

# Priorities for action

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## Introduction and key messages

This chapter sets out the Committee's advice – to both the Government and other organisations – on the highest priority risks to address in the next five years.

**Of the 61 risks and opportunities set out in the CCRA3 Technical Report, the Committee has highlighted eight priority areas that, in particular, should be taken forward as critical adaptation policies at the highest levels of government in the next two years, in advance of the next round of National Adaptation Plans.** These eight priorities are based on the Committee's assessment using the following criteria, which are shown for each risk and opportunity in an accompanying annex to this report:

- the degree of urgency given in the Technical Report
- the gap in adaptation planning
- the growing importance to the UK in the context of the changes taking place, for example the implications of delivering Net Zero
- the opportunity to integrate adaptation into major policies, legislation and strategies over the course of the rest of this Parliament (up to 2024)

### **Our eight priority areas are\*:**

1. Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards
2. Risks to soil health from increased flooding and drought
3. Risks to natural carbon stores and sequestration from multiple hazards leading to increased emissions
4. Risks to crops, livestock and commercial trees from multiple hazards
5. Risks to supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks
6. Risks to people and the economy from climate-related failure of the power system
7. Risks to human health, well-being and productivity from increased exposure to heat in homes and other buildings
8. Multiple risks to the UK from climate change impacts overseas

We set out our analysis supporting these priorities in three sections:

- The adaptation deficit
- Priority risks for action
- The background assumptions for our risk prioritisation, shown in the accompanying annex for this report

\* Note that the priorities are not ranked from one to eight – they are deemed equally urgent

# The adaptation deficit

## **Our assessments of progress in adaptation for England and Scotland show a large deficit in the delivery of adaptation.**

The Adaptation Committee has a statutory role to assess progress in adapting to climate change for England every two years. We have also produced two reports for Scotland evaluating the first Scottish Climate Change Adaptation Programme. These reports have shown pockets of excellence in each for risk assessment, adaptation plans and delivery, but at the national level the scale of action does not meet the scale of risk. In neither nation are there sufficient plans in place for ensuring adaptation is underway for even a 2°C scenario, let alone a 4°C scenario. In no case have we been able to give a high score for delivery of adaptation to reduce risks. Our next progress report for England will be published shortly.

## **The CCRA3 Technical Report shows a similar picture in its assessment of adaptation, with sufficient adaptation underway for only four out of 61 risks and opportunities, and no plans in place at all for a further seven (the remainder being given a 'partially managed' score).**

The Technical Report includes analysis for each risk and opportunity of the extent to which the level of adaptation underway is sufficient. The method considers whether adaptation will keep the future magnitude of risk at a low level in cases where the risk is currently low in the present day, or if it will avoid an escalation of risks and manage the drivers of vulnerability and exposure where the magnitude is already medium or high (such as for flood risk). For opportunities, the opposite applies, where the assessment judges how far the opportunity is likely to be realised.

The assessment has included consideration of government and non-government action, and the barriers that are preventing further action.

Out of the 61 risks and opportunities, only four have been assessed in the CCRA3 Technical Report as being managed sufficiently on the basis of current and planned government and non-government adaptation for any of the four UK nations (i.e., the adaptation score across the UK is 'yes'). These are:

- risks to aquifers and agricultural land from sea level rise (N10)
- risks to offshore infrastructure from storms and high waves (I11)
- opportunities for UK food availability and exports from climate change impacts overseas (ID2)
- opportunities from climate change on international trade routes (ID6)

A further seven risks and opportunities have been assessed in the CCRA3 Technical Report as having a significant gap in policies and plans in place to adapt in at least one of the four UK nations at the time of writing (i.e., the adaptation score across the UK is 'no'). These are:

- opportunities from new species colonisations in terrestrial habitats (N3)
- risks and opportunities to natural carbon stores and sequestration (N5)
- opportunities for new agricultural and forestry species (N9)

Only four out of 61 risks and opportunities in the risk assessment are deemed to be managed sufficiently on the basis of planned adaptation actions.

- opportunities to marine species and fisheries from changing climatic conditions (N15)
- risks to digital infrastructure from high and low temperatures, high winds and lightning (I13)
- risks and opportunities from changing summer and winter household energy demand (H6)
- risk multiplication from cascading impacts of climate change overseas (ID10)

All other risks and opportunities at the UK level have been awarded a 'partially managed' score.

The low adaptation scores have contributed to the large increase in the number of risks and opportunities falling into the most urgent 'more action needed' category for government action.

## Rationale and criteria for prioritisation

**The increase in the number of risks falling into the most urgent category presents challenges for Government in identifying where to focus most attention at the highest levels and through the coordination of adaptation across departments.**

Chapter 2 shows the large increase in the number of risks falling into the top 'more action needed' urgency category compared to CCRA2. All of the 61 risks and opportunities must be addressed in the forthcoming National Adaptation Plans. However, in addition, the Committee has identified, amongst the 'more action needed' risks, eight top priorities that should be addressed in the next two years at the highest levels of government and jointly across departments and between UK Government and the devolved administrations.

We have identified these priorities using expert judgement around four criteria, detailed for each risk and opportunity in an accompanying annex to this report:

Some risks need urgent attention now, even before the next round of National Adaptation Plans is published from 2023.

