UK CLIMATE RISK

HIGH TEMPERATURES BRIEFING

Findings from the third UK Climate Change Risk Assessment (CCRA3) Evidence Report 2021

HIGH TEMPERATURES

This briefing summarises how the risks and opportunities from higher temperatures have been assessed in the latest UK Climate Change Risk Assessment (CCRA) Technical Report, and what types of action to adapt would be beneficial in the next five years.

ukclimaterisk.org

The full assessment looks at risks and opportunities for the UK under two climate change scenarios, corresponding to approximately a 2°C or a 4°C rise in global temperature by 2100. It answers three questions, for 61 different risks or opportunities using available published evidence and analysis:

1. What is the current and future level of risk or opportunity?

2. Is the risk or opportunity being managed, taking account of government action and other adaptation?

3. Are there benefits of further adaptation action in the next five years, over and above what is already planned?

The main findings from the full assessment related to higher temperatures are summarised below, together with the adaptation actions that would be beneficial over the next five years. Each risk or opportunity has an identifier code linked to the full analysis, which is available in the CCRA3 Technical Report.

Readers are encouraged to use these briefings to locate the parts of the Technical Report of most relevance to them.

Alternatively, if you would like a summary of the analysis by UK nation, please go to the national summary documents:

• **England** • **Northern Ireland** • **Scotland** • **Wales**

This briefing is aimed primarily at the UK Government, the governments of Scotland and Wales, the Northern Ireland Assembly and their respective departments and agencies. However, it should also be of interest to a wider audience.

Key messages

- Average and extreme temperatures will continue to increase across the whole of the UK. On average winters are projected to continue to get warmer, summers hotter, and heatwaves more common.
- Higher temperatures will lead to both increases in heat-related deaths and illness, and disruption to the health and social care sector including the emergency services.
- Vulnerable people exposed to high temperatures in hospitals and care homes are of particular concern given the limited options available for reducing their exposure, as they are difficult to move to other locations.
- There is still no preventive policy to address health risks from overheating in buildings.
- High temperatures will also increasingly affect energy and especially transport infrastructure, but the understanding and management of risks across these sectors is inconsistent.
- The quality of evidence for heat risks to digital infrastructure is quite limited, and needs further attention given the reliance of other infrastructure and communications networks on the sector.
- Extreme heat events can lead to negative impacts on employee health and wellbeing, leading to reductions in productivity.
- High temperatures will have complex, interacting and wide-ranging effects on the natural environment, including on biodiversity, agricultural and forestry productivity.
- Adaptation responses should be considered alongside net zero carbon goals to prevent maladaptation and realise common benefits, particularly for adapting buildings.

1. Risks to health and wellbeing from high temperatures, and risks to the health and social care sector (H1 and H12)

High temperatures will lead to increased numbers of people becoming ill or dying across the UK.

In 2020 for example, an additional ~2,500 deaths were recorded during the summer heatwave across England, which could not be explained by other factors.

Heat-related deaths could triple by the 2050s, considering the effects of climate change and population growth (high magnitude now and in the future).

High temperatures also disrupt the emergency services, with good evidence for increased ambulance response times in hot weather.

While there is more evidence since CCRA2 about the risks of overheating in homes, hospitals and care homes, and the effectiveness and limitations of strategies for passive and space cooling, policies to protect people from overheating in new and existing homes and other buildings including care homes are still to be developed fully across the UK.

Further details on these risks: Health, Communities and Built Environment Technical Chapter, risk H1 and H12

Beneficial actions in the next five years include:

- **The updating of building regulations or other policy measures to address overheating in new and refurbished homes.**
- **Increased guidance and incentives to address overheating in existing homes to reduce exposure to excessive heat indoors.**
- **Regional or local level climate risk assessments by NHS Trusts, Health Boards and local government social services (where these are not already happening) to help them plan forward with climate risks in mind.**
- **Ensure that designs for new care homes, hospitals and other health and social care assets are considering future temperatures.**
- **Undertake an economic analysis of adaptation options for care homes alongside the use of adaptive measures such as improved glazing, draught proofing, shutters, reflective surfaces, green cover and green space and ceiling fans, where appropriate.**
- **Monitoring of indoor temperatures and other indicators to respond to changes over time.**
- **Implementing green infrastructure, which has the potential to reduce urban temperatures along with delivering other benefits around air pollution, flood alleviation and increased biodiversity.**
- **Better coordination between decarbonisation and adaptation policies and strategies for homes to manage potential trade-offs between increasing air tightness for energy efficiency gains, and overheating risk.**

2. Opportunities for health and wellbeing from higher temperatures (H2)

Higher temperatures in winter could reduce the number of cold-related deaths and associated burdens on the NHS to some degree, though population aging is likely to offset some of the benefit from warmer winters for cold-related mortality, and a public health response to mitigate the health impacts of cold weather will remain important.

