# CLIMATE CHANGE ADAPTATION REPORT – FOURTH ROUND

SSEN Distribution

December 2024

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# EXECUTIVE SUMMARY

**Electricity networks, in common with other civil infrastructure, will be affected by the physical impacts, as well as the societal and financial impacts, of climate change. This report provides an update on the progress we've made in adapting to climate change risks since the previous round of reporting in December 2021. The report specifically encompasses, qualifies and expands on the Fourth Round Climate Change Adaptation Report produced by the Energy Networks Association for Gas and Electricity Transmission and Distribution Network Companies.**

The report is structured in accordance with the fourth-round reporting guidance provided by the Department for Environment, Food and Rural Affairs and focusses on:

- Describing how we manage and embed climate change action in SSEN Distribution.
- Providing updates to our climate change risk assessment and adaptation plan.
- Outlining our approach to identifying and managing interdependencies.

# ACRONYMS

| Reference | Title |
|---|---|
| ARP | Adaptation Reporting Power |
| CCAR | Climate Change Adaptation Report |
| CCRWG | ENA Climate Change Resilience Working Group |
| CS-N0W | Climate Services for a Net Zero Resilient World |
| DEC | Distribution Executive Committee |
| DEFRA | Department for Environment, Food and Rural Affairs |
| DESNZ | Department for Energy Security & Net Zero |
| DNO | Distribution Network Operator |
| E3C | Energy Emergencies Executive Committee |
| EAP | Environmental Action Plan |
| ENA | Energy Networks Association |
| ESG | Environment, Social and Governance |
| ETR | Engineering Technical Report |
| FTSE-100 | Financial Times Stock Exchange 100 Index |
| ISO | International Organisation for Standardisation |
| LIDAR | Laser Imaging Detection and Ranging |
| NbS | Nature-based Solutions |
| Ofgem | Office of Gas and Electricity Markets |
| PSR | Priority Service Register |
| RCP | Representative Concentration Pathway |
| RIIO ED2 | Revenue=Incentive + Innovation + Outputs – Electricity Distribution 2 |
| SSEN | Scottish and Southern Electricity Networks |
| SEPD | Southern Electric Power Distribution |
| SHEPD | Scottish Hydro Electric Power Distribution |
| TCFD | Task Force on Climate-Related Financial Disclosures |

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|---|---|
| UK | United Kingdom |
| UKCP | UK Climate Projection |
| VFES | Vulnerability Future Energy Scenarios |

# REFERENCES

Table 1: Scottish and Southern Electricity Networks Documents

| Reference | Title |
|---|---|
| SSEN CCAR3 | SSEN Climate Change Adaptation Report Third Round December 2021 |
| RIIO-ED2 Business Plan Annex 7.3 | SSEN Distribution Climate Resilience Strategy 2021 |
| SSEN-D CRSSUPR2023 | SSEN-Distribution Climate Resilience Strategy – Strategic Update and Progress Report 2023 |
| SSEN-D AER2023/24 | SSEN-Distribution Annual Environmental Report 2023/24 |

Table 2: External Documents

| Reference | Title |
|---|---|
| ENA CCAR4 | ENA 4th Round Climate Change Adaptation Report December 2024 |
| ENA ETR 132 | Improving resilience of overhead networks under abnormal weather conditions using a risk-based methodology |
| ENA ETR 138 | Resilience to flooding of Grid and Primary substations |

# INTRODUCTION

## Organisational profile

Scottish and Southern Electricity Networks (SSEN) is the trading name of the two Distribution businesses and one Transmission business that form part of the FTSE-100 energy company, SSE. This report focuses on the two Distribution businesses - Scottish Hydro Electric Power Distribution plc (SHEPD), that operates to the north of the central belt of Scotland, and Southern Electric Power Distribution plc (SEPD), that operates in central southern England - collectively known as Scottish and Southern Electricity Networks Distribution.

We're a regulated business and operate under a licence issued by Ofgem. Our business plan and revenues are approved by Ofgem for periodic price controls, and we're currently delivering our RIIO-ED2 business plan, running from 2023-2028.