- Risks or opportunities with the highest urgency score (more action needed)
- Risks or opportunities where the largest gaps in adaptation policy or action exist; based on both the CCRA Technical Report assessment and the Adaptation Committee's progress reports (covering England and Scotland only)
- Risks which are becoming increasingly urgent because of national and global change, for example the consequences of the transition to Net Zero emissions
- Risks or opportunities where it appears that the largest opportunities for integrating adaptation into key policies are likely to arise over the next 12 months, and where missing the opportunities could lead to lock-in or mal-adaptation

## Summary of the priority risks and opportunities for government

**The Committee has identified eight sets of risks as needing the most attention at the highest levels of government over the next two years.**

The Committee's assessment, using these four criteria across all risks and opportunities for each UK nation is provided in a separate accompanying annex to this report. The results of the prioritisation are shown in Figure 4.1 below, reflecting a UK-wide list of priorities.

**Figure 4.1** Highest priorities for adaptation in the next five years



**The sections below provide a brief summary for each of the eight priority risk areas, including the main hazards associated with the risk, the assessment of the adaptation gap, and short-term policy opportunities for further action.**

## Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards

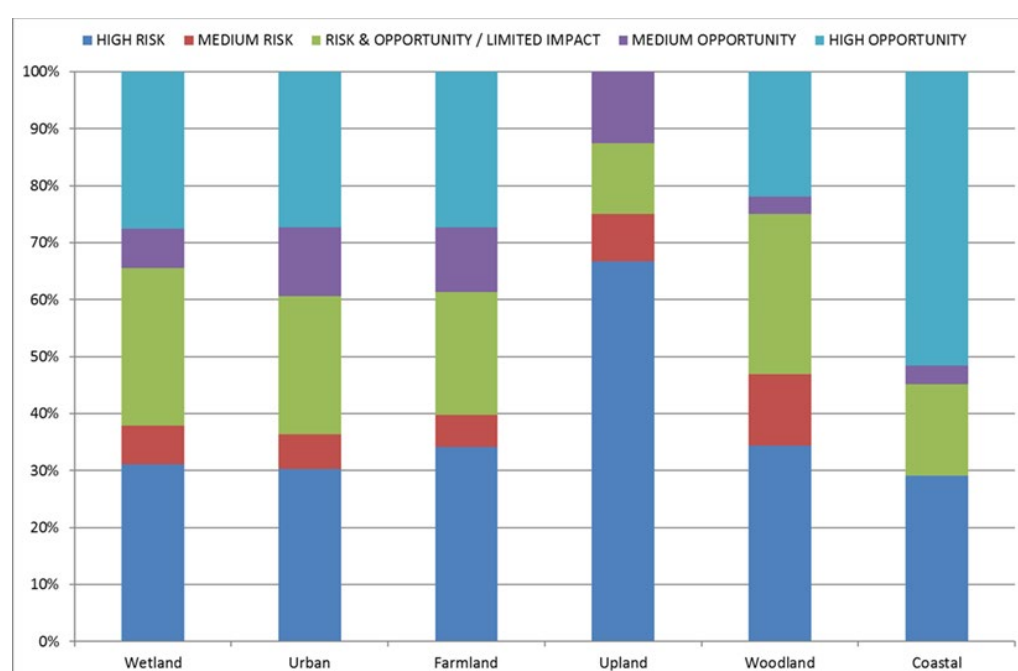
Biodiversity underlies all economic activity and human wellbeing, globally and in the UK. Many of the services that the natural environment provides, such as flood mitigation, water supply and cooling are also key to societal resilience to climate change. However, biodiversity in the UK is degrading, with overall declines in the abundance and distribution of species since 1970.<sup>1</sup> Reversing the decline in UK biodiversity is a major goal for the UK Government and devolved administrations as shown in strategies such as the 25 Year Environment Plan, and Environment (Wales) Act.

Climate change will have complex and mixed effects on UK biodiversity, with some gains and some losses in species and a wide range of effects on different habitats, varying by place and the degree of warming. Terrestrial species and habitats include wildlife that inhabits lowland and upland areas, including farmland, woodland, grassland, heathland, montane habitats, and urban areas.

Freshwater habitats include lakes, ponds, rivers and canals.\* While there are projected to be some benefits for terrestrial and freshwater species from warming, there are also significant projected losses that require adaptation action to minimise negative impacts as far as possible, in order to meet the Government's goals to protect and enhance wildlife.

The risk to upland areas is particularly acute with a predicted decline in the suitability of the climate for 75% of present day upland species by 2100 in a medium (SRES A1B) scenario (Figure 4.2). The uplands provide significant ecosystem services for the rest of the country, from carbon sequestration to water regulation. Such drastic declines would have significant economic consequences for the country.

**Figure 4.2** Proportion of species estimated to be at risk from climate change, by habitat type (medium emissions scenario, 2070-2099)



Source: Reproduced in Chapter 3 of the Technical Report from Pearce-Higgins et al., 2017.

Notes: Proportion of species categorised as likely to be at risk from climate change, based upon the SRES A1B emissions scenario for 2070-2099 or to have an opportunity, according to the habitat each species is associated with.

The range of risks to terrestrial and freshwater species and habitats considered in the assessment include:

- Higher temperatures (warmer winters and hotter summers) leading to changes in the suitability of different habitats for different groups of species; altering the timing of natural events such as trees coming into leaf in the spring; increasing water temperatures; and increasing the risks of pests, diseases and invasive non-native species.
- More frequent and severe extreme events leading to local extinctions or shifts in habitat type (e.g. from woodland to grassland).

\* Marine and coastal habitats and species are covered in other risks in the Technical Report



Wildfire and drought (also leading to low flows) are likely to be the two major hazards that fall into this category, though flooding may also have similar effects.