As well as reducing the risks from cold, there could be health benefits from warmer temperatures that would in turn also reduce disease burdens on the health and social care system.

The physical and mental benefits of increased physical activity and contact with nature are well established (including improved Vitamin D uptake), though there remains limited evidence of whether a warmer climate will increase these activities, and this is an area requiring further research to quantify the benefits. There are also potential risks through increased sun exposure leading to potentially higher levels of skin cancer, so public awareness campaigns will remain important.

The current magnitude is low, rising to medium for England and Wales by the end of the century.

Beneficial actions in the next five years include:

- **Further investment in research as well as strategies (e.g. improved infrastructure) to increase physical activity and improve mental health from greater outdoor recreation and active travel (e.g. walking and cycling) due to warmer temperatures.**
- **Despite a projected reduction in risk, it will be important to maintain planning within the health and social care system for cold-weather impacts. The burden from ill-health associated with cold weather and cold homes will remain significant in the future, even with some decline in hazard due to climate change.**
- **Any increased attention on managing the risks from heat should not lead to a subsequent decline in attention to managing the risks from cold. Both heat- and cold-related health impacts will remain and require health and social care service interventions in the future.**

Further details on this opportunity: Health, Communities and Built Environment Technical Chapter, opportunity H2

The UK is expected to experience **warmer, wetter winters** and **hotter, drier summers** as the climate changes. **Sea levels** will also continue rising.

3. Risks to the energy sector from high and low temperatures, high winds, lightning (I10)

High temperatures can reduce the generation, transmission and efficiency of distribution of electricity, reduce the efficiency of photovoltaic cells, cause power lines to sag, affect the operation of gas compressor stations, and cause faults on the electricity network.

Temperature is also one of the major drivers of energy demand in the UK, and demand for air conditioning and summer cooling is increasing.

The future risks from heat to the energy sector will interact with this energy demand profile, with periods of high demand in summer for cooling, and impacts from excessive heat on supply likely to coincide. These impacts will affect the resilience of society and the economy to constraints on or interruptions to supply. Failures to the electricity system are likely to have much larger impacts in the future if both transport and home energy supply are fully electrified as the UK moves towards net zero emissions of greenhouse gases.

Different energy technologies have different vulnerabilities to weather and climate and so the balance of these technologies in the future will influence the resilience of energy to climate change. The risk is high magnitude now and in the future.

Beneficial actions in the next five years include:

- **A better understanding of the risks from passing specific thresholds that affect energy supply. For example, communications infrastructure supporting telemetry components in the national gas grid have been found to have a maximum operating temperature of 40°C (where external temperature and the load on the asset are contributing factors), a threshold that is becoming increasingly likely to occur across the UK.**
- **Incorporate climate change information into the design of new assets and renewal of existing assets and develop an improved understanding of the influence of climate on future energy demand.**

Further details on this risk: Infrastructure Technical Chapter, risk I10

Later this century more of the rain in summer will come from **short lived high intensity showers.**

4. Risks to transport from high and low temperatures, high winds, lightning (I12)

Extreme heat can cause multiple problems to transport. On the railways, it can cause rails to buckle, overhead cables to sag and signals to fail. On roads, expansion, bleeding and rutting of bridges and pavements can be a problem. In aviation, problems with airport runway conditions, the likelihood of aviation fuel vapours being able to ignite (which is usually around 38°C) and overheating of standing aircraft will increase.

These impacts are a particular issue for health and safety if they occur when passengers are unable to leave a train, plane or bus. Extreme heat can also prevent maintenance. There are examples of good practice in adaptation within different transport modes, particularly in rail, but the understanding and management of risks across the sector is inconsistent.

Actions being taken to reduce risk by the rail industry are likely to be reducing vulnerability in some areas, but evidence is lacking on how far vulnerability or exposure are being reduced. There is also a lack of quantified data on the impact of high temperatures on road infrastructure, thus confidence in the evidence is low. A full understanding of the future risks will also require an assessment of the energy and digital infrastructure supporting electrified transport systems required to meet the UK's net zero carbon targets. The risk is medium magnitude now, rising to high in the future.

