UK Power Networks Climate Change Adaptation 4th Round Report

19 December 2024

Table of Contents

Climate Change Adaptation Report

1.0 Adaptation Reporting Power

The Adaptation Reporting Power (ARP) was introduced under the Climate Change Act 2008. It means statutory undertakers such as UK Power Networks can be directed by government to report on how we are addressing current and future climate impacts.

We have contributed to previous rounds of climate change adaptation reporting, building on our understanding of climate related risks each time. This has been done in collaboration with the Energy Networks Association (ENA) members, with a working group of gas and electricity distribution and transmission network operators. The Climate Change Adaptation Working Group has helped build an understanding of climate change impacts that could affect our network and helped develop a consistent reporting methodology for ARPs.

2.0 Scope

The Third National Adaptation Programme (NAP3) published in 2023 sets out the government's strategy for the fourth round of climate change adaptation reporting. The fourth round of reporting has been brought forward to improve alignment with the Climate Change Risk Assessment (CCRA) and National Adaptation Programme (NAP).

Our ARP3 report was produced during the planning for the Electricity Distribution price control 2023-2028 (RIIO-ED2). A summary of the findings and mitigation measures is shared across ARP3 and our Climate Resilience Strategy which has integrated climate change adaptation into our RIIO-ED2 strategy.

Our fourth-round climate change adaptation report focuses primarily on what has significantly changed since the previous reporting period. The report includes details of any new climate change assessments, and current weather/incident trends and whether this is reflected in our climate change risk assessment scoring. It also includes a review of and reflection on progress made against mitigation actions set in the ARP3 and Climate Resilience Strategy.

UK Power Networks Climate Change Adaptation Reports:

- UK Power Networks Climate Change Adaptation Report (April 2015): Contribution to the second round[1].
- UK Power Networks Climate Change Adaptation Report (16 December 2021): Contribution to third round[2].

UK Power Networks Climate Change Resilience Strategies:

- UK Power Networks Business Plan (2023 to 2028) – Appendix 14: Climate Resilience Strategy[3].
- UK Power Networks Business Plan (2015 to 2023) – Annex 8: Climate Change Adaptation[4].

3.0 Organisational Overview

Who we are

UK Power Networks is the UK's largest electricity distribution network operator ("DNO") in terms of customers. We provide electricity infrastructure to deliver electricity supply to our customers safely, reliably, efficiently and sustainably.

We operate across three DNO licence areas; London, the East and the South East of England, serving almost 8.5 million homes and businesses. UK Power Networks owns three licensed companies who are responsible for operating and maintaining these electricity distribution networks:

Easter Power Networks (EPN) delivers electricity to the East of England region which extends from the Wash in the east, to North London and the Thames estuary, encompassing a diverse range of urban and rural areas as well as a substantial coastline.

London Power Networks (LPN) delivers electricity to people who live and work in Inner London, it has the responsibility for delivering electricity to iconic buildings and businesses in London, as well as high-profile international events held in the city throughout the year.

South Eastern Power Networks (SPN) serves South London, Kent, East Sussex and parts of Surrey and West Sussex, covering a variety of customers and locations.

UK Power Networks in numbers*:

Measure	Number
Number of homes and businesses that electricity is delivered to	8.5 million
UK Power Networks footprint area	29,250km square
People served from Cromer in the East of England to Brighton in the South of England	19 million – 28% of Great Britain's total
Electricity distributed through our network in Great Britain	70,736 GWh – around 28% of Great Britain's total
Length of overhead and underground cable network	Overall total of 190,855km Overhead 42,312km and underground 145,543km

*From UK Power Networks Annual Report and Financial Statements – Year end 31 March 2024

4.0 Climate Change Risk Assessment

4.1 State of the UK Climate

According to the Met Office, the UK has been breaking annual mean temperature records and globally, temperatures have increased and continue to rise. The State of the UK Climate reports (calendar years 2021-2023)[5] from the Met Office provides an annual summary of the UK weather and climate. These reports highlight that the UK's climate continues to change and has become warmer, wetter and sunnier. Recent reports highlight that climate change is affecting the climate conditions we are experiencing now and is not just a problem for the future.

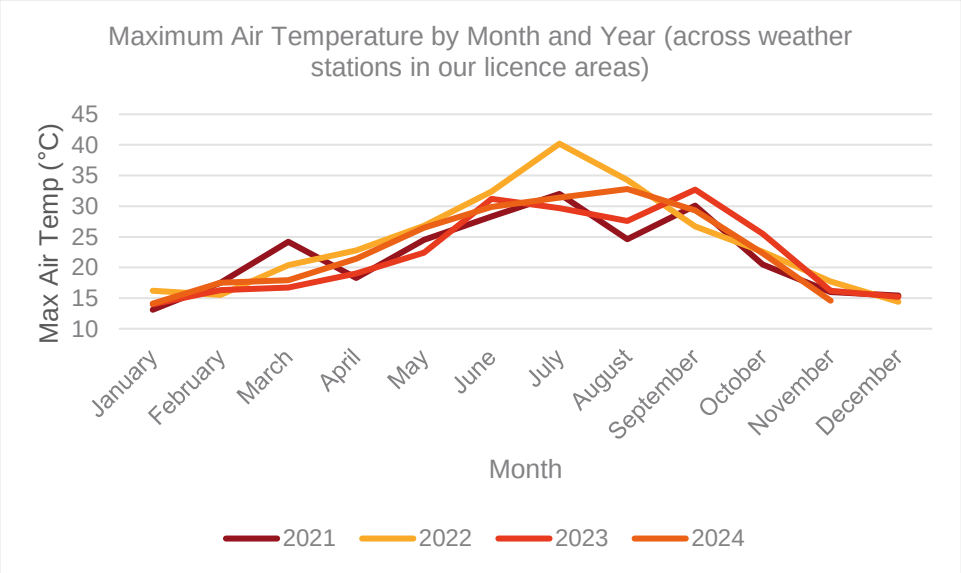
Observations show that extremes of temperature in the UK have been affected much more than average temperatures and are made more likely by climate change. A study by the Met Office Hadley Centre[6] suggests the current chance of seeing days reaching 40°C or more is extremely low. However, by 2100 under a high emissions scenario the UK could see 40°C days every 3-4 years.