Beech woodlands are another example of a highly vulnerable habitat type.

The magnitude of current and future risks is assessed in the Technical Report as 'high' (major impacts on or loss of species groups at the UK level) across the UK due to the number of species and habitats adversely affected by climate change, both now and in the future.\* While the economic costs associated with these impacts are complex and difficult to estimate in full (see Chapter 3), they are important because of the value of the assets at risk (in terms of the services they provide), as captured using the UK's natural capital accounts. One example is the benefits of UK woodlands, estimated to be £3.3 billion in 2017.<sup>2</sup> Beech trees make up 8% of all broadleaved woodland in the UK<sup>3</sup>, but are highly sensitive to hotter, drier conditions and their productivity is projected to decline significantly even under moderate levels of warming.

Adaptation for terrestrial and freshwater species and habitats involves reducing other human pressures such as pollution, creating suitable climatic conditions for existing species to persist (e.g. increased shading of rivers using trees), helping species to move (e.g. installing fish passages), active management of habitats to improve their resilience (e.g. mixed planting and removal of fuel loads such as lying dead wood to reduce the risk from wildfire), underpinned by monitoring and surveillance.

The 'Lawton principles' (Lawton Review, 2010) - creating bigger, better, more and more connected areas of semi-natural habitats - are the main set of actions that achieve these aims. Specific actions listed as being beneficial in the next five years in the Technical Report include:

- Increasing efforts to reduce existing human pressures on biodiversity, improving the ecological condition of sites and restoring degraded ecosystems
- Including specific consideration of adaptation in conservation planning, e.g. more planned site alterations to address climate hazards, and spatial planning to allow species to move
- Continued and enhanced monitoring and surveillance of pests, diseases and invasive non-native species
- Ensuring that nature-based solutions are central to the UK's actions to mitigate and adapt to climate change, including using nature to reduce human exposure to flooding and extreme heat.

The Committee has specifically highlighted terrestrial and freshwater habitats and species as a priority due to the more significant gap in adaptation planning highlighted both in the CCRA and in the CCC's progress reports (covering England and Scotland), and the opportunities presented by current policy reforms. The relevant risks are scored as 'more action needed' for all UK nations in the Technical Report. There are ambitious goals for nature recovery in place across the UK, e.g. as set out in the 25-Year Environment Plan for England and the Natural Resources Management Framework for Wales. However, there is a lack of evidence to show that i) the measures included in these plans are being implemented at scale; and ii) they are proving effective at restoring biodiversity.

\* See Berry, P. and Brown, I. (2021) CCRA3 Technical Report Chapter 3 – Natural environment and assets

A wholesale review of environmental policy provides a significant – but time-limited – opportunity to improve adaptation for terrestrial and freshwater habitats, soil health, natural carbon stores, agriculture and forestry productivity.

There is a once-in-a-generation opportunity in the next two years to build adaptation fully into policies for protecting terrestrial wildlife, given the national priority being given to restoring nature and because the UK is going through a wholesale review of environmental policy post-EU Exit. Relevant policies that are under development or review across the UK that need to include specific adaptation actions include:

- England – Environment Bill, Nature Recovery Network, Environmental Land Management Scheme, Nature for Climate Fund, National Pollinator Strategy, Nature Strategy, Soil Health Action Plan, Green Finance Strategy, update to River Basin Management Plans (and recently published Tree and Peat Action Plans)
- Northern Ireland – All-Ireland Pollinator Plan, NI Environment Strategy, NI Peatland Strategy, NI Biodiversity Strategy review
- Scotland – Forest Strategy, Environment Strategy outcome pathways and monitoring framework
- Wales – National Peatland Action Programme, Natural Resources Policy

## Risks to soil health from increased flooding and drought

Soils\* are a key natural asset; well-functioning and fertile soils underpin food and timber supply, carbon sequestration and storage, as well as supporting a diverse range of organisms that form part of the terrestrial food chain for wildlife. UK soils are already under pressure from human actions, leading to erosion, compaction, and pollution. Present day compaction costs are estimated at £470 million per year in England and Wales, while the costs from soil erosion in terms of loss of soil depth and nutrients and offsite impacts to water quality, are estimated to be £150 million per year.

Like biodiversity, there are likely to be a mix of positive and negative effects on soil health as the climate changes, though adaptation is most important for minimising the negative impacts.

The effects of climate change on soil health will be mixed and are difficult to predict precisely, but there is robust evidence that flooding and drought will pose significant risks.

The main climate hazards considered in the CCRA3 Technical Report are heavier rainfall events (erosion and compaction risks), and drier conditions leading to increased soil moisture deficits in summer (loss of biota and organic matter). Wind erosion could also potentially increase in the future, though this is uncertain. The magnitude of risks from climate change to soils are identified as medium (thousands of hectares lost or severely damaged at the UK level per year) for the present day, increasing to high (tens of thousands of hectares or more lost or severely degraded at the UK level per year) in all future climate scenarios by the 2050s and 2080s. For instance, climate projections suggest increasing soil moisture deficits over much of the UK, that are likely to affect soil structure through desiccation effects, modification of soil aggregates, and reductions in organic material that also influence nutrient cycling and water-holding capacity.

In order to meet the UK's Net Zero and other environmental targets, soil health needs not just to remain stable but to improve. For example, the Committee's scenarios for the path to Net Zero involve around a 10% per decade improvement in crop yields.

\* Note that peatlands are included in the priority on natural carbon stores rather than in the soils priority.

Productivity improvement is needed alongside diet change to free up land for carbon sequestration through tree planting, which sees forest cover grow from 13% today to around 18% by 2050.

