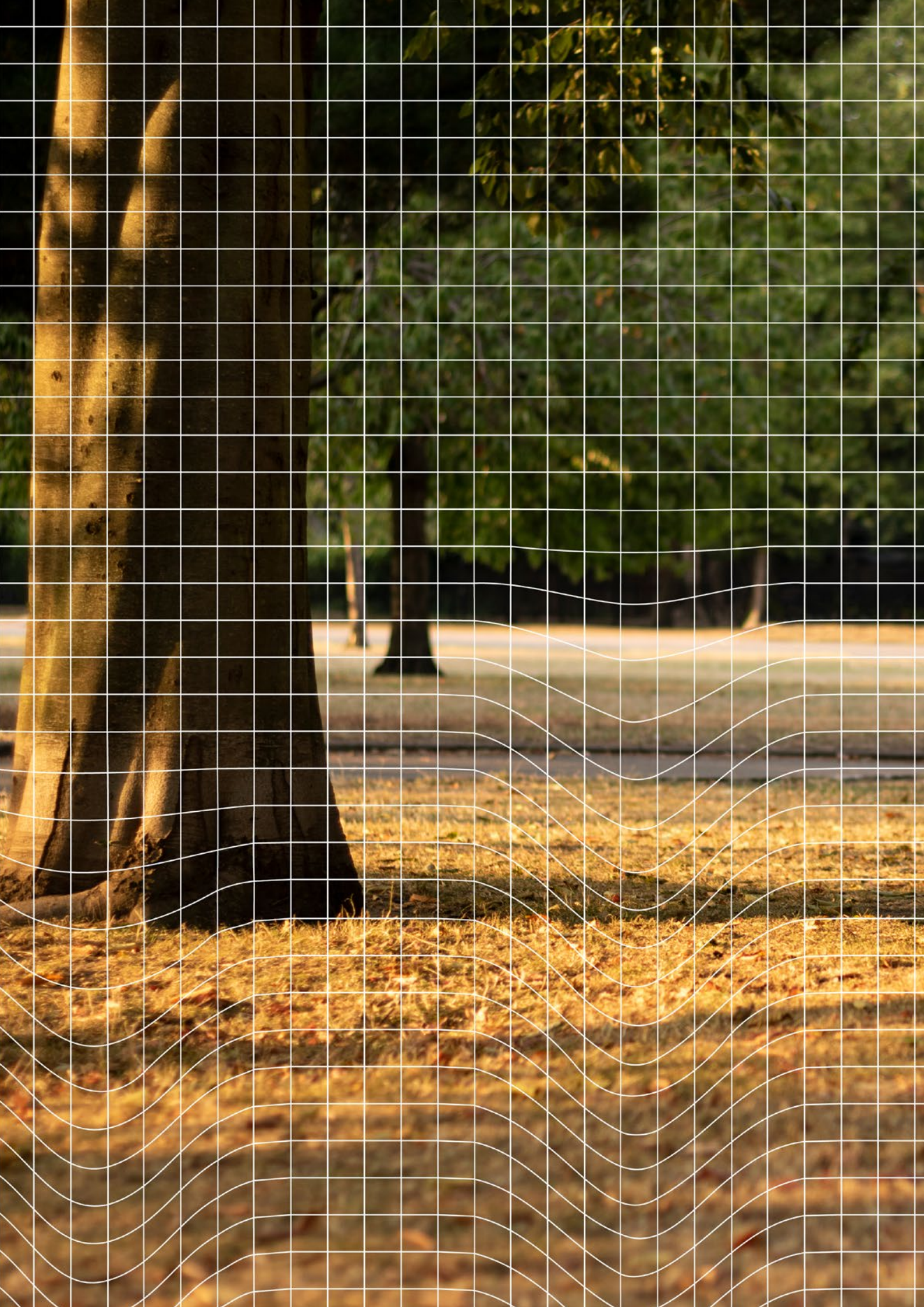
Chapter 2

Assessing UK climate risk



Introduction and key messages

This chapter synthesises the assessment from the CCRA3 Technical Report on the risks and opportunities that climate change will bring to the UK and what issues need to be considered in effective risk assessments.

The Technical Report has assessed both the magnitude (size) and the degree of urgency of further adaptation action for 61 risks and opportunities. It considers climate change from the present day to 2100. It also considers a series of cross-cutting issues that relate to understanding risk, including how the costs from climate change alter in the future in different scenarios, the importance of understanding thresholds and interactions between risks, and to what extent there are opportunities from climate change for the UK.

