEIS’ Climate Services for a Net Zero Resilient World programme**

We have actively supported the Department for Energy Security and Net Zero’s Climate Services for a Net Zero Resilient World (CS-NOW) project and other academic and UK Government partnerships through the ENA CCRWG.

**Identify the climate risks associated with our low-income and vulnerable customers/ communities, and work together to manage these risks**

Our Customer Service Team continually monitors and updates our Priority Services Register to ensure our most vulnerable customers are provided with extra help and support during a power cut. During the coming reporting period we will work with our Customer Service Team to ensure that we identify the climate risks associated with the customers on our Priority Services Register to ensure we can manage these risks effectively.

Following Storm Arwen, and in conjunction with other DNOs, we clarified roles and responsibilities between us and our resilience partners, enhanced non-digital communications during prolonged outage events, improved the refund and compensation process mechanisms, and reaffirmed our position to make voluntary payments on a case-by-case basis.

Additionally, in RIIO-ED1, we awarded £4.7m to 680 not-for-profit community groups and charities through the Resilient Communities Fund. The fund was aimed at helping communities in our licence areas to build resilience for emergency events and protect the welfare of vulnerable community members. We will continue this work through RIIO-ED2 via our ‘Powering Communities to Net Zero’ fund.

Reporting and Communication	<b>Continue to contribute to TCFD reporting with updated climate risk and resilience assessment results</b>	Since the implementation of our RIIO-ED2 Climate Resilience Strategy, we have continued to contribute to TCFD reports via SSE, and also provided input to climate risk and resilience reviews, ensuring that key risks and opportunities posed to our network are considered. We will continue to do this moving forward throughout RIIO-ED2.
	<b>Update customers and the public on action taken to improve our resilience to climate change via our website and newsletter</b>	Our RIIO-ED2 Climate Resilience Strategy is available on our website and our first progress report is due to be published in October 2023. In RIIO-ED1, we updated our stakeholders on our flood mitigation work and our resilience-related innovation projects through our Annual Environment Report. During RIIO-ED1, a total of £16.63m was invested into investigation works and flood mitigation measures across both of our licence areas. We also progressed innovation projects such as Informed Lightning Protection, which trialled the use of surge arresters to protect circuits against lightning strikes, with 450 surge arresters installed during RIIO-ED1. All of this work is to be continued into RIIO-ED2, with flood mitigation being securely embedded as business as usual. We also regularly update stakeholders on other initiatives undertaken via our website, such as our response to Storm Arwen.
Monitoring and Evaluation	<b>Update policy documents, codes of practice and progress reports to consider the impact of climate change</b>	Climate risk and resilience is considered as part of our business as usual strategic, tactical, and operational decision making and investment governance. We have established a Strategic Planning and Sustainability team within our business to ensure that climate risk and resilience is considered within our asset strategy and governance processes. We have also created an Environment, Social and Governance Subcommittee to focus decision making and governance for wider sustainability considerations including climate risk and resilience. We will continue to monitor the impacts of climate change to our network, to ensure that our policies and procedures reflect the associated risks, so that our network is fit for purpose into RIIO-ED2 and beyond.
	<b>Deliver Adaptation Reporting and National Adaptation Programme for the 4th round.</b>	We provided a response to the UK Government consultation on the proposals for the fourth round of reporting under the Adaptation Reporting Power (ARP) in early 2023, and will report in the fourth round when it opens in late 2024.
	<b>Review and update our climate risk and resilience assessment</b>	Our climate risk and resilience assessment is currently being reviewed via the ENA CCRWG with an update expected in 2024/25.
	<b>Review and update our adaptation plan</b>	As part of the strategic update, published in October 2023, we have reviewed and updated our strategic actions and we will report progress against these in our next update report. Our climate risk and resilience assessment is currently being reviewed via the ENA CCRWG with an update expected in 2024/25 when we will update our adaptation plan accordingly.
	<b>Monitor proximity and likelihood of exceeding defined climate thresholds</b>	Through our RIIO-ED2 Climate Resilience Strategy and Environmental Action Plan, we have committed to undertaking initiatives to mitigate, and adapt to, the effect of climate change on our network assets. Through continued active participation with industry and academics via the ENA CCRWG, we will look to continually monitor these critical thresholds. In the near term, we plan to update our adaptation risk matrix to reflect learnings from recent extreme weather events. This update will consider movements to the critical thresholds based upon the latest research. We will continue to monitor the impacts of climate change to our network to ensure that our policies and procedures reflect the associated risks so that our network is fit for purpose into RIIO-ED2 and beyond.