Beneficial actions in the next five years include:

- **Developing improved indicators of climate resilience for road, rail, ports and airports.**
- **Mainstreaming climate change adaptation into planning and design of new infrastructure, to avoid future retrofitting, alongside improved monitoring, maintenance practices and operations.**
- **Improving weather and climate services, including early warning systems, through use of digital platforms, remote sensing and real time network management.**
- **Revising standards for railways to align with future climate projections.**

Further details on this risk: Infrastructure Technical Chapter, risk I12

The chance of **extreme maximum daily temperatures** will increase.

5. Risks to digital infrastructure from high and low temperatures, high winds, lightning (I13)

Heatwaves and droughts can affect information and communications technology (ICT) infrastructure through ground shrinkage that damages underground electrical, gas, and water infrastructure and thus co-sited ICT, and through demands for cooling putting pressure on energy networks, causing energy failures and 'brown outs.'

Heat and humidity pose a challenge for data centres, which need to be kept cool to operate. Risks to digital systems from climate change are currently considered to be of medium magnitude under different climate change scenarios, although the quality of the evidence supporting this conclusion is low. While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative assessment of how climate change will affect the frequency and magnitude of interruptions is lacking.

A further challenge to assessing risk nationally is that the location or specification of assets is often kept out of the public domain in the interests of security and commercial sensitivity. ICT is critical to the operation of wider infrastructure networks and underpins access to key services and wider communication, and therefore interruption can have wide ranging and cascading impacts. The risk is low now, rising to medium from the 2050s across the UK.

Beneficial actions in the next five years include:

- **Further attention to the climate resilience of the sector and quantitative information about current and future risks from climate change, along with improving evidence of risk and vulnerability of assets.**
- **The incorporation of digital infrastructure into existing infrastructure climate change adaptation plans.**

Further details on this risk: Infrastructure Technical Chapter, risk I13

A decrease in soil moisture during summers is projected, consistent with the reduction in summer rainfall

6. Risks to business from reduced employee productivity (B5)

High temperatures can have negative impacts on employees' health and wellbeing and ability to commute to work.

There is some evidence that businesses are experiencing these impacts already, but in the UK the risk remains largely unquantified, as was the case for the last CCRA in 2017.

The impacts of extreme heat are likely to vary widely across business sectors or geographies, depending on factors such as the type of work, whether work is indoors or outdoors, and the local built environment and infrastructure.

Home working due to COVID-19 is likely to offer insights into overall productivity but also creates a new risk for those employees working from homes prone to overheating (as well as other climate hazards like damp and mould).

The risk is low to medium across the UK by the 2050s, but could become high by the 2080s.

Beneficial actions in the next five years include:

- **Analysis to start to quantify the current and future risk of overheating to businesses.**
- **Further research into interdependencies between business and infrastructure, types of employees at greatest risk, and effectiveness of planned or autonomous adaptation.**
- **Better collection of business continuity information related to extreme weather.**
- **Adaptation reporting by businesses to increase understanding of the risk.**

Further details on this risk: Business Technical Chapter, risk B5

The UK's annual average temperature has **increased by 1˚C** above the pre-industrial period.

7. Risk to delivery of education and prison services from extreme weather (H13)

The effects of climate hazards, including high temperatures, on education and prison services are also a health concern given the risks to people in those settings.

These sectors include schools, universities, nurseries and other early years settings, prisons, courts, and secure units.

Recent local studies have shown that high temperatures can be one of the key factors in affecting the concentration of children in schools, and high numbers of complaints have been received because of overheating in prisons.

The risk to education and prison services specifically was not addressed in CCRA2 and is an emerging area of concern. The risk is considered medium now, potentially rising to high for England by the 2080s.

Beneficial actions in the next five years include:

- **Site risk assessments and adaptation plans with specific targets, tasks and roles to ensure delivery and effectiveness.**
- **Promote use of cooling technologies and ventilation in schools, such as natural ventilation systems, automated window ventilation, hybrid natural and mechanical ventilation, thermal massing and solar shading.**
- **The installation of retrofit measures such as cool or green roofs, solar shading, and cooling and water saving technologies.**
- **Understanding how to move people in an emergency; particularly for prisons but also nurseries and schools, is an important area for ensuring up to date plans are in place.**

Further details on this risk: Health, Communities and Built Environment Technical Chapter, risk H13

4°

The UK could experience an increase in annual average temperature of **up to 4˚C** or more by the **end of the century**, depending on the success of global greenhouse gas reductions.