Awareness of the threat from climate change to soils, and the need for ongoing measurement of soil quantity and quality, has improved, but the necessary adaptation responses are not yet commensurate with the level of risk, leading to a 'more action needed' urgency score across the UK.

Although soil health is included in all of the latest UK national adaptation programmes, planning is not yet accompanied by a comprehensive soil monitoring strategy to understand better and monitor progress on climate change adaptation in the context of other drivers, and to assess the effectiveness of different interventions and land management strategies, both locally and at national scale. The Technical Report highlights a large range of beneficial actions for the next five years including:

The UK still lacks a comprehensive soil monitoring strategy.

- More investment in national-scale soil monitoring programmes
- Payments and advice for land managers that incentivise improvements to soil health
- Development and increased uptake of precision farming technology to minimise erosion and pollution
- Improved evidence on the climate-related implications for the multiple benefits delivered by soils; including to maintain water quality, alleviate flooding at catchment-scale, reduce drought risk and support priority habitats and species.

As is the case for the risks to terrestrial habitats and species, forthcoming updated environmental policies across the UK present a unique opportunity to define targets, monitor condition and incentivise widespread soil conservation measures that address the impacts of a changing climate while maintaining and improving productivity. Opportunities to integrate adaptation into major forthcoming policies include:

- England – Environment Bill, Environmental Land Management Scheme, Soil Health Action Plan (and recently published Peat Action Plan)
- Northern Ireland – Sustainable Agricultural Land Management Strategy
- Scotland – Soil and nutrient network and Farm Advisory Strategy
- Wales – Sustainable Farming and Our Land Strategy

## Risks to natural carbon stores and sequestration from multiple hazards, leading to increased emissions

UK peatlands are a critically important terrestrial carbon store, but this storage capacity could be greatly reduced due to hotter, drier conditions

This priority considers climate change threats specifically to the carbon storage and sequestration properties of soils, trees, wetlands and the marine environment. The current pressures on natural carbon stores are the same as for habitats and species: pollution, erosion, degradation and removal. UK peatlands are one of the most important terrestrial natural stores for carbon. They are estimated to store the equivalent of around 11,700 ( $\pm 1,100$ ) MtCO<sub>2</sub><sup>4</sup>, which is an order of magnitude higher than the carbon stored in trees and over 25 times larger than the UK's total



annual emissions in 2020.\* However, the area of land suitable for peat-forming vegetation in the uplands could decline by between 50% – 65% by 2050.<sup>5</sup> Blue carbon stored in coastal and marine habitats is also thought to be a critical store, though a baseline assessment of the total stock is still needed.

In addition to human pressure, there are both risks and opportunities from the effects of a changing climate on natural carbon stores and resulting greenhouse gas emissions, and therefore on the UK's commitment to achieve Net Zero emissions by 2050 (see Chapter 3). Addressing the risks from climate change will be critical in order for the UK to create the negative emissions needed to meet Net Zero by 2050. This priority focusses on the risks rather than the opportunities to carbon stores, as it is the risks that require the most urgent adaptation responses.

The major threats to carbon stores and sequestration include: hotter and drier conditions reducing the functioning and threatening the existence of peatlands and forests at higher levels of warming; erosion from wind and rain; fire damage; and the potential for increased soil respiration due to higher temperatures. The balance of negative and positive impacts on natural carbon stores remains uncertain though the balance is likely to become increasingly negative with higher rates and levels of warming. The current risk magnitude is assessed as medium across the UK in the CCRA Technical Report, rising to high in the future.

Maintaining the carbon storage capacity of the natural environment through adaptation will be critical for achieving Net Zero by 2050.

Maintaining these carbon stores is critical to delivering the net removal of CO<sub>2</sub> from the atmosphere needed on the path to Net Zero by 2050. The Committee's scenarios involve annual CO<sub>2</sub> removals based on UK nature-based solutions of around 50 MtCO<sub>2</sub> per year by 2050. Even a small loss from existing stores could entirely offset this. These stores are already at risk from the human pressures listed above, and climate change adds an additional, significant threat.

The critical role of CO<sub>2</sub> removals from tree planting and growth, peatland restoration, wetlands, bioenergy production and other nature-based solutions on the path to Net Zero make this risk a high priority. There is a high chance of lock-in leading to permanent losses if action is not started now to plant suitable trees for the future climate in suitable locations and restore and recover peatlands and other wetlands.

Actions with benefits in the next five years could include:

- Integrated land use policy with more spatial targeting for land use change initiatives, and integration of the mitigation and adaptation policy agendas.
- More targeted actions to restore degraded carbon stores, particularly peatlands.
- Research to account for climate change risks to carbon stores in UK GHG Inventory projections.
- A better understanding of carbon storage and sequestration potential for blue carbon (aquatic and marine environments) and the risks to these assets from climate change.
- A systematic programme of soil carbon monitoring for diverse land uses, bioclimatic zones, management interventions etc.

\* Estimates of carbon storage across UK trees are hard to estimate, but the England Biodiversity Indicators suggest that 460 MtC is stored in trees in England.

Key forthcoming policies that should include measures to protect natural carbon stores include:

- England – Net Zero Strategy, Environmental Land Management Scheme, Soil Health Action Plan, Green Finance Strategy and funding measures (e.g. Sovereign Green Bond), recently published Tree and Peat Action Plans.
- Northern Ireland – Sustainable Agricultural Land Management Strategy
- Scotland – Soil and nutrient network and farm Advisory Strategy
- Wales – Sustainable Farming and Our Land Strategy

## Risks to crops, livestock and commercial trees from multiple climate hazards

Productive agriculture and forestry sectors are essential for future domestic food security and for the UK's land to contribute fully on the path to Net Zero emissions by 2050. To maintain and enhance agricultural and forestry productivity, the health and diversity of terrestrial and freshwater ecosystems need to be protected and enhanced.