Table 5: Progress Update on Original SSEN Climate Resilience Implementation and Improvement Plan

Adaptation Risk	Action(s)	Progress to Date
<b>(AR1) Overhead line conductors affected by temperature rise, reducing rating and ground clearance</b>	Review and update design standards for overhead lines to specify the upsizing of capacity to meet future load demands and projected higher temperatures.	Considering the impact on ratings and ground clearance of our overhead lines from increased average temperatures due to climate change, we have increased our minimum design standards for overhead lines, for both low and high voltage applications, in line with our Environmental Action Plan.
<b>(AR2) Overhead line structures affected by summer drought and consequent ground movement</b>	Undertake technical review of the impact of summer droughts on ground shrinkage, and the destabilisation of the foundations of single structures and towers, to ascertain the real risk of this occurring and any mitigation required.	Droughts experienced to date have not impacted overhead line foundations. However, we will continue to monitor the impact on our structures and modify our standards and policies as necessary.
<b>(AR3) Overhead lines affected by interference from vegetation due to prolonged growing season</b>	<p>Use of LiDAR to aid in the management of trees is being explored allowing a better understanding of circuit resilience to be amassed.</p> <p>Tree cutting cycle frequency increased from 4 to 3 years to maintain current risk score in SEPD as climate is more favourable. Frequency remaining at 4 years for SHEPD.</p> <p>A project to determine if a tree-resilient overhead line has been instigated. The idea is to ensure that the line can remain live but also safe with a tree having fallen onto it. This will use covered conductor and smart technology to detect when a tree has fallen on the line.</p>	We have a statutory duty to identify and address vegetation intrusions to our overhead lines to keep them within safe limits. In order to build greater efficiency into managing these works, we are investigating and seeking funding for a new data management and modelling solution to target vegetation management through a risk-based approach, instead of relying on cyclical survey requirements. The need is currently being assessed through internal governance channels.
<b>(AR4) Underground cable systems affected by increase in ground temperature, reducing ratings</b>	<p>Investigate and determine the effects of increase in ground temperature on underground cable systems.</p> <p>Verify the thermal models of the cables currently being used for distribution cables.</p> <p>Consider the effects of the changes to cyclic loading to LV levels.</p>	Considering the impact on ratings of our underground cables from increased average temperatures due to climate change, we have increased our minimum design standards for underground cables in line with our Environmental Action Plan. This increase in cable sizing has mitigated the current projected increase in ground temperature in our licence areas. However, we will continue to monitor this and develop mitigation and management policies as necessary.
<b>(AR5) Underground cable systems affected by summer drought and consequent ground movement, leading to mechanical damage</b>	Review and update (if required) design standard for the use of ducted systems and joints at high voltage in urban environments to mitigate the impacts of the drying out of soils.	Our internal investigations have concluded that this would primarily be a risk to areas with clay soil where the ducts fill with soil during periods of ground movement. We are continuing to investigate this to determine a mitigation and management process. Design standards will be updated as necessary.
<b>(AR6) Substation and network earthing systems adversely affected by summer drought conditions, reducing the effectiveness of the earthing systems</b>	Investigate a risk-based approach to inspect and monitor changes in conditions of network earthing systems.	Our internal investigations have concluded that current Global Earthing System specifications mitigate the projected impacts of increases in earthing resistance. We are continuing to investigate this, in particular in relation to islanded systems, and will continue to apply a risk-based approach to the inspection routine.
<b>(AR7) Transformers affected by temperature rise, reducing rating</b>	<p>Where transformers have radiators, investigate the need for increasing the size of the radiators or the use of water cooling to comply with excess heat and reduce temperature.</p> <p>Explore installation of temperature monitors for monitoring temperature conditions in distribution substations and current primary substations where applicable.</p>	Preliminary findings of our internal investigations have suggested that this impact is seen most significantly in secondary substations as opposed to primary or grid substations. We have been piloting load verification at a few of our secondary substations. We will look to commence further investigations into temperature monitoring in the coming reporting period.