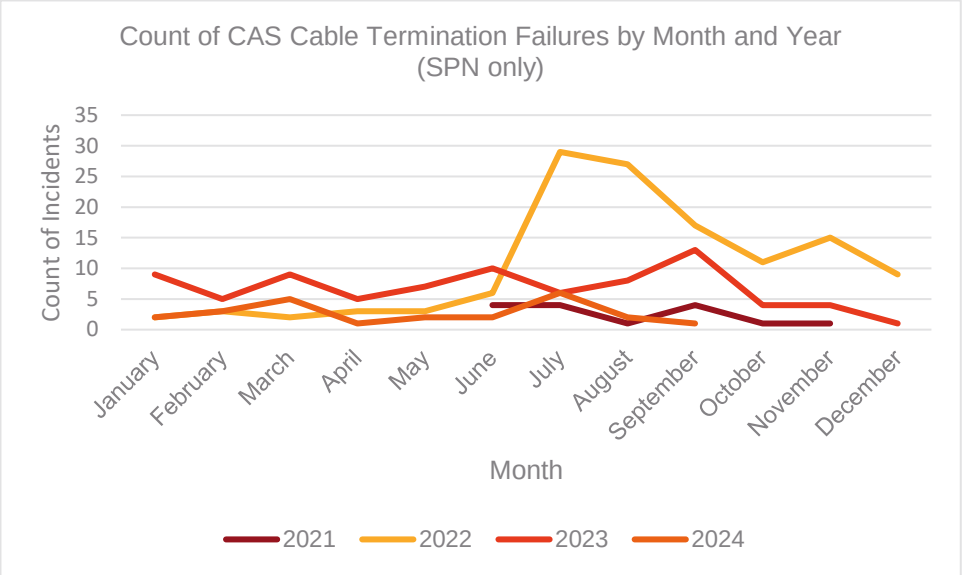
4.2 Recent Weather Events

July 2022 - Heat Wave:

The July 2022 heatwave saw the highest temperature ever recorded in the UK which was 40.3°C at Coningsby, Lincolnshire. Tropical nights occurred across parts of south/central England, where temperatures remained above 20°C for a 72-hour period.

During this hot spell, the highest temperature recorded in our licence area was 39.8°C at St. James Park, London. We have reviewed exceptional weather periods since 1 January 2015, including maximum air temperatures across our licence areas and compared this with our fault data. While there were no significant increases in temperature related faults during July 2022 in comparison to other hot spells, analysis of fault data covering our SPN licence area highlighted an increasing trend in Corrugated Aluminium Sheath (CAS) cable termination failures during periods of extreme heat, as shown by the graphs below:





This has highlighted an asset that is more vulnerable to extreme heat. Part of a corrugated aluminium sheath cable termination includes a ring, which is put around the cable sheath when splitting out the cable's cores. This can put stress on the cable because of thermal expansion during high temperatures and can result in failures.

This knowledge allows emergency response teams to locate and fix associated faults quickly. There is a plan to replace CAS cable terminations opportunistically whilst we continue to monitor the number of CAS cable termination failures with prevailing weather conditions to confirm this trend change.

July 2022 – Wildfires:

With increasing temperatures and changes in precipitation (drought) becoming more common in the South East, it makes this part of the UK and our network more susceptible to wildfires. The dry and hot weather on 19 July 2022 meant the London Fire Brigade faced its "Busiest day since World War Two" as wildfires broke out across London[7].

According to scientists at the Met Office and the UK Centre for Ecology & Hydrology, there is projected to be a rise in wildfires globally by 14 per cent by 2030, 30 per cent by 2050 and 50 per cent by 2100[8].

The wildfires that occurred in July 2022 were isolated mostly to the fringes of urban areas but were significant in numbers, resulting in the London Fire Brigade responding to over 1000 fires. Whilst fires of this size and extent are not likely to significantly impact our network, we have seen wildfires occur in the north of the UK during the summer of 2018 which extended over 7 square miles and lasted three weeks. Major incidents such as these could have the potential to cause significant damage to our overhead line structures and conductors. They can also affect other infrastructure we rely on such as telecommunications systems, potentially disabling remote control of the network and risking loss of supply. We continue to monitor the occurrences of wildfires in our area and their impact on our network, developing a better understanding of the risks and how we can mitigate these into the future.

November 2021 - Storm Arwen:

On the 26th of November 2021, Storm Arwen resulted in the Met Office issuing a rare red weather warning to Scotland and parts of North East England for high wind speeds with gusts exceeding 90mph. Many thousands of customers across the country experienced a loss of supply.

Following a review into the actions of electricity networks by the department for Business, Energy & Industrial Strategy (BEIS) and Ofgem, a Storm Arwen Re-opener[9] was built into the RIIO-ED2 price control to allow Distribution Network Operators (DNOs) the opportunity to put forward requests for additional allowances required to address actions taken as a result of the reviews recommendations.

Whilst UK Power Networks was not significantly affected by Storm Arwen, we put forward a number of investment cases proposing to improve our networks resilience to windstorms. Ofgem issued their final decision on the Storm Arwen reopener allowances in December 2024, including investment for:

Investment Case	Description
Small-section Conductor Replacement	Replacing small section overhead lines with a conductor that has a larger cross-sectional area improves its resilience to windborne debris.
DFA – Distribution Fault Anticipation	Installing Distribution Fault Anticipation devices (DFA-Plus) allows high voltage feeders to be monitored in real-time to identify events that are indicative of emerging issues that are otherwise not visible and can facilitate the implementation of proactive repair strategies.
MetrySense 5000 Sensors	Installing MetrySense 5000 Sensors on HV feeders (with Arc Suppression Coils – ASC) will allow for the location of grounded conductors to be found quicker, reducing the duration of interruptions to our customers electricity supply.
Telecontrol Delayed Auto Reclose	Deployment of auto reclose functionality software at source circuit breakers will improve restoration of supplies, as manual switching during storms can take longer, especially if there are resource constraints.
Auto Reclose Penetration	Reclosers reduce the number of customers affected by transient faults, such as those caused by trees or windborne material contacting overhead lines and conductors clashing.
Overhead Circuit Sectionalisation Enhancement	Sectionalisation reduces the size of a 'fault zone' meaning less customers suffer a permanent interruption to their supply during incidents caused by large scale storm events.

February 2022 – Storms Dudley, Eunice and Franklin:

In February 2022, three named storms affected the UK within the space of a week. Two rare red weather warnings were issued for Storm Eunice, which hit EPN and SPN on the 18th of February 2022. The Met Office states that Storm Eunice was the most severe and damaging storm to affect England since February 2014[10]. A new England wind gust speed record was recorded at

122mph at Needles Old Battery, Isle of Wight and wind gusts were widely over 69mph (~30m/s) across southern England.

A Met Office study[11] revealed that wind gust speeds of 25 m/s or above are critical to the occurrence of wind throw (felling of trees by the wind), which can result in a greater number of wind-related faults and customers power interrupted. Our fault reporting showed that storms Dudley, Eunice and Franklin combined resulted in the highest number of faults across our network from the period since 1 January 2015.

UK Power Networks Storm Eunice Facts:

EPN Licence Area	SPN Licence Area
453 HV faults in 5 hours	747 HV faults in 12 hours
700,000 customers affected	400,000 customers affected
94% of power back on in 24 hours	90% of power back on in 24 hours
99% of power back on in 48 hours	96% of power back on in 48 hours
Wind gusts up to 75 mph	Wind gusts up to 80 mph

Our approach to storm events, and our emergency response plans have not changed significantly since ARP3. In response to Storm Eunice, we saw a full deployment of scouts (Operational and non-operational staff on standby) to help identify issues on our network quicker, we used smart meter pinging to identify outage causes and effectively used back up generation for single premise customers.

Including the above-named storms, the Met Office confirm that between 2020/21 and 2023/24 there have been 25 named storms impact the UK. 12 storms were named in 2023/24, which is the most in one year since naming of storms started in 2015.