Climate change poses a direct risk to crops, livestock and commercial trees through increased exposure to heat stress, drought risk, waterlogging, flooding, fire, and pests, diseases and invasive non-native species. Key threats include changing land suitability for both forestry and agriculture; in particular, hotter and drier conditions in the south of the UK, although some northern areas may become more suitable for commercial forestry and arable production. The risks to grassland productivity from increased wetness in the north and west of the UK could limit an otherwise longer growing season. Livestock will be at increased risk directly from heat stress. Wildfire, flooding and erosion also represent a growing risk to commercial agriculture and forestry.

Agriculture and forestry are vulnerable to a wide range of climate hazards. Adaptation is needed to improve land management, change what is planted and grown, and to prepare for increased unpredictability in weather patterns.

The magnitudes of the relevant risks are assessed as medium (impacts on up to 10% of production at the UK level) at present, increasing to high (impacts on 10% or more of production) in future across the UK in all climate scenarios.\* This is due to both increased hazard exposure (heat stress, drought risk, wetness-related risks) and inherent socioeconomic factors in the land use sector that increase sensitivity and vulnerability, such as growing pressures on agricultural land for increased food production.

An effective adaptation response will require different or new varieties of crops, livestock and trees that are more climate resilient, changes to land management including better technologies for managing water and nutrient input, and improved soil conservation. The lead times to develop and establish these can be significant. Action now to address future risks is especially important to avoid lock-in. Other actions identified as beneficial in the next five years include better long-term seasonal forecasts for land managers, assessment of land use options given changing water availability, and land use strategies that bring climate change mitigation and adaptation together, particularly when considering any potential future agronomy and bioenergy production in the UK.

There is no clear evidence that climate risks or opportunities for agriculture and forestry are being strategically managed across the UK. There is more strategic

\* See Berry, P. and Brown, I. (2021) CCRA3 Technical Report Chapter 3 – Natural environment and assets.

planning in the forestry sector compared to agriculture, but much of the impetus for this is provided by Net Zero, rather than adaptation. There is an opportunity to improve climate resilience in forthcoming national and devolved policies for land management, Net Zero and nature protection, as well as using these new policies to support training and skills. But it is not being taken; the signs so far are that specific actions are not yet being included in these policies. Opportunities to integrate adaptation into major forthcoming policies include:

- England – Net Zero Strategy, Environmental Land Management Scheme, Soil Health Action Plan, recently published Tree and Peat Action Plans
- Northern Ireland – Sustainable Agricultural Land Management Strategy
- Scotland – Future rural support schemes
- Wales - Sustainable Farming and Our Land Strategy, Natural Resources Policy

## Risks to supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks

A single flood in Thailand in 2011 cost over \$45 billion in damages including disrupted supply chains.

Most products, including food, finished goods, components and materials, have complex supply chains. Extreme weather is already causing supply chain disruption and exposure to climate hazards is set to increase. For example, severe flooding in Thailand in 2011 disrupted five major manufacturers of hard disk drives. Output declined by up to 30% compared to the previous quarter, and the shortage of hard disk drives increased global prices by 80 - 190%. The World Bank estimated that the total economic cost from this one event was US\$45.7 billion, equivalent to around 13% of Thailand's GDP at the time (Box 4.1). These sorts of hazards affect both the supplies themselves and the infrastructure and routes by which they are transported. Businesses are reporting that while heavy rainfall, surface water flooding and high temperatures, including heatwaves, will continue to dominate their supply chain risks, coastal and river flooding and water scarcity will become more significant drivers in the future.

Some supply chains may present a greater risk due to the importance of the goods for people in the UK and/or because of their economic importance. Currently 64% of the total food consumed in the UK is produced domestically – although the figure for food that can be grown most efficiently in Britain's climate, such as meat and cereals, is higher.<sup>6</sup> This can vary among food groups, for example 16.4% of the total UK supply of fruit in 2019 was grown in the UK, a decline on the 2018 figure of 17.3%. Home production of vegetables contributed to around 54% of the total UK supply in 2019, compared to 53% in 2018.<sup>7</sup>

Cars are both the top imported and exported good for the UK in terms of value, with imports and exports each totalling more than £30bn in 2019.<sup>8</sup> The Society of Motor Manufacturers and Traders states that 81% of all vehicles made in Britain are exported. Other high value imports and exports in 2019 included medicinal and pharmaceutical products, refined and crude oil, mechanical power generators (intermediate), clothing and aircraft.<sup>9</sup>



#### Box 4.1

##### Impacts from 2011 Thailand Floods

An example of a climate-related supply chain shock is the flooding that affected Thailand extensively in 2011, impacting the supply of components – particularly for the automotive and high-tech sectors – which led to global disruption in these sectors. The flooding was reported to cost the Lloyd's of London insurance market \$2.2 billion.

Japanese automakers were particularly hard hit by the inundation of Thai factories and related disruptions to their operations. Toyota and Honda lost operating profit of US\$1.25 billion and US\$1.4 billion respectively, equivalent to 37% and 55% of their operating profit.