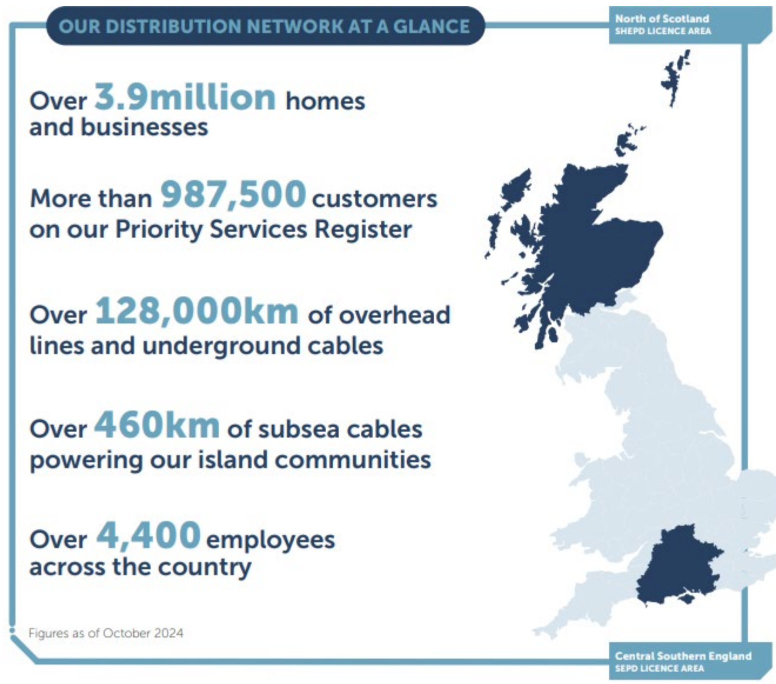


Figure 1: Summary of SSEN Distribution

Our core purpose is to safely deliver the electricity that powers communities, now and in the future. We keep the lights on and deliver electricity to over 3.9 million homes and businesses across our two regions, whilst playing a pivotal role in the transition to a lower-carbon economy.

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 Distribution Network Operators (DNOs), covering 72 local authority areas and 75,000km$^2$ of extremely diverse terrain. Figure 1 provides a summary of our organisational context.

This report specifically encompasses, qualifies and expands on the Fourth Round Climate Change Adaptation Report produced by the Energy Networks Association (ENA) for Gas and Electricity Transmission and Distribution Network Companies. The ENA report can be accessed here and should be read in conjunction with this report. The ENA report intentionally provides information at an industry level. We've used the ENA report as the basis for this individual report and included company specific information to report on the progress we've made since the Third Round Climate Change Adaptation Report - December 2021.

## Governance, management and strategy

In 2021, we developed our Climate Resilience Strategy where we took a top-down, system-wide view of our assessment of climate risks for our SHEPD and SEPD licence areas to identify the critical points of our network and specific vulnerabilities to climate change. As part of our involvement with the ENA Third Round Climate Change Adaptation Reporting, we identified 15 direct adaptation risks which 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. More information on these adaptation risks can be found in the Understanding Risks and Challenges section.

Our approach for effectively managing climate resilience and adaptation, as outlined in figure 2, has been developed with guidance from principals within ISO 14090:2019 Adaptation to Climate Change – Principles, Requirements and Guidelines. Our Climate Resilience Strategy contains an implementation and improvement plan and a climate resilience adaptation plan which contain specific climate change adaptation objectives. The strategy is managed by our Environment & Sustainability team who work with teams across the business to deliver the strategic objectives which aim to improve the businesses adaptive capacity.

Figure 2: Our Approach to Climate Adaptation

Progress is reported to the SSEN Distribution Environmental, Social & Governance (ESG) Subcommittee on a regular basis. This subcommittee is convened to agree the sustainability and environmental strategic direction of the business and monitor performance, they operate under delegated authority of the Distribution Executive Committee (DEC). The subcommittee is composed of Directors and Senior Managers from across the business and reports into the DEC as and when required.

As part of SSE plc, we also have a Group Climate Change Policy, which outlines the group's approach to mitigate and adapt to the impacts of climate change and ensure that climate-related risks and opportunities are integrated into both strategic and operational decision making.

We've committed to providing updates to customers and the wider public on action taken to improve our resilience to climate change. Our Climate Resilience Strategy and annual progress reports are available on our website, with our second progress report included in our 2023/24 Annual Environmental Report.

# UNDERSTANDING RISKS AND CHALLENGES

We're 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 plays 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.

Since ARP3 we have updated both our Climate Resilience Adaptation 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 Action Plan below 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.

An internal adaptation action monitoring document has been created to track the progress against our Climate Resilience Adaptation Plan and overall progress is reported annually to our stakeholders. We also review our Climate Resilience Adaptation Plan annually to ensure actions remain suitable, adequate and effective. A six-monthly update on the progress of our climate resilience strategy is also presented to our Environment, Social and Governance (ESG) Subcommittee.

In order to provide comparison between the reporting rounds, the risk assessment has been repeated for ARP 4 using the ARP 3 risk matrices which are based on industry progression in mitigating or managing climate change impacts, utilising the information and predictions set out in the Met Office Report provided for the Energy Networks Association in November 2020. The risk assessment has been extended to consider a future climate scenario of 4°C rise by 2100 using UKCP18 RCP 8.5 projections across our 15 direct adaptation risks. The Energy Networks Association combined Risk Matrices can be found in the ENA Fourth Round Climate Change Adaptation Report.