4.3 Existing Climate Change Assessment

In considering the impacts of climate change on our electricity distribution network, the Met Office UK Climate Change Projections 2018 (UKCP18) were used in ARP3 and a consistent reporting methodology was implemented through the ENA Climate Change Adaptation Working Group. Through this group, ENA members identified and reviewed eight weather and climate related hazards which needed consideration against our physical network system both now and into the future. 15 priority asset-related risks were identified and are summarised below:

Risk Code	Risk Description
AR1 Temperature	Overhead line conductors affected by temperature rise.
AR2 Drought	Overhead line structures affected by summer drought and consequent ground movement.
AR3 Wetter conditions	Overhead lines affected by interference from vegetation due to prolonged growing season.

AR4 Temperature	Underground cable systems affected by increase in ground temperature.
AR5 Drought	Underground cable systems affected by summer drought and consequential ground movement.
AR6 Temperature / Drought	Substation and network earthing systems adversely affected by summer heat and drought conditions.
AR7 Temperature	Transformers affected by temperature rise.
AR8 Temperature	Transformers affected by urban heat islands and coincident air conditioning demand leading to overloading in summer months.
AR9 Temperature	Switchgear affected by temperature rise.
AR10 Precipitation	Substations affected by river (fluvial) flooding due to increased winter rainfall.
AR11 Precipitation	Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter.
AR12 Sea Level	Substations affected by sea flooding due to increased rainstorms and/or tidal surges.
AR13 Precipitation	Substations affected by water flood wave from dam burst.
AR14 Lightning	Overhead lines and transformers affected by increasing lightning activity.
AR15 Wildfire	Overhead lines and underground cables affected by extreme heat and fire smoke damage.

On behalf of its members, the ENA commissioned the Met Office to undertake a review of UKCP18 data and existing studies in order to understand the changes in potential impact to energy infrastructure assets from climate change. This work for ARP3 focused on a 'high emissions scenario' – Representative Concentration Pathway (RCP) 8.5. The RCP 8.5 scenario has a best estimate increase in global mean surface temperatures of 4.3°C by 2081-2100.

The decision to use the RCP 8.5 scenario was made collaboratively by the ENA members through the Climate Change Adaptation Working Group. This position has not changed for ARP4 and continues to be the plausible worst-case scenario for key climate change hazards and thought to still be a pragmatic decision based on data and tools available at the time.

The ENA members, including UK Power Networks acknowledge that future climate projections are speculative and increase in uncertainty the further in the future the projection is made. The ENA's ARP4 climate change risk assessment scoring for periods 2050 and 2100 are 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 used and this includes the data used by UK Power Networks in the development of ARP3.

4.4 New Climate Change Assessment

UK Power Networks has recently input into the Climate services for a Net Zero resilient world (CS-N0W) research programme. Work Package D3 Enhancing Resilience in UK Energy Networks[12] presents an assessment of four key hazards for distribution networks identified during interviews with Distribution Network Operators (DNO). This included assessing the intensity of windstorms (maximum windspeed), hot spells (maximum temperatures), cold spells (minimum temperatures) and wet spells (accumulated rainfall) based on the UKCP18 and simulated using a high-emission RCP8.5 future scenario.

This analysis shows the likely changes (1-to-50-year return periods) over our region (three licence areas) for two future time periods (2021 to 2040 and 2061 to 2080).

For ARP4 we have compared the findings of the CS-N0W report and any other new assessments of climate change and compared this with the assessments completed as part of ARP3:

Climate Hazard	New Assessment (ARP4)	Existing Assessment (ARP3)
Windstorms	Projections show no obvious change in maximum wind gusts in windstorms in our network's region but do indicate a strong variability in wind-related risk over the coming 60 years.	Analysis also confirmed there was no strong signal within UKCP18 climate projections for a change to future storm intensity.
Hot Spells	Maximum temperatures are projected to increase during hot spells in future periods.	ARP3 projected an increase in frequency and duration of high temperature days.
Wet Spells	There is no large change projected in the accumulated rainfall during wet spells.	Projections were quite uncertain for prolonged rainfall, though in the Southeast of England it may remain roughly the same as the current climate. Short, intense rainfall events are projected to increase potentially leading to pluvial and flash flooding.
Cold Spells	Cold spells are projected to become warmer and less severe, with minimum temperatures in cold spells projected to increase in the future.	Analysis suggests overall that winters are going to become warmer in the future, so snow and ice related hazards are likely to decrease.
Sea Level Rise	Sea level rise is widely projected to increase. Storm surges will contribute to the risk of sea level rise, yet the likelihood and severity remains uncertain. Regional studies indicate the combined mechanism of sea level rise and storm surge events may have a significant impact on the coastal areas that our network operates in.	Analysis conducted for ARP3 also suggested an increase in sea level rise.

Alternative Data Sources:

In Assessing the impact from Climate Change, we have used Met Office UKCP18 data. This approach is reiterated by Ofgem in their RIIO-3 Sector Specific Methodology Decision overview document[13]. We are aware that UKCP18 can exhibit higher rates of warming in response to modelled greenhouse gas emissions and simulations may observe larger climate changes, such as temperature.

Whilst we do not currently have any intention to deviate far from this approach, we have been exploring the use of World Climate Research Programme (WCRP) Coordinated Regional Climate Downscaling Experiment (CORDEX) climate model data to add to our ability to sample a greater range of uncertainty.

4.5 Governance

We have continued to take an integrated governance approach to managing our climate change adaptation risks and have used our established corporate risk management process. This process provides the Board oversight of key climate change risks through an established Risk Management and Compliance Committee. Physical climate change risks are also discussed at our Environmental, Social, Governance (ESG) Board, together with other climate-related and Net Zero transition risks.

Our governance system remains effective by taking into account new and emerging risks facing the business which are regularly and systematically assessed. In 2022, we established a Climate Change Resilience Steering Group with senior representation from across the business. Through the steering group, existing and new or emerging climate change risks are assessed and challenged. Depending on the nature and extent of the risk, consideration is given to whether or not the risk requires inclusion into the corporate risk management process.

During ARP3, we improved our understanding of future climate change and reviewed existing mitigation measures to identify any gaps. ARP3 was carried out at the same time as planning for the Electricity Distribution Price Control RIIO-ED2. Climate change adaptation was integrated into our RIIO-ED2 Climate Resilience Strategy, with an action plan shared across both reports. The price control extends from 2023-2028, providing a 5-year period to implement our strategy.

Whilst the ARP4 reporting window occurs very early into the price control period, we continue to deliver against our RIIO-ED2 strategy, including our action plan with progress monitored at our Climate Change Resilience Steering Group. The outputs of this work will inform our plans for RIIO-ED3 and update for ARP5, timings of which will align much closer.

Through undertaking a recent gap analysis against our current processes, we are considering the integration of ISO 14090:2019 Adaptation to climate change – Principles, requirements and guidelines, and supplementary standards into our future approach.

4.6 Climate Change Adaptation Risk Review

Our approach to assessing climate change risks has not changed since ARP3 and continues to be assessed using the ENA risk assessment methodology.

We have reviewed recent information that could change our assessment of risk likelihood or severity based on current climate conditions and future climate change. This has included:

- A review of any new assessments of climate change hazards i.e. CS-N0W,

- An assessment of our recent fault data and weather data, including storm events, wind speed and temperature to determine any trends and correlations,
- A review of recent extreme weather events and current UK climate trends.