The floods also affected Thailand's role as the world's second largest producer of hard disk drives, accounting for 43% of world production. Many of the factories that make hard disk drives were flooded, leading to worldwide shortages of hard disk drives in the short-term, increasing the price of desktop drives by 80–190% and mobile drives by 80–150%, with losses for re-insurers of around \$10 billion.

The World Bank estimated that the total economic cost of flood damage in Thailand was US\$45.7 billion, around 13% of Thailand's GDP.

Source: CCRA3 Valuation Report.

Exposure to climate hazards is set to increase, both within the UK and internationally. Businesses are reporting that while heavy rainfall, surface water flooding and high temperatures, including heatwaves, will continue to dominate their supply chain risks, coastal and river flooding and water scarcity will also become more significant drivers in the future.

Both domestic and international supply chains are at risk from climate change.

Imports of goods such as staple crops are also at risk, which are considered in the Technical Report. There is no national estimate for any sector of the total average annual economic damage from supply chains shocks. Expert judgement from the CCRA technical authors has given a medium magnitude current risk rating (£tens of millions in costs per year at the UK level), but an unknown rating in the future.\*

Some action has been taken by business and there are opportunities from advances in technologies and from the learning and increased focus on supply chain resilience following the COVID-19 pandemic, and other recent events such as the high profile temporary blockage of the Suez Canal by the Ever Given container ship. However, it is unclear whether this action will keep pace with the increasing risk or how effective it will be specifically in managing climate and weather-related disruption. All of the relevant risks in the Technical Report have been given a 'more action needed' score across all UK nations.

Adaptation actions involve information, awareness raising and capacity building, institutional changes, supply chain management, risk sharing and risk transfer, technology, infrastructure and storage, and trade policy which will take time to develop, test and implement. Enhancing supply chain resilience should be a priority both for post-COVID recovery planning, which has highlighted some vulnerabilities, and in the development of new trade agreements and changing trade patterns following EU-Exit. It will also be important in planning for some of the opportunities for the UK to grow some currently imported fruit and vegetables locally, if soil and water quality and quantity permit.

Opportunities to integrate adaptation into major forthcoming policies include:

\* See Surminski, S. (2021) CCRA3 Technical Chapter 6 - Business and industry

- UK - HM Treasury's Plan for Growth; Green Finance Strategy including TCFD and TNFD reporting; the developing global reporting system led by major sustainability reporting organisations (CDP, CDSB, GRI, IIRC and SASB); FCA's Sustainable Finance Strategy and the Climate Financial Risk Forum.
- In addition, increasing awareness of guidance or tools through channels such as the SME Climate Hub; Transforming public procurement programme and public procurement guidance; Department for International Trade's Business of Resilience campaign.

## Risks to people and the economy from climate-related failure of the power system

The UK's dependence on electricity will increase significantly because of the transition to Net Zero, leading to much greater impacts from power outages.

The UK will become heavily dependent on electricity as the dominant energy source as the country reduces greenhouse gas emissions to Net Zero. While electricity provides about 15 - 20% of the UK's energy today, by 2050 it could account for 55 - 65%, used for light, heat, communications, transport, industry and delivery of other critical services such as water. People and the economy will be increasingly exposed and vulnerable to electricity system failures.

Different parts of the power sector can be impacted by all of the major climate hazards: flooding, water shortages, increased temperatures and wildfire, sea level rise and potential increases in storms, swells and wave heights. While the power sector generally has good plans today for the risks of 2°C and 4°C warming scenarios, climate-related problems still occur. For example, a lightning strike on an electricity circuit between Cambridgeshire and Hertfordshire in August 2019 (Box 4.2) led to a cascade of impacts on other generators, interrupting supply to over 1 million people and stranding affected trains for hours.

The risk assessment shows these risks will become more common and more damaging as our dependence on electricity grows and the variability of our weather increases. Within a Net Zero power system, weather-dependent renewables like offshore wind are expected to play a dominant role. We strongly recommend that the Government (Cabinet Office and BEIS) works with the regulator (Ofgem) and the industry to review the approach to electricity system design and risk assessment in the context of the central role of electricity in the UK's future energy system and the changing climate.

The CCRA3 Technical Report considers case studies of power outages and other literature in assessing the magnitude of the risk from cascading impacts across infrastructure and the resulting impacts on people and businesses.\* The evidence supports an assessment of current high magnitude, with disruption in urban areas potentially impacting hundreds of thousands of people annually. Future magnitude is given as high across the UK in all climate scenarios as the impacts are only projected to grow. All of the major climate hazards considered in the CCRA could trigger a cascade effect from the power sector to other sectors.

Ensuring a power system that is resilient to the future climate impacts is an urgent issue because the next 10 years will see a huge growth in investment in both electricity generation and expansion of the transmission and distribution grids. For example, the Government plans a four-fold increase to 40 GW of offshore wind by 2030, to support decarbonisation of transport, heat and industry and to prepare for a doubling, or even a trebling, of electricity demand by 2050.

\* See Jaroszweski, D., Wood, R., and Chapman, L. (2021) CCRA3 Technical Report Chapter 4 – Infrastructure

The implementation of the 2020 Energy White Paper and of the new National Infrastructure Strategy provide opportunities to embed climate resilience in the power system. Climate resilience must also be reflected in the wider energy system governance (e.g. by Ofgem, and in considering the possible role for an independent Energy System Operator). More generally, the Government should implement stronger approaches to systemic risk assessments and resilience for critical infrastructure, especially where the interdependencies are so ubiquitous.