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

Table 3: Progress update on our Climate Resilience Adaptation plan

| Risk Code | Risk | Description | ARP3 Risk Score | Action(s) | Progress to Date | ARP4 Risk Score | 2050 Risk | 2050 Confidence Rating | 2100 Risk | 2100 Confidence Rating |
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| **AR1** | Overhead line conductors affected by temperature rise | Despite the thermal expansion of conductors being considered when being designed to account for sag, lines exposed to frequent and prolonged extreme temperatures by UK standards may cause the sag to exceed current overhead line design parameters. This could increase the number of incidents where conductor clearance limits are compromised. Increasing temperatures also impact on the capacity of the conductors. Conductors are designed to operate at their maximum efficiency up to a maximum core temperature, and as air temperature increases it becomes difficult for the heat from the conductor to radiate. As the core temperature increases so does | 9 | 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.<br><br>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions. | Considering the impact on ratings and ground clearance of our overhead lines from increased average temperatures due to climate change, we've increased our minimum design standards for overhead lines, for both low and high voltage applications, in line with our Environmental Action Plan. We've continued work on our internal weather-related fault forecasting model to support improved resource planning and drive network improvements. | 9 | 12 | Medium | 15 | Low |

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| | | resistance within the conductor reducing its ability to carry current, thus reducing its capacity. | | | | | | | | |
| **AR2** | Overhead line structures affected by summer drought and consequent ground movement | Rising temperatures can dry the ground, causing ground shrinkage. This applies movement to structures built on top of it, leading to instability of the foundations. Overhead line foundations are vulnerable to this process. | 6 | 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.<br><br>Progress the internal weather-related fault-forecasting model workstream, and utilise learnings to drive network planning and investment decisions | Droughts experienced to date have not impacted overhead line foundations. However, we'll continue to monitor the impact on our structures and modify our standards and policies as necessary. We've continued work on our internal weather-related fault-forecasting model to support improved resource planning and drive network improvements. | 2 | 4 | Low | 9 | Low |
| **AR3** | Overhead lines affected by interference from | Increasing temperature and precipitation encourages increased vegetation growth. | 8 | Explore the use of LiDAR to aid in the management of trees, allowing | We've a statutory duty to identify and address vegetation intrusions to our | 9 | 9 | Medium | 9 | Low |

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| | vegetation due to prolonged growing season | Accelerated growth in trees increases the occurrence of physical damage to overhead lines where trees adjacent to these structures impact them. | | a better understanding of circuit resilience.<br><br>Increase the tree-cutting cycle frequency from four to three years in SEPD to account for more favourable weather conditions for vegetation growth.<br><br>Commence a project to determine if a tree-resilient overhead line can be achieved, which would 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.<br><br>Progress the internal weather-related fault-forecasting model workstream and utilise learnings to | overhead lines to keep them within safe limits. To build greater efficiency into managing these works, we're investigating new data management and modelling solutions to target vegetation management requirements through a risk-based approach, instead of relying on cyclical survey requirements. We've amended our cyclical tree cutting policy in SEPD to aim for a 3-year cycle and are monitoring performance. Investigations are continuing into improved fault detection and automation systems to determine if a tree resilient overhead line can be achieved. And we've continued work on our internal weather-related fault-forecasting model to support improved resource planning and drive network improvements. | | | | | |

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| | | | | drive network planning and investment decisions. | | | | | | |
| **AR4** | Underground cable systems affected by increase in ground temperature | Cables are designed to operate at their maximum efficiency up to a maximum core temperature. But as the ground temperature increases significantly it becomes difficult for the heat from the conductor to radiate; as the core temperature increases so does resistance within the conductor reducing its ability to carry current and thus reducing its capacity. | 9 | Investigate and determine the effects of increase in ground temperature on our underground cable systems.<br><br>Verify the thermal models currently being used for distribution cables. Consider the effects of the changes to cyclic loading to low voltage levels.<br><br>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions. | Considering the impact on ratings of our underground cables from increased average temperatures due to climate change, we've 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'll continue to monitor this and develop mitigation and management policies as necessary. We've also continued work on our internal weather-related fault forecasting model to support improved resource planning and drive network improvements. | 10 | 10 | High | 15 | High |