Our assessment of risks based on future climate change projections has generally seen no variation between rounds of climate change adaptation reporting. There has only been a short period of time since ARP3 concluded and since we have begun implementing mitigations measures outlined in our RIIO-ED2 Climate Change Resilience Strategy. There has also been no major advancement in available information or climate change data that would result in a significant change in our respective risk landscape.

Whilst there has been no discernible change in future climate change risks, we do recognise that the preset-day climate has already changed and continues to change rapidly. Since ARP3 we have seen recording breaking weather in the Southeast of England, including maximum air temperatures, maximum wind gusts and wildfires.

In summary, taking into consideration the current climate signals, the present-day scenario in our Climate Change Risk Assessment should include recognition that the climate has already changed, and some assets may be exposed to impacts more frequently (increased likelihood). We therefore revise the priority climate change risk scores for the present-day for assets affected by temperature rise.

The table below shows the revised ARP4 risk scoring for temperature related risks in a present-day scenario and includes a summary of our mitigation progress so far:

Climate Change Adaptation Risk	ARP3	ARP4	Risk Change
	Present-day Scenario:	*Present-day Scenario:*	
AR1 Temperature: Overhead line conductors affected by temperature rise	**3 / Minor**	**6 / Moderate**	↑

AR1 Mitigation progress: Overhead line conductors continue to be installed to industry standards (Engineering Recommendation P27). While the latest version includes revised ratings which takes into account current climate conditions, we acknowledge that ratings and standards may require reviews to ensure some resilience to future climate change impacts.

High capacity conductors are still stipulated for over headline towers providing efficiency in hotter conditions.

Predicted weather data and its impact on overhead lines continue to be assessed. Fault events and weather data is monitored and analysed for trends, proving the effectiveness of current controls and informing replacement plans. New HV and EHV monitoring solutions employed across the network help identify pre-fault events leading to proactive maintenance. An increase in enhanced automation, including remotely controlled assets and LV reclosers reduces the impacts of faults for customers by building reliability into the network.

We have initiated an innovation programme looking at making conductors more resilient to extreme heat. We continue to undertake Infrared suveys to determine possible overheating. Some overhead lines in National Landscape status areas are being undergrounded, reducing the risk of over-heating conductors in those areas.

AR4 Temperature: Underground cable systems affected by increase in ground temperature	3 / Minor	6 / Moderate	↑

AR4 Mitigation Progress: Underground cables are installed to current British Standards. Current engineering standards and recommendations, including cable ratings therein, may need to be reviewed to account for future climate change scenarios, in particular likely increases in soil ambient temperature.

Demand on our network is forecast using our DSO's Distribution Future Energy Scenarios (DFES) and cable sizes are installed based on projected load, reducing the risk of distribution network losses and building resilience to increasing ground temperatures by ensuring cable temperatures and ratings are not exceeded.

The correlation between increased ambient temperatures and cable faults continues to be monitored. It is widely understood that cable joints and cable fluids expand during periods of increased ground temperatures and can lead to an increased risk of oil leakage from Fluid Filled Cables. The installation of oil expansion tanks, active oil pressure management and other mitigation measures are being considered as a means to reduce the risk of oil leakage.

Fluid Filled Cables continue to be proactively replaced or refurbished with a focus on those in the poorest condition and those with environmental constraints such as within areas of high environmental sensitivity or susceptible ground conditions. Proactive maintenance is undertaken during prolonged hotter periods to reduce unplanned downtime and cable failures.

Partial Discharge monitors are being installed on solid cables to help identify issues and proactively investigate and remedy situations before there is premature failure. Proactive monitoring may help identify excessive overheating of cables due to temperature extremes leading to cable derating/electrical overloading.

AR7 Temperature: Transformers affected by temperature rise	2 / Minor	4 / Moderate	↑

AR7 Mitigation Progress: Distribution, grid and primary transformer replacement programmes continue to take place due to the availability of capacity on our network. Upsized low-loss transformers are installed which can increase capacity of transformers. Many transformers continue to operate at about 50% capacity, resulting in reduced network losses and greater resilience to heat. The network in London still operates with a high redundancy built in which reduces the risk of service interruptions.

More advanced transformer controls, such as Dynamic Rating Management Control and proactive temperature monitoring and management allows transformers to operate within specified parameters. Enhanced monitoring and inspections, including hot spot measurements and oil testing and analysis help understand the core condition of transformers and allow the risk of temperature rise to be better understood and managed.

The use of synthetic insulating oils, that have greater performance in hotter temperatures, is still being assessed. While it has already been adopted in some distribution transformers, the programme is still in its infancy.

AR8 Temperature: Transformers affected by urban heat islands and coincident air conditioning demand leading to overloading in summer	2 / Minor	6 / Moderate	↑

AR8 Mitigation Progress: Demand on our network is forecast using Distribution Future Energy Scenarios projections and new transformers are installed based on projected load, reducing the distribution network losses and building resilience to increasing temperatures. While this may ensure that transformer temperatures and ratings are not exceeded in the shorter term, we acknowledge that applying current engineering standards and recommendations, including transformer ratings therein, may need to be reviewed to account for future climate change scenarios. This may be more prevalent for areas such as London that is considered a urban heat island "hot spot", with temperatures 4.5°C hotter than rural surroundings[14] and where transformers tend to be designed to operate a cyclic rating (not continuous) where higher ambient seasonal temperatures will need to be accounted for.

In addition to the points raised in AR7, increased remote monitoring and operation enabled by SCADA continues to improve operational response and system recovery by redistributing load within the system should it be required. The use of demand side response continues to be deployed to manage peak load if appropriate.

AR9 Temperature: Switchgear affected by temperature rise	2 / Minor	4 / Moderate	↑

AR9 Mitigation Progress: Similarily to AR1, CAS cable terminations are replaced opportunistically. Our switchgear replacement programme continues to improve switchgear capacity, condition and is creating more resilience in our network. Existing switchgear specifications still specify designs with a maximum continuous ambient air temperature of 40°C over a 24hour period. Whilst forced ventilation, air conditioning and dehumidifcation can be used to help control ambient air temperatures for enclosed switchgear, we acknowledge that switchgear and ancillarly equipment specifications or the requirement to de-rate assets may require a review in the medium term to ensure some resilience to future climate change impacts, in particular more regular high temperatures in excess of 40°C by 2100.

AR15 Wildfire: Overhead lines and underground cables affected by extreme heat and fire smoke damage	2 / Minor	4 / Moderate	↑

AR15 Mitigation Progress: We continue to build a better understanding of our risks to Wildfire. We benefit from shared learning and resources from being a member of the Edison Electric Institute, such as recommendations to conduct a wildfire risk assessment and develop wildfire mitigation and contingency plans. Instances of wildfire incidents on our network are continually reviewed and compared against the Met Office Fire Severity Index or other data sources to assess trends.

Routine vegetation management programs mitigate some wildfire risk. Enhancing vegetation management and asset maintenance programs in areas of highest wildfire risk could reduce chances of wildfire ignition. These areas could also be subject to more resilient tree cutting programmes such as those specified in ETR 132 or more targeted reinforcement programmes.