<p><b>(AR8) Transformers affected by urban heat islands and concurrent air conditioning demand leading to overloading in summer months</b></p>	<p>Where transformers have radiators, investigate the need for increasing the size of the radiators or the use of water cooling to comply with excess heat and reduce temperature.</p> <p>Explore installation of temperature monitors for monitoring temperature conditions in distribution substations and current primary substations where applicable.</p>	<p>Preliminary findings of our internal investigations have suggested that this impact is seen most significantly in secondary substations as opposed to primary or grid substations. We have been piloting load verification at a few of our secondary substations. We will look to commence further investigations into temperature monitoring in the coming reporting period.</p>
<p><b>(AR9) Switchgear affected by temperature rise, reducing rating</b></p>	<p>New design standard will have the provision for suitable environmental conditions (e.g. increased ventilation, air-con and dehumidification) that will function in line with climate changes.</p> <p>Consider the provision for ventilation/air-conditioning in current substations.</p>	<p>Our current primary and grid substation switchgear is rated to run at 40oC. Our current policies reflect the need for ventilation, air conditioning and dehumidification where containerised solutions are employed. We plan to undertake a literature review to determine whether this issue is being researched within the academic and industrial communities, and whether there are any projects being undertaken or planned so that we can consider any outputs and learnings.</p>
<p><b>(AR10) Substations affected by river flooding due to increased winter rainfall</b></p>	<p>Assess risk and resilience of critical substations affected by river flooding and where required develop a local flood mitigation plan.</p> <p>Build and invest in flood mitigation measures for critical substations affected by river flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in guidance with ETR138 which applies to Grid / Primary sites.</p> <p>Consider the use of flooding maps developed by EA and SEPA.</p>	<p>During RIIO-ED1, significant investments in flood mitigation were made to ensure the resilience of the substations on our network. Across RIIO-ED1, a total of £16.63m was invested into investigation works and flood mitigation measures across both of our licence areas.</p> <p>We are currently undertaking additional assessment and works required to align with the industry standard ENA Engineering Technical Report 138 across our fleet of primary substations. We have also assessed both the Scottish Environment Protection Agency and the Environment Agency pluvial, fluvial, and coastal flood risk data to identify primary substations at risk. We have completed desktop and on-site surveys to identify investment works required and the delivery of capital works to provide flooding protection where necessary.</p> <p>Additionally, we are seeking to kick-off an innovation project to investigate how Nature-based Solutions may provide a more efficient and collaborative approach to providing flooding resilience to assets. We are preparing applications to secure innovation funding to progress this project.</p>
<p><b>(AR11) Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter</b></p>	<p>Assess risk and resilience of critical substations affected by river flooding and where required develop a local flood mitigation plan.</p> <p>Build and invest in flood mitigation measures for critical substations affected by river flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in guidance with ETR138 which applies to Grid / Primary sites.</p> <p>Consider the use of flooding maps developed by EA and SEPA.</p>	<p>During RIIO-ED1, significant investments in flood mitigation were made to ensure the resilience of the substations on our network. Across RIIO-ED1, a total of £16.63m was invested into investigation works and flood mitigation measures across both of our licence areas.</p> <p>We are currently undertaking additional assessment and works required to align with the industry standard ENA Engineering Technical Report 138 across our fleet of primary substations. We have also assessed both the Scottish Environment Protection Agency and the Environment Agency pluvial, fluvial, and coastal flood risk data to identify primary substations at risk. We have completed desktop and on-site surveys to identify investment works required and the delivery of capital works to provide flooding protection where necessary.</p> <p>Additionally, we are seeking to kick-off an innovation project to investigate how Nature-based Solutions may provide a more efficient and collaborative approach to providing flooding resilience to assets. We are preparing applications to secure innovation funding to progress this project.</p>