Opportunities to integrate adaptation into major forthcoming policies include:

- UK – the Implementation of the Energy White Paper 2020 and National Infrastructure Strategy 2020, the next National Infrastructure Assessment in 2023, the Offshore Transmission Network Review (and wider network plans), and the upcoming Net Zero Strategy, including any plans to phase out unabated gas power generation by 2035 (as recommended by the Committee).
- England – Review of public procurement rules and guidance, TCFD reporting, implementation of National Flood and Coastal Erosion Risk Management Strategy and Policy Statement
- Northern Ireland – second round of Flood Risk Management Plans for Northern Ireland
- Scotland – implementation of Scottish Government Infrastructure Investment Plan, The final tranche of the Low Carbon Fund investment in Emerging Energy Technology, key energy infrastructure considerations in the fourth National Planning Framework.
- Wales – future Welsh Climate Change Adaptation Plan

#### **Box 4.2**

##### **Cascading impacts from 2019 power outages in England and Wales**

Power outages in England and Wales on the 9th of August 2019 demonstrate the potential for cascading infrastructure failure (Ofgem, 2020). The event was triggered by a lightning strike on the Eaton Socon-Wymondley circuit between Cambridgeshire and Hertfordshire, causing a routine fault on the national electricity transmission system and the disconnection of a number of small generators connected to the local distribution network. Simultaneously, two larger generators (Hornsea 1 Limited and Little Barford) experienced technical issues and were unable to provide power. The combined power losses exceeded the back-up power generation capacity of the Electricity System Operator (ESO), triggering a power outage.

A total of 892 megawatts (MW) of net demand was disconnected from local distribution networks. The electricity supply of over 1 million consumers was interrupted. The outage had significant knock-on impacts for the rail sector, with the Train Operating Company (TOC) Govia Thameslink Railway experiencing stranded trains, triggered by on-board automatic safety systems. This in turn caused knock-on delays across the rail network (Ofgem, 2020). Hornsea 1 Limited and RWE Generation UK plc (operators of Little Barford) each agreed to make voluntary payments of £4.5m to the Energy Industry Voluntary Redress Scheme.

*Source: Jaroszowski, D., Wood, R., and Chapman, L. (2021) CCRA3 Technical Report Chapter 4 – Infrastructure.*



## Risks to human health, wellbeing and productivity from increased exposure to heat in homes and other buildings

People in the UK are at risk of illness and death from high temperatures. For those with existing health conditions (mainly heart and respiratory conditions), death rates start to increase even at moderate temperatures over 17 - 20°C, depending on location. High temperatures contribute to significant excess mortality in England, with more than 2,500 heat-related deaths during three 2020 heatwaves, higher than at any time recorded since statistics began to be collected in 2003.\* While there is a lack of evidence of present-day impact on mortality in the devolved administrations, the risk from heatwaves and higher temperatures will increase across the UK in the future. The Met Office's UK Climate Projections (UKCP18) show a hot summer like 2018 will likely occur on average every other year by 2050. There is also a small chance of exceeding 40°C before 2040; by 2080 the frequency of exceeding 40°C could be similar to the frequency of exceeding 32°C today in a high emissions scenario.† Night-time urban heat island effects are expected to be more intense, leading to more 'tropical nights' in major cities.

As well as a risk to life, high temperatures will lead to productivity losses for UK workers. Analysis across 11 UK city regions estimated that the benefits of urban greening in avoided productivity losses and reduced cooling costs was nearly £300 million in a single year.<sup>10</sup> Before the pandemic, around 5% of people in employment worked mainly from home.<sup>11</sup> As a result of the COVID-19 pandemic, levels of homeworking have risen substantially, with an average of around 30% of the workforce working exclusively from home each week during 2020.<sup>12</sup>

Exposure to heat in homes could increase if some businesses and workers choose to adopt this style of working on a permanent basis. This also has implications for the future delivery of health and social care as trends indicate a move to more home-based care rather than in hospitals.

There is more evidence since CCRA2 about the risks of overheating in buildings and the effectiveness and limitations of strategies for space cooling. Building designs and technology exist that, if implemented at scale, could deliver buildings which have high levels of thermal efficiency (staying warm in winter while cool in summer), while being moisture-safe and with excellent indoor air quality. Key actions that have been identified as beneficial in the next five years include:

- The updating of building regulations or other policy measures to address overheating in new and refurbished homes through passive cooling measures.
- 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 with climate risks in mind.
- Ensuring that designs for new and refurbished care homes, hospitals and other health and social care assets consider future temperatures.
- Undertaking an economic analysis of adaptation options for care homes alongside the use of adaptive measures such as improved glazing, draught

\* See Kovats, S. and Brisley, R. (2021) CCRA3 Technical Report Chapter 5 – Health, communities and the built environment

† See Slingo, J. (2021) CCRA3 Technical Report Chapter 1 - Latest Scientific Evidence for Observed and Projected Climate Change

proofing, shutters, reflective surfaces, green cover and green space and ceiling fans, where appropriate.

- Increasing green infrastructure, setting greenspace targets and monitoring uptake of 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.
- Including long term risks and action planning within current emergency preparedness planning.
- Monitoring of indoor temperatures and other indicators across homes, care homes and health care buildings.

Policies still remain largely absent to address the risks to health from heat, even though it has been highlighted as one of the largest risks in all three UK climate change risk assessments.