DEFRA's Third National Adaptation Programme, committed to scoping out a Wildfire Strategy and Action plan by 2024. We are awaiting this report to give us some further guidance and steer on how to address the risk of wildfires in the UK.

New Climate Change Adaptation Risk – Windstorm (strong winds):

In ARP3, analysis of UKCP18 data showed that there was no strong signal within the climate projections for a change to future storm intensity. The risk of strong winds was assessed in the current climate only, however there was consensus that there will be an increase in windstorm

frequency. As such, windstorm was never ranked as a priority climate change risk through the ENA Climate Change Adaptation Working Group in previous rounds of climate change adaptation reporting.

While the analysis undertaken by CS-N0W shows no discernible change in maximum wind gusts across our licence areas, there is evidence that there is a strong natural variability to the results of their analysis. The Met Office assessment[15] of strong winds conducted for ARP3 implies it is reasonable to suggest that, given the worst-case climate change scenario we should consider the potential for increased risk from strong winds in the 21st century.

Windstorm events can have a considerable impact on our network, directly or indirectly contributing to fault numbers and customers off power. February 2022 highlighted that successive storms (increased frequency and duration) can result in disruption with high numbers of faults. It is now recognised amongst DNOs that windstorms present an increasing risk to overhead line networks, therefore a Wind-related risk, affecting overhead lines will be included as a priority climate change risk and will continue to be explored through the period leading to ARP5.

Climate Change Adaptation Risk	ARP3	ARP4	Risk Change
	Present-day Scenario:	*Present-day Scenario:*	
AR16 Windstorm: Overhead lines (OHL) affected by strong winds	-	6 / Moderate	→

AR16 Mitigation progress: The investment cases awarded allowances as part of the Storm Arwen Re-opener will improve OHL resilience to high wind speeds, including replacing small section overhead lines, installing Distribution Fault Anticipation (DFA) devices and installing MetrySense 5000 Sensors.

OHL's are installed to industry design specifications, which takes into account wind pressure and also ice loading. Ice accretion can exacerbate the risk to OHL's during high winds.

The use of automatic circuit reclosures across our network reduces the impacts of transient faults. Circuit breakers are retrofitted so they can be operated remotely. Installing covered electricity conductors improves resistance to windborne debris. Metal supports are proactively installed on wooden poles to ensure structural integrity and to extend the life of the pole. The use of Automatic Power Restoration Systems (APRS) restores supplies, and our storm preparedness plans ensure we respond quickly and carry out repairs in the wake of windstorms.

Mitigation measures to minimise climate change adaptation risk 'AR3', including targeted tree cutting and vegetation management addresses areas at greatest risk of interference from vegetation, reducing the effects of wind throw.

Through previous reporting periods, climate change adaptation risk 'AR3' highlights that different contributing factors of impacts can overlap and result in a compound climate change risk. In the case of AR3, increases in temperature and precipitation can prolong vegetation growing seasons leading to vegetation interference affecting overhead lines.

CS-N0W and the Met Office review for ARP3 notes that wind intensity is only one contributing factor to wind related faults. The combination of wetter soils, length of growing season, wind-direction can result in destabilisation of roots and cause trees to be less resistant to wind. There

is a need to better understand contributing factors of impact to help inform an in-depth understanding of current and future risks. Therefore, future analyses of climate change risks, especially further developing an understanding of AR16, will assess contributions of other factors.

Review of ARP3's highest Climate Change Adaptation Risks

Substations affected by Flooding (Fluvial, Pluvial and Coastal):

Our climate change adaptation risks associated with flooding have remained our highest ranked risks throughout the ARP reporting periods. In ARP3, analysis of UKCP18 data and existing forecasting from the Environment Agency has shown a clear increase of both occurrence frequency and severity of pluvial flooding.

CS-N0W analysis suggests no significant change in the accumulated rainfall during wet spells in future climate scenarios, therefore the forecast of future fluvial and pluvial flooding risk looks similar to ARP3.

The increase in the pluvial flood risk in the present-day comes from the increasing expansion of impermeable surfaces in urban environments. These do not have the same rates of percolation of rainwater compared to natural land. This can cause rainwater to inundate the public sewer systems leading to the systems backing up and causing pluvial flooding.

The risk from sea level rise in the present-day scenario has not increased from ARP3 however, we are planning on the basis that coastal flooding combined with storm surges is likely to increase in future climate change scenarios.

The magnitude of flooding impact is considered more severe than our analysis in APR3, especially in a 'Do Nothing' scenario. Such flooding may cover a vast geographical area, which is beyond any individual remedy measure can successfully mitigate and calls for collaborative protection and planning methods across different sectors, authorities and industries.

Climate Change Adaptation Risk	ARP3	ARP4	Risk Change
	Present-day Scenario:	*Present-day Scenario:*	
AR10 Precipitation: Substations affected by river (fluvial) flooding due to increased winter rainfall	12 / Major	12 / Major	→
AR11 Precipitation: Substations affected by pluvial (flash) flooding due to increased rainstorms in summer and winter	12 / Major	15 / Major	↑
AR12 Sea Level: Substations affected by sea flooding due to increased rainstorms and/or tidal surges	12 / Major	12 / Major	→

AR10/11/12 Mitigation progress: UK Power Networks are continuously assessing, monitoring and updating flood risk assessments at all Grid and Primary substations. Investment has been allocated for permanent flood mitigation projects to protect critical substations from fluvial, pluvial and coastal flooding, as well as floods caused by infrastructure failure such as water main bursts.

The increasing risk demands a comprehensive system to mitigate. We are using a combination of proactive and reactive methods such as flooding early warning systems and temporary flood barriers to ensure our supply of power. The criticality of secondary substations is also identified, especially if they supply other essential infrastructure and vulnerable customers. Future investment strategies shall consider these critical substations in subsequent price control periods.

Please refer to the table in the appendix (section 7.1) for changes to future climate change risk scores for AR12 Sea Level Rise.

Vegetation interfering with OHL's (prolonged growing season):

It has already been recognised through ARP3 that increasing temperatures and precipitation encourages increased vegetation growth. Accelerated growth in trees increases the occurrence of physical damage to overhead lines where trees adjacent to these structures impact them. We have observed more recently that tree growth has accelerated, but new growth is becoming increasingly weaker, resulting in large branches snapping or trees falling more easily. This has the potential to cause damage to our network.

Whilst we are aware of this emerging issue, we continue to develop a greater understanding of this risk and ensure we manage it with effective mitigations.

As mentioned above, there has been no change in future climate change assessments, we therefore do not plan to amend the priority climate change adaptation risk AR3 scoring for the present-day scenario or future climate change.

Climate Change Adaptation Risk	ARP3	ARP4	Risk Change
	Present-day Scenario:	*Present-day Scenario:*	
AR3 Temperature / Precipitation: Overhead lines affected by interference from vegetation due to prolonged growing season	12 / Major	12 / Major	→

AR3 Mitigation progress: We continue to identify vegetation intrusions to our OHL's to keep them within safe limits and meet the enhanced resilience requirements in ETR 132 - Improving resilience of overhead networks under abnormal weather conditions using a risk-based methodology. We have an enhanced vegetation management programme for the period 2023-2028. Vegetation growth is assessed on a cyclical basis to prioritise a cutting plan for maximum benefit to help prevent power cuts.