8. Risks and opportunities to terrestrial, freshwater and marine species and habitats from changing climatic conditions and extreme events (N1, N3, N11, N13, N14, N15), soils and carbon sequestration (N4, N5) and risks to terrestrial, freshwater and marine species from pests, diseases and invasive non-native species (N2, N12, N16)

High temperatures will have complex, interacting and wide-ranging effects on the natural environment. These include:

- Warmer winter temperatures could benefit some overwintering UK terrestrial species by increasing survival rates; for example, for species of small birds like goldcrests and long-tailed tits, as well as wading birds like woodcock which need thawed ground to search for food.
- Warmer winters are conversely likely to increase the survival potential and spread of pathogens, pests and invasive species, such as signal crayfish or pacific oyster.
- Higher temperatures can increase metabolism and therefore the productivity within soil, but also carbon and methane emissions, including from degraded peatlands leading to impacts on all terrestrial ecosystems.
- High temperatures can lead to increased spread and ferocity of wildfires and make them much harder to control (see wildfire briefing).

There is a range of policies and measures aimed at facilitating adaptation and which would be expected to build resilience to climate change including for higher temperatures.

However, there is a lack of evidence of the effectiveness of these measures to date, while a range of indicators show ongoing declines in biodiversity, which leaves species and habitats more vulnerable to climate change. There are also few examples of adjustments to manage climate change impacts for the best biodiversity outcomes, when building resilience is not sufficient to prevent change.

Beneficial actions in the next five years include:

- **The large number of beneficial actions summarised in the freshwater, terrestrial, marine, and wildfire briefings are relevant to managing the risks and opportunities from high temperatures.**
- **Climate and environmental change explicitly should be accounted for in conservation planning at site level and more widely.**
- **Site-level conservation objectives and plans could be reviewed to assess whether management is appropriate for new and potential colonists and adapted accordingly.**

Further details on these risks and opportunities: Natural Environment and Assets Technical Chapter

We can expect increases to **extreme coastal water levels** driven mainly by increases in **sea level rise.**

9. Risks and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions (N6, N9) and pests, pathogens and invasive non-native species (INNS) (N7, N8)

As well as affecting underpinning natural assets, high temperatures will impact on the services they provide. Agriculture and forestry are considered here while impacts on wild fisheries will be similar to the marine impacts mentioned above.

High temperatures will affect both land utilisation and agriculture and forestry productivity, as well as threats from pests, pathogens and INNS. High temperatures can increase photosynthesis in plants (including trees and crops), leading to increased productivity if water is not limiting, though extreme heat has the opposite effect and causes plants to shut down. Growing seasons are also likely to increase across the UK, which could benefit agriculture and forestry productivity. Heat combined with dry conditions also presents a higher risk of wildfires spreading and increasing in intensity. A decline in winter and spring frosts can negatively affect plant growth triggers (such as in blackberries) and lead to increases in over-wintering survival or pathogens, pests and INNS.

As for the risks and opportunities to biodiversity and soils above, there will be high magnitude impacts in the future, both positive and negative, for agriculture and forestry from high temperatures. Knock-on effects on the food and drink supply chain, and price rises during times of scarcity, will also occur, as happened in the summer drought and heatwave of 2018.

Beneficial actions in the next five years include:

- **An improved assessment capability for agriculture and forestry.**
- **Regular systematic surveys on the uptake of adaptation practices in the UK.**
- **Application of near-term climate forecasts.**
- **A more comprehensive assessment of climate resilience and robustness of different land use options in the context of changing water availability.**
- **Better integration of net zero carbon targets and adaptation pathways.**
- **Combined use of climate projections with socioeconomic scenarios to place UK production in an international context.**

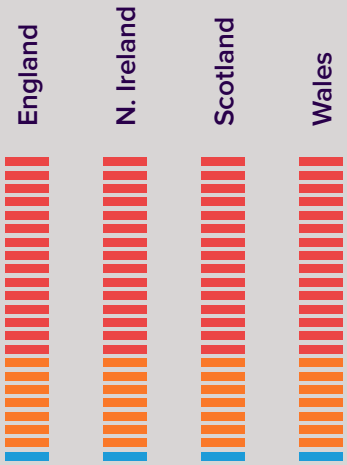
Further details on these risks and opportunities: Natural Environment and Assets Technical Chapter

Rainfall is expected to **decrease in summer**, but when it does rain it is projected to be **more intense**, by as much as **25%**.