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| **AR5** | Underground cable systems affected by summer drought and consequential ground movement | Ground movement caused by drying and shrinkage will exert tensile forces on cables. Whilst cables have an inherent tensile strength, joints in the network are more vulnerable and can fail by being pulled apart. Extreme wet-dry and freeze-thaw ground movements will create a similar impact. | 6 | 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. Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions. | 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're continuing to investigate this to determine a mitigation and management process. Design standards will be updated as necessary. And we've continued work on our internal weather-related fault forecasting model to support improved resource planning and drive network improvements. | 1 | 2 | Medium | 4 | Low |
| **AR6** | Substation and network earthing systems adversely affected by summer drought conditions | Drought seasons deprive soil of moisture thereby increasing soil resistivity, thus reducing the effectiveness of electricity passing through the earthing system. Where earthing design parameters are exceeded, system and public safety issues can | 6 | Investigate a risk-based approach to inspect and monitor changes in the conditions of network earthing systems | Our internal investigations have concluded that current global earthing system specifications mitigate the current projected impacts of increases in earthing resistance. We're continuing to investigate this, | 6 | 6 | Medium | 9 | Low |

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| | | arise with reduced touch potential distances or failure to fully dissipate fault currents, leaving live and exposed metal components in and outside the site boundary. | | | particularly in relation to islanded systems, and will continue to apply a risk-based approach to the inspection routine. | | | | | |
| **AR7** | Transformers affected by temperature rise | Transformers are designed to operate within specified temperature parameters. However, as air temperature increases, it becomes more difficult to expel the heat created by the transformation process, consequently transformers can begin to overheat reducing capacity and life expectancy and, in extreme cases, causing catastrophic failure of the unit. | 6 | 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.<br><br>Explore the installation of temperature monitors for monitoring conditions in our substations and current primary substations where applicable. | 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've been piloting load verification at a few of our secondary substations, and we'll look to commence further investigations into temperature monitoring in the future. | 6 | 4 | Medium | 6 | Low |
| **AR8** | Transformers affected by urban heat islands and coincident air | As a result of increased air conditioning and ventilation use to cope with rising temperatures, some | 9 | Where transformers have radiators, investigate the need for | Preliminary findings of our internal investigations have suggested that this impact is seen most | 4 | 4 | High | 6 | Low |

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| | conditioning demand | network operators are seeing little difference between summer and winter customer electricity demand when previously winter was significantly more demanding. Increased demand can overload transformers, causing tripping and supply loss. | | increasing the size of the radiators or the use of water cooling to comply with excess heat and to reduce temperature.<br><br>Explore the installation of temperature monitors for monitoring conditions in our substations and current primary substations where applicable. | significantly in secondary substations as opposed to primary or grid substations. We've been piloting load verification at a number of our secondary substations, and we'll look to commence further investigations into temperature monitoring in the future. | | | | | |
| **AR9** | Switchgear affected by temperature rise | Switchgear is designed to international standards, however there are recorded days where switch room ambient temperatures have exceeded the switchgear's operational maximum as a result of prolonged periods of hot weather. In such cases, switchgear may reduce in capacity, or in extreme cases, cause improper operation or loss of supply, thereby damaging the network. Increased temperature can also raise the | 4 | 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.<br><br>Consider the provision for ventilation/air-conditioning in | Our current primary and grid substation switchgear is rated to run at 40°C. 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 | 8 | 6 | High | 8 | Low |

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| | | potential for faults or maloperation. | | current substations. | whether there are any projects being undertaken or are being planned so that we can consider any outputs and learnings | | | | | |
| **AR10** | Substations affected by river (fluvial) flooding due to increased winter rainfall. | Flood water, regardless of its source, can physically damage plant and equipment. Additionally, water ingress can cause faulting within assets and the network, leading to extensive loss of supply. Consequential repair or replacement of assets is costly and time-consuming. Network operators will often choose to switch out plant and equipment in order to avoid water ingress, causing a fault and uncontrolled shut down. | **9** | Assess the risk and resilience of critical substations affected by river flooding and, where required, develop a local flood mitigation plan.<br><br>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 line with the ENA Engineering Technical Report 138 which applies to Grid and Primary sites. | We've continued to develop our flood risk assessment process and have completed further surveys and assessments across our licence areas to inform our decision making, for where flood mitigation investment is needed the most, as well as effective planning for the rest of RIIO-ED2. We've also delivered flood mitigation works to one site for our communities in SHEPD. Additionally, we've progressed our Nature for Networks innovation project to investigate how nature-based solutions may provide a more efficient and collaborative approach to providing flood resilience to assets, | 20 | 20 | High | 25 | High |