We have begun an innovation programme looking at different methods of conducting aerial tree surveys. The use of high-resolution imagery and AI can efficiently measure and monitor vegetation and can identify specific trees posing a risk to our OHL network. The use of predictive models using machine learning to forecast the future state of vegetation means we could take a more dynamic approach to vegetation management in the future.

5.0 Interdependencies

The Committee on Climate Change reported[16] that "Connectedness of infrastructure systems means that climate and weather-related impacts in one system can cause large and cascading failures in connected systems" that is echoed by the National Infrastructure Commission. Energy networks are at the heart of critical infrastructure, interdependencies, and cascading risks.

We have been actively participating in cross-sector discussions and forums to share our focus, expectations and experience. Our online open data portal features large sets of information about our electricity network. This information can aid cross-sector collaboration during investment planning and economic regeneration.

We are pioneering innovative tools such as CReDo - Climate Resilience Demonstrator[17] to map infrastructure assets across energy, water and telecoms networks and assess the impacts of climate change. This will lead to a better understanding of infrastructure interdependencies and capture cascading risks through asset failure, risk modelling and system impacts.

We are working closely with the leading professionals, consultancies, Local Authorities and Regulators to focus on a holistic approach to protection at regional scales and the community within. As part of the ENA Climate Change Resilience Working Group, we are working with Ofgem on developing climate resilience metrics and indicators. The National Infrastructure Commission has also urged the UK Government to establish clear standards of climate resilience for other infrastructure sectors[18]. This information may be useful in the future to assess cross-sectoral resilience to climate change.

Whilst recent focus has been on downstream infrastructure interdependencies, we have a climate change adaptation action to assess climate change risks across our supply chain to better understand our exposure to upstream interdependency risks because of climate change.

Through the Beta stage of the CReDo innovation project (during early 2025) we will be undertaking a thorough stakeholder and interdependency mapping exercise.

CReDo Case Study:

CReDo is a climate change adaptation decision support tool that helps cross-sectoral infrastructure networks to connect data and experience. This helps enable coordinated decision making and efficient investment strategies against extreme weather events and climate change.

The Alpha stage of the CReDo project focused on the effects of flooding and demonstrated the potential benefits across the UK of £81m-£186m by 2050. The project extended its scope into the Beta stage to include the effects of extreme heat and will create a prototype model and platform for energy networks to trial.

In ARP3 we identified telecommunications and road transport as our most important sources of risk to the electricity sector. This was mostly because of our increasing reliance on smart systems to operate our network and the need for road access to allow essential maintenance to restore supplies in the event of extreme weather.

Whilst two sectors have been identified as of primary importance, there are many other sectors that have interconnections with the energy network:

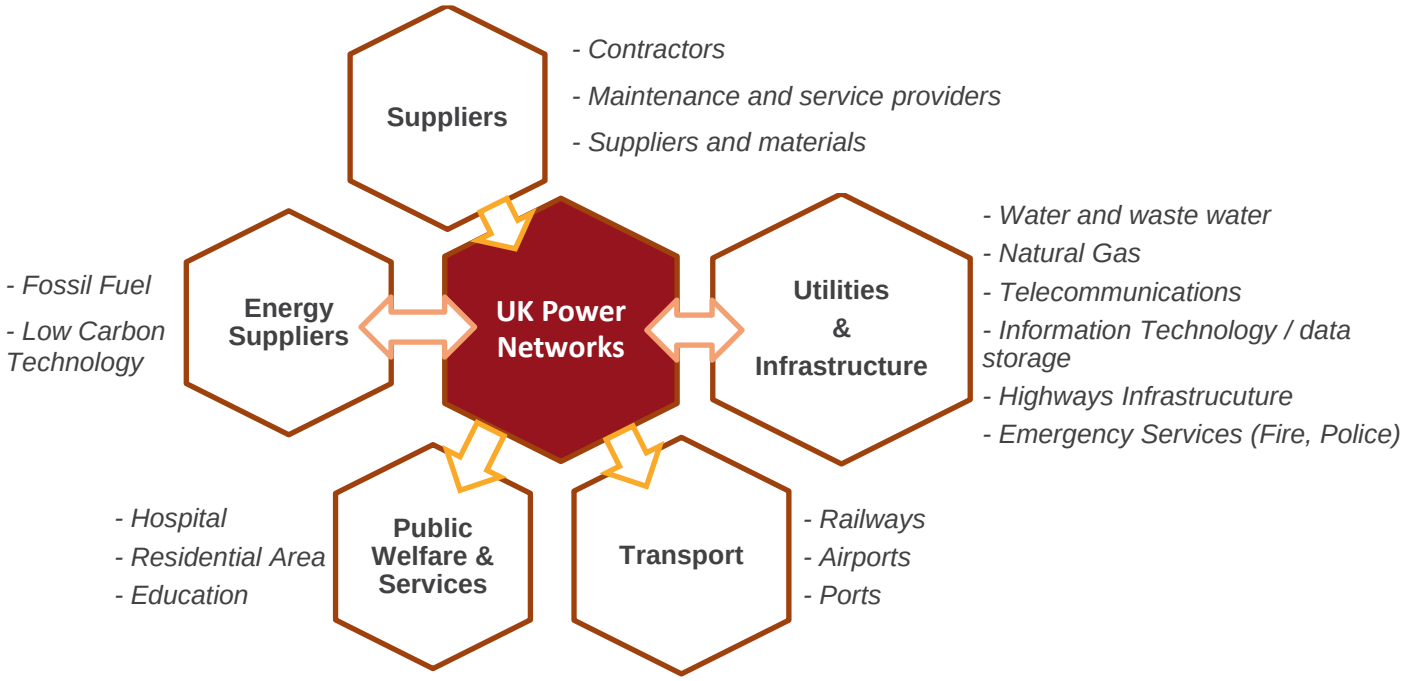


Figure 1: Interconnections between UK Power Networks and other infrastructure and industries.

6.0 Climate Change Action Plan

6.1 Progress since Adaptation Report Round 3

In ARP3, we identified some steps within our Climate Change Action Plan (CCAP) to be implemented in response to the level of present-day risks determined as part of our climate change risk assessment.

We committed in ARP3 to establishing a Climate Change Resilience Steering Group. This began in 2022 and convenes monthly. Members of the group have accountability for delivering the CCAP and progress against the actions are reviewed at the steering group.

The climate change action plan has also been specifically reviewed for ARP4, with input from other internal stakeholders who have responsibilities for delivering the action plan, including business functions such as Asset Management, Supply Chain Management, and Strategy and Regulations teams.