Out of the Committee's list of priorities, this risk is notable for being the one where policies still remain largely absent. There is still little preventative action being taken to address health risks from overheating in buildings, and in homes in particular. In England, where a quarter of homes are at risk from overheating, the Ministry of Housing, Communities and Local Government (MHCLG) published a consultation in early 2021 proposing to introduce an overheating standard in new residential buildings (including houses, flats, care homes, and residential educational settings). If brought into policy this would help tackle the risk of overheating in new buildings. The Welsh Government ran a similar consultation in 2020 proposing a new part of Building Regulations focussing on overheating risk in new build homes.

For existing dwellings, there remains little incentive for retrofitting across the UK. Given that at least 300,000 homes are due to be built each year, along with a focus on enhanced energy efficiency and low-carbon heating in new and existing homes, there is a major risk of lock-in if urgent action is not taken now. As well as escalating costs, inaction could make many existing and new homes largely uninhabitable as temperatures rise.

Opportunities to integrate adaptation into major forthcoming policies include:

- England – Building Regulations review; review of the National Planning Policy Framework; revision of the Heat and Cold weather plans; NHS Green Plans; Heat and Buildings Strategy, any replacement for the Green Homes Grants or similar schemes, Homes England requirements, new Building Safety Regulator.
- Northern Ireland – New Housing Strategy; review of Building Regulations; expand Northern Ireland Climate Change Adaptation Programme to include actions to address heat hazards in health and social care settings.
- Scotland – Review of energy standards and supporting guidance; use of Green Infrastructure Fund and Green Infrastructure Community Engagement Fund to support urban greening; creation of NHS Boards adaptation plans; NHS Scotland Sustainability Strategy.
- Wales – Introduce overheating standards into Building Regulations; PHW extreme weather strategy review; PHW climate change Health Impact Assessment; commitment to address climate risks to health and social care delivery and update of contingency plans.

## Multiple risks to the UK from climate change impacts overseas

Many of the risks to the UK from climate change overseas have increased in urgency since CCRA2 was published, as more evidence has become available.

There is growing potential for hazards in the UK and globally to create cascading risks that spread across sectors and countries, creating impacts an order of magnitude higher than impacts that occur within a single sector. These systemic risks act in a non-linear way, may not be attributed to any one driver, and have tipping-points that are highly unpredictable.

The COVID-19 pandemic has been a recent example, albeit not a climate-driven event, with government spending costs in the UK projected at over £300bn.\*

The climate hazards that can trigger similar cascading impacts globally are becoming more frequent and more severe. The Technical Report highlights that all elements of climate risk; hazard, exposure and vulnerability, are increasing globally, with a high present day and future magnitude in all climate scenarios and all UK nations.

There is growing potential for weather-related hazards – such as floods, hurricanes, or drought - to spark these cascading impacts globally. Due to the potential for hidden tipping points and the unpredictability of systemic risks, the current model of conventional risk governance in the UK that focusses on single events, single sectors and characterisation of reasonable worst-case scenarios should be reviewed. There is a need to plan better for classes of risk (such as interruptions to food supply chains) rather than predicting specific risks and their transmission pathways.

There is an immediate opportunity to learn from the experience of the COVID-19 pandemic to embed resilience building across government functions. There is also a longer-term opportunity following the UK's exit from the EU to incorporate considerations of systemic risk into future trade agreements and foreign policy aims.

Opportunities to integrate adaptation include:

- Increased capacity building by FCDO programmes overseas to improve global capacity for climate resilience, including supply chains, health systems and early warning systems for climate hazards. Overseas programmes should work to reduce underlying vulnerabilities and not just respond to disasters. This ties in with the Government's 'levelling up' agenda and aims for global leadership, including through presidencies of the G7 and upcoming UN climate talks (COP26).
- Increased research and capacity building by BEIS via its International Climate Finance work overseas, to ensure low-carbon development and delivery of Net Zero include co-benefits of adaptation and are not undermined by climate risks.
- Increased research through the UKRI global challenge fund to improve understanding of interacting risks, which regions and sectors are most fragile and how to improve resilience.
- Development of a UK Resilience Strategy by the Cabinet Office.

\* See Challinor, A. and Benton, T. (2021) CCRA3 Technical Chapter 7 - International Dimensions

- Clear commitments at COP26 to leverage increased adaptation financing and support developing countries with capacity building for implementing national adaptation actions.



# Endnotes

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- <sup>2</sup> Woodland natural capital accounts, UK - Office for National Statistics (ons.gov.uk)
- <sup>3</sup> <https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2018/woodland-areas-and-planting/national-forest-inventory/woodland-area-by-species-broadleaves/>
- <sup>4</sup> Converted to CO<sub>2</sub> from carbon stocks, reported as 3,200 ± 300 million tonnes from Worrall, Chapman et al (2010) Peatlands and climate change: scientific review for the IUCN UK peatland programme (as set out in CCC (2018) Land use: reducing emissions and preparing for climate change.
- <sup>5</sup> CCC (2013) Managing the land in a changing climate
- <sup>6</sup> Dimbleby, H. et al. (2020) *The National Food Strategy: Part One*.
- <sup>7</sup> Defra horticultural statistics 2019.
- <sup>8</sup> ONS (2020) UK trade: April 2020.
- <sup>9</sup> <https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/bulletins/uktrade/april2020>, <https://www.smmf.co.uk/industry-topics/europe-and-international-trade/key-exports-data/>
- <sup>10</sup> <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapitalaccounts/2019#regulating-services>
- <sup>11</sup> Office for National Statistics (2020), *Coronavirus and homeworking in the UK labour market: 2019*.
- <sup>12</sup> Office for National Statistics (2021), *Social behaviours during the different lockdown periods of the coronavirus (COVID-19) pandemic dataset*.