<b>(AR12) Substations affected by sea flooding due to increased sea levels and/or tidal surges</b>	<p>Assess risk and resilience of critical substations affected by river flooding and where required develop a local flood mitigation plan.</p> <p>Build and invest in flood mitigation measures for critical substations affected by river flooding (e.g. raising individual sites above the flood level or the installation of temporary barriers). Continue to develop substations in guidance with ETR138 which applies to Grid / Primary sites.</p> <p>Consider the use of flooding maps developed by EA and SEPA.</p>	<p>During RIIO-ED1, significant investments in flood mitigation were made to ensure the resilience of the substations on our network. Across RIIO-ED1, a total of £16.63m was invested into investigation works and flood mitigation measures across both of our licence areas.</p> <p>We are currently undertaking additional assessment and works required to align with the industry standard ENA Engineering Technical Report 138 across our fleet of primary substations. We have also assessed both the Scottish Environment Protection Agency and the Environment Agency pluvial, fluvial, and coastal flood risk data to identify primary substations at risk. We have completed desktop and on-site surveys to identify investment works required and the delivery of capital works to provide flooding protection where necessary.</p> <p>Additionally, we are seeking to kick off an innovation project to investigate how Nature-based Solutions may offer a more efficient and collaborative approach to providing flooding resilience to assets. We are preparing applications to secure innovation funding to progress this project.</p>
<b>(AR13) Substations affected by water flood wave from dam-bursts</b>	<p>Continue to monitor the current position regarding dam-bursts and take action where necessary.</p>	<p>We are looking to investigate this work in the coming period in order to inform any immediate risks to our substations.</p>
<b>(AR14) Overhead lines and transformers affected by increasing lightning activity</b>	<p>Continue with the current strategy to use class 2 surge arresters.</p>	<p>During RIIO-ED1, we progressed innovation projects such as Informed Lightning Protection, which trialed the use of surge arresters to protect circuits against lightning strikes. We installed 450 surge arresters across both of our licence areas during RIIO-ED1. We will continue the use of these surge arresters during RIIO-ED2.</p> <p>We also successfully trialed our internal Weather-Related Fault Forecasting Model during RIIO-ED1, and will progress this work into RIIO-ED2 in order to enhance our understanding of risks to our network by enabling machine-learning capabilities.</p>
<b>(AR15) Overhead lines and underground cables affected by extreme heat and fire/smoke damage</b>	<p>Explore wildfire risk areas and look towards prevention methods.</p>	<p>We have yet to commence our investigations into the impacts on our overhead lines and underground cables affected by extreme heat and fire smoke damage. We will look to instigate this work during the coming reporting period.</p> <p>During RIIO-ED1, we successfully trialed our internal Weather-Related Fault Forecasting Model during RIIO-ED1, and will progress this work into RIIO-ED2 in order to enhance our understanding of risks to our network by enabling machine-learning capabilities.</p>

Table 6: Progress Update on Original SSEN Adaptation Action Plan

## APPENDIX 2

### Additional information

SSEN Distribution Climate Resilience Strategy, RIIO-ED2 Business Plan Annex 7.3

#### LOCATION

<https://www.ssen.co.uk/globalassets/about-us/sustainability/documents/ssen-climate-resilience-strategy-progress-report-.pdf>

## CONTACT US

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