As mentioned above, ARP3 was carried out at the same time as planning for the Electricity Distribution Price Control RIIO-ED2. Climate change adaptation was integrated into our RIIO-ED2 Climate Resilience Strategy, with an action plan shared across both reports. Whilst the below section provides a progress update against our actions set in ARP3, we will extend the timescales associated with current actions 'in-progress' to align better with the delivery of our RIIO-ED2 Climate Resilience Strategy, which extends from 2023-2028:

Minor Climate Change Adaptation Risks *(Present-day Scenario)*:	
Action No.1 *- Advocate for the continuation of the current ENA Climate Change Resilience working group with expansion to include stakeholders external to the energy sector such as telecoms, water and local authorities.*	**Status: Complete**
ARP4 Progress: We have continued to participate in the ENA's Climate Change Resilience Working Group (CCRWG) and Climate Change Adaptation Working Groups. We are an advocate for a cross-sectoral approach to managing climate change risks. The CCRWG has expanded to include the Regulator Ofgem, and representatives from academic institutions involved in the CS-N0W project. Whilst there is no regular attendance from other infrastructure operators, we have continued to develop our own understanding of interdependencies between sectors and identify cascading risks which continues to be a focus area for the CCRWG.	
Action No.2 - *Establish a UK Power Networks Climate Change Resilience Steering group consisting of stakeholders from key business directorates to own the climate change strategy going forward with oversight from the UK Power Networks Risk and Assurance team.*	**Status: Complete**
ARP4 Progress: In 2022, we established a Climate Change Resilience Steering Group. The steering group meets monthly and has senior representation from across the business, including stakeholders from environment and Sustainability, Asset Management, Strategy and Regulations, Risk and Assurance, Organisational Resilience and Innovation. Through the steering group, climate change risks continue to be assessed and progress against our climate change action plan is monitored.	
Action No.3 - *Identify opportunities for further data collection and work with our DSO team to integrate this into our asset data systems.*	**Status: In-progress**
ARP4 Progress: UK Power Networks launched the country's first ever independent Distribution System Operator (DSO) in April 2023. We are engaging with our DSO colleagues on how we could use the various types of data available, including how the DSO collects data on many different weather variables that affect our network today. The DSO already uses an ensemble numerical weather prediction which can account for short term weather changes and forecast how our assets may be used. Flexibility procurement processes or dynamic asset ratings can then be utilised to minimise constraints on the network and improve network resilience. The DSO will have early insight based on the forecast of how the assets will be used (such as a significant influx in the use of air conditioning units during hot spells) so that short-term interventions can used to respond to climate changes and minimise constraints. We continue to invest in high-performing assets with a high-availability redundancy across our network which allows the DSO to leverage state of the art machine learning and Artificial Intelligence approaches to improve resilience.	

Action No.4 - *Analyse and assess our interdependencies against other sectors and customers to better understand our climate change resilience.*	**Status: In-progress**
ARP4 Progress: Refer to Section '1.5 Interdependencies' for an update on progress against climate change adaptation action 4.	

Moderate and Major Climate Change Adaptation Risks *(Present-Day Scenario)***:**	
Action No.5 - *Quantify risk(s) at an asset voltage class level within the license areas to identify risk 'hot spots' and take targeted action to mitigate.*	**Status: In-progress**
ARP4 Progress: Refer to Section '1.4.6 Climate Change Risk Review' for mitigation progress against ARP3 moderate and major climate change adaptation risks.	
Action No.6 - *Assess risk(s) across our supply chain to better understand exposure and collaborate to address risks through increased innovative and resilient solutions.*	**Status: In-progress**
ARP4 Progress: UK Power Network's Supply Chain Code of Conduct has 27 mandatory aspects and 13 focus areas which have been drafted to address a number of our current and anticipated key supply chain risks and opportunities – many of which are climate-related. The Code of Conduct was formally released in May 2023, and includes a 'focus area' that our suppliers will support UK Power Networks in achieving supply chain resilience, including climate resilience. The Code of Conduct has been signed by 80.7% of supplier (based on 2023/24 invoice spend). We will continue to use our existing procurement processes and systems, including evidence gathered through survey questions to increase our ability to identify current and anticipated effects of climate change on our value chain and highlight high risk partners who are not appropriately mitigating against climate-related risks.	

Severe Climate Change Adaptation Risks *(Present-Day Scenario)*:	
Action No.7 - *Take immediate actions to mitigate and control risks through appropriate measures in the short-term and incorporate long-term mitigations as part of a proceeding regulatory period.*	**Status: BAU***

ARP4 Progress: There are no climate change adaptation risks currently rated as severe in the present-day scenario.

**This action is addressed as part of our 'business as usual' corporate risk management process.*

6.2 Climate Change Action Plan – ARP4 Update

Following the review of our existing ARP3 climate change adaptation action plan, we acknowledge that some actions are still current. These actions remain in progress, and we will continue to work on these through the period leading to ARP5.

Several of our actions set in ARP3 focused on addressing 'moderate' or 'major' climate change adaptation risks (in a present-day scenario). As a result of our revised climate change risk assessment, more 'moderate' climate change adaptation risks have been linked to current ARP3 climate change adaptation actions. All other associated risks have been reviewed to ensure the ARP3 actions remain clear on what risks they intend to address.

While compiling information for this ARP4 report, several new climate change adaptation actions were set. These should help improve our understanding of our key climate change adaptation risks and assist in identifying appropriate measures necessary to address the effects of climate impacts.

Revised Climate Change Action Plan – ARP4:

Action Ref	Climate Change Adaptation Action	Action Category	Associated Risk Code	Status / Due Date
ARP3 Action No.3	Identify opportunities for further data collection and work with our DSO team to integrate this into our asset data systems.	Scoping, monitoring and identifying impacts / risks	**AR1** **AR4** **AR7**	Current / End of 2025
ARP3 Action No.4	Analyse and assess our interdependencies against other sectors and customers to better understand our climate change resilience.	Scoping, monitoring and identifying impacts / risks	**AR1** **AR3** **AR4** **AR7** **AR8** **AR9** **AR10**	Current / End of 2025
ARP3 Action No.5	Quantify risk(s) at an asset voltage class level within our licence areas to identify risk 'hot spots' and take targeted action to mitigate.	Scoping, monitoring and identifying impacts / risks		Current / End of 2025

ARP3 Action No.6	Assess risk(s) across our supply chain to better understand exposure and collaborate to address risks through increased innovative and resilient solutions.	Scoping, monitoring and identifying impacts / risks	**AR11** **AR12** **AR13** **AR16 (New)**	Current / End of 2026
ARP4 Action No.8	Explore the use of local (finer resolution) climate change projections to better understand the effects of Urban Heat Islands on our assets.	Scoping, monitoring and identifying impacts / risks	**AR8**	Planned / End of 2025
ARP4 Action No.9	Install temperature monitors to measure a) ambient air temperatures within our indoor substations, and b) measure the effects of solar radiation and local cooling factors to better understand the probability of exceeding certain temperature thresholds during hot spells. Compare results with other proactive temperature monitoring and enhanced inspections, including hot spot measurements, and oil testing and analysis to help better understand the core condition of transformers allowing for the risk of temperature rise to be better understood.	Scoping, monitoring and identifying impacts / risks	**AR4** **AR7** **AR9**	Planned / End of 2026
ARP4 Action No.10	Work with the DSO to better understand the impacts of climate change on future demand profiling to make sure any adjustments are made to ensure investment plans provide sufficient network capacity.	Scoping, monitoring and identifying impacts / risks	**AR1** **AR4** **AR7**	Planned / End of 2025
ARP4 Action No.11	Undertake a new study to identify the relationship between severe weather and faults, customer interruptions (CI) and customer minutes lost (CML). The outputs of such analysis should be used to quantify the future impacts of climate change.	Scoping, monitoring and identifying impacts / risks	**AR1** **AR4** **AR7** **AR10** **AR11** **AR14** **AR16 (New)**	Planned / End of 2026