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| | | | | 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. | and we're seeking further funding to expand the project to specific use cases. | | | | | |
| **AR11** | Precipitation - substations affected by pluvial (flash) flooding due to increased rainstorms in Summer and Winter | Flood water, regardless of its source, can physically damage plant and equipment. Additionally, water ingress can cause faulting within assets and the network, leading to extensive loss of supply. Consequential repair or replacement of assets is costly and time-consuming. Network operators will often choose to switch out plant and equipment in order to avoid water ingress, causing a fault and uncontrolled shut down. | **6** | Assess the risk and resilience of critical substations affected by river flooding and, where required, develop a local flood mitigation plan.<br><br>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 line with the ENA | We've continued to develop our flood risk assessment process and have completed further surveys and assessments across our licence areas to inform our decision making, for where flood mitigation investment is needed the most, as well as effective planning for the rest of RIIO-ED2. We've also delivered flood mitigation works to one site for our communities in SHEPD. Additionally, we've progressed our Nature for Networks innovation project to investigate how nature-based solutions may | 20 | 20 | High | 25 | High |

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| | | | | Engineering Technical Report 138 which applies to Grid and Primary sites.<br><br>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. | provide a more efficient and collaborative approach to providing flood resilience to assets, and we're seeking further funding to expand the project to specific use cases. | | | | | |
| **AR12** | Precipitation - substations affected by sea flooding due to increased rainstorms and/or tidal surges | Flood water, regardless of its source, can physically damage plant and equipment. Additionally, water ingress can cause faulting within assets and the network, leading to extensive loss of supply. Consequential repair or replacement of assets is costly and time-consuming. Network operators will often choose to switch out plant and equipment in order to avoid water ingress, causing a fault | 8 | Assess the risk and resilience of critical substations affected by river flooding and, where required, develop a local flood mitigation plan.<br><br>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 | We've continued to develop our flood risk assessment process and have completed further surveys and assessments across our licence areas to inform our decision making, for where flood mitigation investment is needed the most, as well as effective planning for the rest of RIIO-ED2. We've also delivered flood mitigation works to one site for our communities in SHEPD. Additionally, | 20 | 20 | High | 25 | High |

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| | | and uncontrolled shut down. | | installation of temporary barriers). Continue to develop substations in line with the ENA Engineering Technical Report 138 which applies to Grid and Primary sites.<br><br>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. | we've progressed our Nature for Networks innovation project to investigate how nature-based solutions may provide a more efficient and collaborative approach to providing flood resilience to assets, and we're seeking further funding to expand the project to specific use cases. | | | | | |
| **AR13** | Precipitation - substations affected by water flood wave from dam burst | Where substations 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 substations are close enough to dams to be | **5** | Continue to monitor the current position regarding dam burst and develop and implement a mitigation plan where necessary. | We're looking to investigate this work in the future to inform any immediate risks to our substations. | 5 | 5 | Medium | 10 | Low |

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| | | impacted by the full force of a breach, the damage to a substation would be substantial. Plant and equipment would not only be impacted by water ingress but are likely to be physically damaged or washed away. It would not be possible to re-establish supply without fully reconstructing and recommissioning the site. | | | | | | | | |
| **AR14** | Overhead lines and transformers affected by increasing lightning activity | Increased storm frequency can lead to an increased lightning strike frequency. Where lightning strikes exposed substation plant or, more likely, overhead line assets, the resulting surge will cause circuits to trip under fault condition. In extreme cases, strikes will lead to physical damage to the assets or a loss of generation, leading to other network protection systems operating and leading to loss of supply. | **6** | Continue with the current strategy to use Class 2 surge arresters and investigate the latest technology and research where applicable.<br><br>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions. | During RIIO-ED1, we installed 450 surge arresters across both of our licence areas and will continue to monitor and assess future changes in technology and research. We've also continued work on our internal weather-related fault forecasting model to support improved resource planning and drive network improvements | 6 | 6 | Low | 9 | Low |

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| **AR15** | Overhead lines and underground cables affected by extreme heat and fire smoke damage | Despite being a result of increased temperatures and reduced precipitation, wildfires pose a significant risk to overhead line structures and conductors where they are located in susceptible areas (e.g. open heathland). Operational telecommunication systems can also be threatened from this scenario, potentially disabling control of the network and risking loss of supply. | **6** | Explore wildfire risk areas and develop and implement a mitigation plan where necessary.<br><br>Progress the internal weather-related fault forecasting model workstream and utilise learnings to drive network planning and investment decisions. | We'll look to commence our investigations into future potential impacts on our overhead lines and underground cables from extreme heat and fire/smoke damage. Also, we've continued work on our internal weather-related fault-forecasting model to support improved resource planning and drive network improvements. | 9 | 12 | Medium | 12 | Low |

# INTERDEPENDENT AND CASCADING RISKS

**The operation of our organisation depends upon interconnections and services of other organisations, sectors and communities and the impact resulting from the service failure of one can have cascading impacts on the others. Understanding and managing our interdependencies in a changing climate is critical to fully understanding the resilience of our operations and how we could potentially impact the resilience of others.**

Since ARP3, we've explored and mapped our critical interdependencies through collaborative engagement with colleagues, our customers, other key infrastructure operators and the Government. Our interdependency map is shown in Figure 3 with the arrows indicating the dependencies. For example, our customers are dependent on us to distribute electricity to them, but they can also impact our ability to supply by changing their energy demand, such as by using more air conditioning in warmer summer conditions. Further information on the breakdown of our interdependencies is available in our Climate Resilience Strategy.