Variations across the UK

Key

- More action needed
- Further investigation
- Sustain current action
- Maintain a watching brief



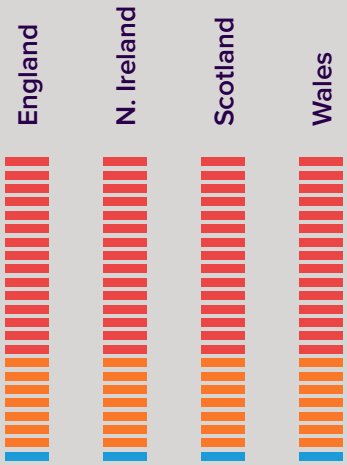
Risk or opportunity	England	Northern Ireland	Scotland	Wales
Risks to health and wellbeing from high temperatures **(H1)**	●	●	●	●
Risks to health and social care delivery **(H12)**	●	●	●	●
Opportunities for health and wellbeing from higher temperatures **(H2)**	●	●	●	●
Risks to energy from high and low temperatures, high winds, and lightning **(I10)**	●	●	●	●
Risks to transport from high and low temperatures, high winds, and lightning **(I12)**	●	●	●	●
Risks to digital from high and low temperatures, high winds, and lightning **(I13)**	●	●	●	●
Risks to business from reduced employee productivity **(B5)**	●	●	●	●
Risks to prison and education services from extreme weather **(H13)**	●	●	●	●
Risks to terrestrial species and habitats from changing climatic conditions and extreme events, including temperature change, water scarcity, wildfire, flooding, wind, and altered hydrology (including water scarcity, flooding and saline intrusion) **(N1)**	●	●	●	●
Risks to terrestrial species and habitats from pests, pathogens and invasive species **(N2)**	●	●	●	●
Opportunities from new species colonisations in terrestrial habitats **(N3)**	●	●	●	●
Risk to soils from changing climatic conditions, including seasonal aridity and wetness **(N4)**	●	●	●	●

Continued...

Variations across the UK

Key

- More action needed
- Further investigation
- Sustain current action
- Maintain a watching brief



...continued

Risk or opportunity	England	Northern Ireland	Scotland	Wales
Risks and Opportunities to natural carbon stores and sequestration from changing climatic conditions, including temperature change and water scarcity **(N5)**	●	●	●	●
Risks to freshwater species and habitats from changing climatic conditions and extreme events, including higher water temperatures, flooding, water scarcity and phenological shifts **(N11)**	●	●	●	●
Risks to freshwater species and habitats from pests, pathogens and invasive species **(N12)**	●	●	●	●
Opportunities to freshwater species and habitats from new species colonisations **(N13)**	●	●	●	●
Risks to marine species, habitats and fisheries from changing climatic conditions, including ocean acidification and higher water temperatures **(N14)**	●	●	●	●
Opportunities to marine species, habitats and fisheries from changing climatic conditions **(N15)**	●	●	●	●
Risks to marine species and habitats from pests, pathogens and invasive species **(N16)**	●	●	●	●
Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind and saline intrusion) **(N6)**	●	●	●	●
Risks to agriculture from pests, pathogens and invasive species **(N7)**	●	●	●	●
Risks to forestry from pests, pathogens and invasive species **(N8)**	●	●	●	●
Opportunities for agricultural and forestry productivity from new/ alternative species becoming suitable **(N9)**	●	●	●	●

UK CLIMATE RISK

HIGH TEMPERATURES BRIEFING

Findings from the third UK Climate Change Risk Assessment (CCRA3) Evidence Report 2021

Background

The UK Government is required by the UK Climate Change Act 2008 to assess the risks and opportunities from climate change to the UK every five years and respond to the risks via a National Adaptation Programme, covering England. The devolved administrations also publish their own adaptation programmes in response to the risk assessment.

For this third UK Climate Change Risk Assessment, the Government's independent advisers on climate change, the Climate Change Committee (CCC), have been asked to prepare an independent risk assessment setting out the latest evidence on the risks and opportunities to the UK.

Over 450 people from more than 130 organisations have contributed to preparing the assessment. The risks have been assessed using the latest climate projections for the UK which were updated in 2018 by the Met Office. These briefings summarise some of the key topics that are assessed through the Technical Report, to enable readers to understand the key messages and where to find more detail.

Where to find more detail

Each risk or opportunity in this briefing has an identifier code linked to the full analysis, which is available in the CCRA3 Technical Report. Readers are encouraged to use these briefings to locate the parts of the Technical Report of most relevance to them.

Alternatively, if you would like a summary of the analysis by UK nation, please go to the national summary documents: • **England** • **Northern Ireland** • **Scotland** • **Wales.**