ARP4 Action No.12	Consider the earlier onset of bird breeding/nesting seasons and tree pests/diseases in the transition from winter to spring as an emerging risk and how this may impact upon current tree maintenance and construction schedules.	Scoping, monitoring and identifying impacts / risks	**AR3**	Planned / End of 2026
ARP4 Action No.13	Develop a route map of adaptation pathways and assemble sequences of actions, and trial interventions that address the identified risks and opportunities from analysis undertaken as part of ARP3 climate change adaptation action No.5. The process outlined in BS 8631:2021 Adaptation to climate change – using adaptation pathways for decision making (guide) shall be followed.	Consideration of impacts, risks and likely actions	**AR1** **AR3** **AR4** **AR7** **AR8** **AR9** **AR10** **AR11** **AR12** **AR13** **AR16 (New)**	Planned / End of 2026
ARP4 Action No.14	Implement effective monitoring and evaluation of our adaptation pathways and actions by identifying and tracking appropriate process and outcome indicators at the Climate Change Resilience Steering Group.	Monitoring actions and evaluation against plans		Planned / End of 2025
ARP4 Action No.15	Explore the potential to incorporate previous weather data or events and associated faults/incidents into asset condition assessments and reporting.	Consideration of impacts, risks and likely actions		Planned / End of 2026

7.0 Appendix

7.1 UK Power Networks Priority Climate Change Risk Scores

Climate Change Adaptation Risk	Adaptation Reporting Round 3				Adaptation Reporting Round 4			
	Present-day Scenario	2050 (Do-Nothing) Scenario	2050 (Mitigated) Scenario	2100 (Mitigated) Scenario	Present-day Scenario	2050 (Do-Nothing) Scenario	2050 (Mitigated) Scenario	2100 (Mitigated) Scenario
AR1 Temperature - Overhead line conductors affected by temperature rise	3 / Low	12 / Major	6 / Moderate	6 / Moderate	6 / Moderate	12 / Major	6 / Moderate	6 / Moderate
AR2 Temperature - Overhead line structures affected by summer drought and consequent ground movement	2 / Low	9 / Moderate	3 / Low	3 / Low	6 / Moderate	9 / Moderate	3 / Low	3 / Low
AR3 Temperature / precipitation - Overhead lines affected by interference from vegetation due to prolonged growing season	12 / Major	20 / Severe	8 / Moderate	8 / Moderate	12 / Major	20 / Severe	8 / Moderate	8 / Moderate
AR4 Temperature - Underground cable systems affected by increase in ground temperature	3 / Low	12 / Major	6 / Moderate	6 / Moderate	6 / Moderate	12 / Major	6 / Moderate	6 / Moderate
AR5 Temperature - Underground cable systems affected by summer drought and consequential ground movement	2 / Low	12 / Major	4 / Moderate	4 / Moderate	2 / Low	12 / Major	4 / Moderate	4 / Moderate
AR6 Temperature - Substation and network earthing systems adversely affected by summer heat and drought conditions	2 / Low	12 / Major	4 / Moderate	6 / Moderate	2 / Low	12 / Major	4 / Moderate	6 / Moderate
AR7 Temperature - Transformers affected by temperature rise	2 / Low	12 / Major	4 / Moderate	6 / Moderate	4 / Moderate	12 / Major	4 / Moderate	6 / Moderate

AR8 Temperature - Transformers affected by urban heat islands and coincident air conditioning demand	2 / Low	12 / Major	4 / Moderate	6 / Moderate	6 / Moderate	12 / Major	4 / Moderate	6 / Moderate
AR9 Temperature - Switchgear affected by temperature rise	2 / Low	12 / Major	4 / Moderate	6 / Moderate	4 / Moderate	12 / Major	4 / Moderate	6 / Moderate
AR10 Precipitation - Substations affected by river (fluvial) flooding due to increased winter rainfall	12 / Major	20 / Severe	8 / Moderate	8 / Moderate	12 / Major	20 / Severe	8 / Moderate	8 / Moderate
AR11 Precipitation - Substations affected by pluvial (flash) flooding due to increased rainstorms in Summer and Winter	12 / Major	20 / Severe	10 / Major	8 / Moderate	15 / Major	20 / Severe	10 / Major	8 / Moderate
AR12 Precipitation - Substations affected by sea flooding due to increased rainstorms and/or tidal surges	12 / Major	16 / Major	9 / Moderate	12 / Major	12 / Major	20 / Severe	12 / Major	12 / Major
AR13 Precipitation - Substations affected by water flood wave from dam burst	5 / Moderate	5 / Moderate	5 / Moderate	5 / Moderate	5 / Moderate	5 / Moderate	5 / Moderate	5 / Moderate
AR14 Lightning - Overhead lines and transformers affected by increasing lightning activity	3 / Low	12 / Major	4 / Moderate	4 / Moderate	3 / Low	12 / Major	4 / Moderate	4 / Moderate
AR15 Wildfire - Overhead lines and underground cables affected by extreme heat and fire smoke damage	2 / Low	12 / Major	4 / Moderate	4 / Moderate	4 / Moderate	12 / Major	4 / Moderate	4 / Moderate
AR16 Windstorms - Overhead lines (OHL) affected by strong winds	N/A	N/A	N/A	N/A	6 / Moderate	TBC	TBC	TBC

7.2 Energy Networks Association (ENA) ARP Risk Matrix

The following risk explanations and matrices have been developed by ENA members as a means of measuring climate adaptation risk based on the definition and assessment of both the level of impact and likelihood of the identified risks being realised:

ARP Risk Matrix (Electricity Networks)

Horizons: 2025, 2025, 2080		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

Rating:	**Impact Definition:**
Extreme	Regional area affected with people off supply for a month or more OR asset de-rating exceeds ability to reinforce network leading to rota disconnections on peak demand.
Significant	County or city area affected with people off supply for a week or more OR asset de-rating requires a significant re-prioritisation of network reinforcement and deferment of new connection activities.
Moderate	Large town or conurbation off supply for up to a week OR significant increase in cost of network strengthening.
Minor	Small town off supply for a 24-hour period OR significant increase in cost of network maintenance requirements.
Limited	Limited impact - can be managed within “business as usual” processes.
Rating:	**Likelihood Definition:**
Extreme	The risk in the process of materialising and may already be under active management as an event.
Significant	Past events have not been fully resolved, effective mitigations not yet identified, control weakness are known and are being managed.
Moderate	Past events satisfactorily resolved, mitigations are in place or are on track to be in place, control improvements are under active management.
Minor	Events are rare, required mitigations in place, controls are effective.
Limited	No known event or if known extremely rare, extreme industry-wide scenarios.

7.3 References

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