Figure 3: SSEN Distribution Climate Change Interdependency Map

In our Climate Resilience Strategy Implementation and Improvement Plan we've committed to:

- Further investigate and analyse our interdependencies to develop a better understanding of the impacts of climate change on our business.
- 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.

We're working with the ENA Climate Change Resilience Working Group (CCRWG) and other relevant forums such as the newly formed Climate Ready Infrastructure Forum for operators and owners of infrastructure in Scotland to further develop our approach to assessing and managing interdependencies. Under the terms of the Civil Contingencies Act, we are a Category Two responder and work closely with other utilities, the emergency services and local authorities on local emergency planning arrangements. At the national level, we support work by the Department for Energy Security & Net Zero (DESNZ) such as participating in the Energy Emergencies Executive Committee (E3C). We've also participated in national and city level climate resilience workshops and are monitoring the regional adaptation partnerships initiating and mobilising across the areas in which we operate. At a high level we've risk-assessed three key interdependencies from loss of communications, disruption to logistics and supply chain and road access issues from climate change. We'll be embedding the learnings from our activities into future adaptation plans, using the latest tools and guidance and ensuring interdependent risks are integrated into future risk assessments, and ranked and prioritised in terms of the scale of impact that cascading risks have on functional delivery.

# ADAPTATION ACTION PLAN AND IMPLEMENTATION

**We're committed to delivering our Climate Adaptation and Mitigation Plan to address the risks and opportunities from the impact of climate change on our business. We've developed adaptation actions for the 15 potential direct impacts of climate change that we've identified for our network, along with developing an implementation and improvement plan for delivering our Climate Resilience Strategy. Progress against our plans is regularly monitored with actions and priorities adjusted as needed.**

Table 3 in the Understanding Risks and Challenges section, and Table 4 below, detail our adaptation risk action plan and our implementation and improvement plan and they also both provide a summary of progress made since the third climate change adaptation report, SSEN CCAR3. The ownership (at directorate level) and anticipated timescales for the actions (Short Term - under 2 years, Medium Term - under 5 years, Long Term - over 5 years) have been added for the fourth round of reporting.

An internal adaptation action monitoring document has been created to track the progress against both plans by the Strategic Planning and Sustainability team and overall progress is reported annually to our stakeholders. We also review our adaptation action plan and our implementation and improvement plan annually to ensure actions remain suitable, adequate and effective. A six-monthly update on the progress of our climate resilience strategy is also presented to our Environment, Social and Governance (ESG) Subcommittee.

Table 4: Progress Update on our Climate Resilience Strategy Implementation and Improvement Plan

| Action | Timescale | Ownership | Progress since ARP3 |
|---|---|---|---|
| **Assessing climate change risks** | | | |
| Investigate the effects of climate change across our seven different regions. | Short term | Asset Management and Operations | • Initial risk assessment at licence area level.<br>• Further risk assessment for four key climate hazards under DESNZ 'Climate Services for a Net Zero Resilient World' (CS-N0W) research programme 2021-25. |

| Action | Timescale | Ownership | Progress since ARP3 |
|---|---|---|---|
| | | | • Completed climate change adaptation risk assessments for our 13 SEPD permitted sites.<br>• Developing regional climate resilience plans. |
| 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. | Medium term | Asset Management | • Identified critical thresholds / climate hazards need to monitor and implemented adaption risk actions which aim to reduce the likelihood of crossing thresholds. |
| Further investigate and analyse our interdependencies to develop a better understanding of the impacts of climate change on our business | Short term | Asset Management | • Refer to Interdependent and Cascading Risks section above. |
| 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 | Medium term | Asset Management | • Extended risk assessment to consider future climate scenario of 4°C rise by 2100 using UKCP18 RCP8.5 projections across 15 direct adaptation risks (AR1–AR15). |
| 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 | Medium term | Asset Management | • Extended risk assessment to consider future climate scenario of 4°C rise by 2100 using UKCP18 RCP8.5 projections across 15 direct adaptation risks (AR1–AR15). |
| Identify the climate risks associated with our low-income and vulnerable customers/communities, and work together to manage these risks | Short term | Asset Management and Customer Services | • Refreshed our **Consumer Vulnerability Strategy.**<br>• Delivered Vulnerability Future Energy Scenarios (VFES) innovation project which accurately predicts where communities are less resilient, less affluent, and more seriously affected by prolonged or frequent power cuts.<br>• Working with our Priority Services Register (PSR) customers piloting tailored Personal Resilience Plans to help them know what to do during power cuts, provisioning battery packs to those who depend on electricity for medical reasons |

| Action | Timescale | Ownership | Progress since ARP3 |
|---|---|---|---|
| | | | and preparing power cut resilience packs.<br>• Launched our 'Powering Communities to Net Zero' £3m fund with half available to support community-led physical and environmental resilience schemes. |
| **Adaptation planning** | | | |
| 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 | Medium term | Asset Management and Operations | • Collaborated via ENA CCRWG with Governments, industry and academia to further investigate indirect, interdependent and cascading climate risks.<br>• Participated in national and city level climate resilience workshops to help define our approach. |
| 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 | Medium term | Asset Management | • Identified critical thresholds / climate hazards need to monitor and implemented adaption risk actions which aim to reduce the likelihood of crossing thresholds.<br>• Investigating use of Nature-based Solutions (NbS) (refer to Best Practice Case Studies section below). |
| 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. | Continually | Asset Management and ESG Committee | • Strategic Planning and Sustainability Team drives our climate resilience strategy with oversight from Environment, Social and Governance (ESG) Subcommittee.<br>• Increased climate change awareness across directorates through internal engagement and external climate resilience training targeting senior leaders. |
| **Monitoring and evaluation** | | | |
| Update policy documents, codes of practice and progress reports to consider the impact of climate change. Develop a specific Climate Resilience Policy. | Short term | Asset Management | • Increased minimum design standards for overhead lines and underground cables to mitigate against higher average temperatures. |

| Action | Timescale | Ownership | Progress since ARP3 |
|---|---|---|---|
| | | | • Integrated climate change planning into management system of our SEPD permitted sites.<br>• SSE plc Group Climate Change Policy outlines our approach. |
| Review and update our Adaptation Action Plan and our Implementation and Improvement Plan, including any updates from our climate risk and resilience assessment. | Medium term | Asset Management | • Extended risk assessment to consider future climate scenario of 4°C rise by 2100 using UKCP18 RCP8.5 projections across 15 direct adaptation risks (AR1–AR15).<br>• Developing regional climate resilience plans. |
| **Reporting and communication** | | | |
| Update customers and the public on action taken to improve our resilience to climate change via our website and newsletter | Annually | Asset Management | • Climate Resilience Strategy and annual progress reports published on our website. |
| Actively participate in the ENA CCRWG with other DNOs, collaborating with industry and experts (e.g., supporting the DESNZ CS-N0W programme and any other relevant academic projects or partnerships). | Continually | Asset Management | • Actively participate in the ENA CCRWG with the current focus on the CS-N0W research programme, ARP4 reporting and Climate Resilience metrics. |
| 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; Government reporting such as Adaptation Reporting Power and National Adaptation Programme for the fourth round; contributing to SSE group-level reporting including TCFD. | As per reporting requirement | Asset Management | • Climate Resilience Strategy and annual progress reports published on our website.<br>• ENA CCAR4 and SSEN-D CCAR4 reports being submitted December 2024.<br>• Contributed to SSE Group Annual and Sustainability Reports. |

# BEST PRACTICE CASE STUDIES

## Network flood mitigation measures

**As part of our RIIO-ED2 Environmental Action Plan we secured £21.8m of funding to protect our network from the risk of flooding and improve the resilience of our network to climate change. We're currently undertaking a programme of work to ensure that all of our primary substations meet the requirements of ETR138 - Resilience to flooding of Grid and Primary substations. This work involves carrying out flood mitigation surveys and implementing flood defence works where required. We monitor the progress of these works on a monthly basis as part of our environmental and sustainability key performance indicators.**

An example of completed network flood mitigation projects since ARP 3 include a £4.7m programme on Osney Island in Oxfordshire and a £2.9m project in Drakes Way, Wiltshire. The works completed will protect around 35,000 people from potential outages associated with flooding whilst also ensuring power supplies and infrastructure are fit for the future. With the Drakes Way project, consideration was also taken to keep the site as green as possible, following recommendations put forward by ADAS, the UK's largest independent provider of agricultural and environmental consultancy. A grass mix was planted instead of using stone or shingle to enhance biodiversity and slow water runoff, reducing pressure on the water drainage infrastructure thereby reducing risks of flooding.

Wildflowers and grass mix

Elevated substation at Drakes Way

## Nature for Networks (N4N) innovation project

**Electricity networks are increasingly exposed to the impacts of climate change and face broader challenges such as visual amenity, noise, and security. Traditional engineering solutions are usually used to mitigate these issues, which are often costly, carbon intensive and deliver limited additional environmental and social benefits. Recognising the need for more sustainable approaches, and in partnership with GHD, Frontier Economics and Scottish Power Transmission, we've secured Ofgem funding to explore using Nature-based Solutions (NbS) in tackling network challenges through the N4N project.**

Nature-based Solutions use and mimic natural processes to address societal challenges which are cost-effective and simultaneously provide environmental, social and economic benefits. For climate change adaptation, NbS can include natural flood management, restoring natural coastal defences, and using vegetation to mitigate the impacts of temperature extremes.

During the Discovery phase, which concluded in June 2024, the feasibility, costs and benefits of using NbS were assessed. The project identified that NbS can provide effective alternatives to traditional engineering solutions with financial savings for consumers as well as wider environmental and social benefits (e.g. noise abatement, reduced carbon, carbon sequestration, biodiversity enhancement, physical and mental well-being benefits). The main outputs of the Discovery phase were:

- A catalogue of various NbS approaches suitable for DNOs.
- An opportunities and barriers report for scaled roll-out of NbS around energy networks.
- A cost-benefit-analysis toolkit to assess costs and the benefits of environmental, social and visual impacts.
- Development of two use cases, linear woodlands and sustainable drainage systems (example in Figure 4).

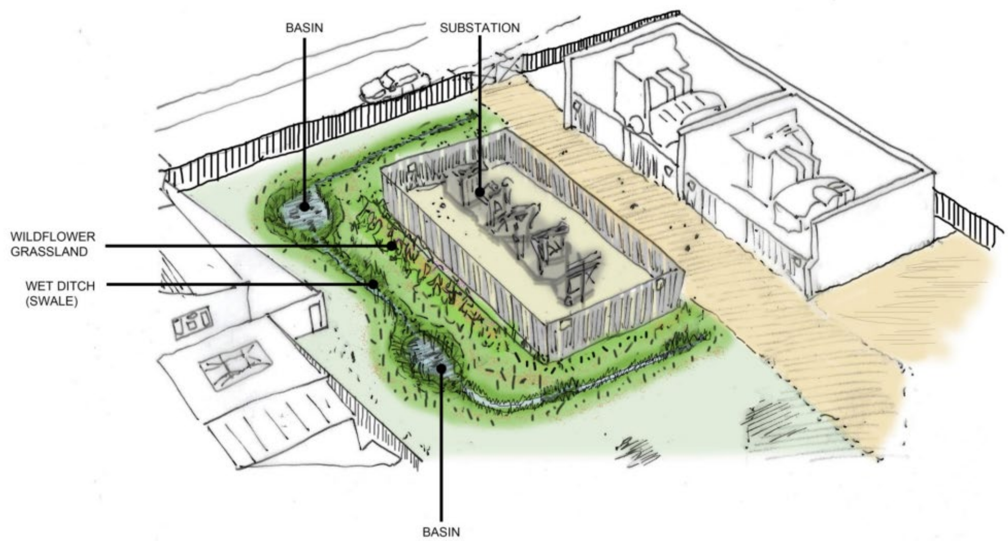


Figure 4: Sustainable Drainage Systems for Substation Flood Protection [GHD]

The Alpha phase is ongoing and will enable the expansion of the initial feasibility studies to understand how these new solutions could be rolled out at scale and allow the development of ways of working with landowners to advance such solutions. The project illustrates how innovation can be used to develop best practices for climate adaptation.

# CONCLUSION

**Electricity networks, in common with other civil infrastructure, will be affected by the physical impacts, as well as the societal and financial impacts, of climate change. This report sets out our progress in adapting to climate change risks since the previous round of reporting in December 2021, and what our future adaptation pathways need to be.**

As a result of effective climate resilience planning and taking the time to investigate and validate the climate risks posed to our network, we've built our awareness and adaptation plans up credibly over time, with an acceleration over the past five years. We've undertaken a thorough risk assessment of our material climate change risks and opportunities, and we've made meaningful steps to adapt to climate change and embed climate risk and resilience into business as usual across our organisation. We'll continue to accelerate our approach, ensuring our asset-management processes are adapted to manage this ever-increasing risk, build on our interdependency work to minimise cascading risk and strive to embed a culture of climate change awareness within all parts of the organisation.

Resilient energy networks are critical to the delivery of net zero. However, as a nation this means that we all become more reliant on this critical infrastructure to survive and to thrive, whilst at the same time this network is facing tougher climate related risks than ever before. We understand this challenge, and so as well as being committed to doing everything in our power to mitigate this risk, we're also committed to understanding our interdependencies and working closely with our regulators, local authorities and governments to ensure policy and action can address this challenge in the best interest of our current and future consumers.

# CONTACT

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