We set out a summary of this information from the Technical Report in this chapter, alongside our analysis of how climate risks are likely to affect societal goals, how climate risks need to be integrated into policy making, and how the assessment of risk has changed since the last CCRA in 2017.

Our conclusions are:

- **The UK faces risks from climate change to its natural environment, its food and water supplies, its infrastructure, the health and wellbeing of its population and disruption to its business.** The risk assessment considers different impacts across these sectors. Many of the risks are already material and all are expected to worsen under warming of 2°C, with escalating impacts in a 4°C scenario even with high levels of adaptation.

- **The assessment shows an increase in high magnitude risks between today and 2100.** The percentage of 'high' magnitude risks increases from 26% of the total in the present day, to 79% in the 4°C pathway in the 2080s. There is also a noticeable increase in the number of high magnitude risks compared to similar risks assessed in CCRA2; 14 risks in this assessment have higher future risk scores than in CCRA2, whereas none have lower scores. A key evidence gap that must be filled for CCRA4 is to develop better quantitative estimates of impacts across all of the risks and opportunities in a 2°C and 4°C scenario.

- **There are significant economic costs from negative impacts under all future scenarios in the absence of further adaptation.** While it was not possible to calculate a total economic cost of climate change for the UK in this assessment, the valuation analysis suggests that the number of individual risks with very high annual damage costs (£billions/year) could triple in the 2°C scenario compared to the present day.

- **Key Government and societal goals will be harder to meet because of climate change.** These include ensuring a healthy and safe society with natural and cultural heritage protected; having a reliable and safe supply of food, water, transport, energy and digital services; sustainable businesses; thriving plants, wildlife and ecosystems that underlie human life and economic activity; and reducing UK emissions of greenhouse gases to Net Zero. Without further adaptation even in a 2°C scenario, these goals will become more expensive to achieve at best, and impossible to achieve at worst.

- **Effective risk assessments need to consider interacting risks and threshold effects.** Interacting risks pose one of the biggest challenges when assessing climate risks. A single hazard, such as a flood, will often have knock-on impacts across a range of sectors, amplifying the resulting risk. Siloed thinking remains a problem for addressing climate change risks or opportunities that interact, that are subject to cascading impacts, or where adaptation responsibility falls across more than one government department. Another component of risk planning that is often missed out is understanding threshold effects. A threshold is the point at which a 'non-linear' change in a system occurs as a result of change in a climate driver – such as temperature. For example, algal blooms can start to occur when water temperatures exceed 17°C. Understanding where these thresholds exist and how likely they may be in the future is important for understanding the size of a given risk and its economic costs, as well as at what point a different approach to adaptation might be required.

- **Climate change may also present some opportunities for the UK,** including for new species and longer growing seasons in agriculture and forestry, benefits from warmer temperatures for health and energy bills, and opportunities for adaptation goods and services**.** While many opportunities will not require government action, there are cases where intervention could help fully realise benefits (such as through finance), but there is little evidence of such action being taken. Most of the opportunities will not be realised unless the corresponding risk is also addressed; increased agricultural productivity will not happen without adequate soil and water quantity and quality, for example.

- **The UK is less well prepared for climate change now than it was five years ago.** This largely reflects that the pace of change in risk has outstripped the pace of adaptation; only four of the 61 risks and opportunities have been scored as not having an adaptation gap. At the UK level, 56% of the risks and opportunities assessed have been given the highest 'urgency score' in the CCRA3 Technical Report, compared to 36% for the last assessment in 2016. More of the risks are now classed as 'high magnitude' in the future, meaning that the assessment of the impact of the risks in the absence of additional adaptation has increased.

We set out our analysis in the following sections:

1. Introduction to the risk assessment
2. Impacts of climate change for 2°C and 4°C warming scenarios
3. Costs of climate impacts in the UK
4. Impact on societal goals
5. Threshold effects
6. Interacting risks
7. Opportunities from climate change
8. How risks and opportunities have changed since CCRA1 and CCRA2

The CCRA3 Technical Report provides a detailed assessment and scoring for the risks and opportunities to the UK from climate change.

The CCRA3 Technical Report follows a three step method, based on assessing the magnitude of current and future risks or opportunities, the extent of adaptation planned, and the benefits of further action in the next five years.

The CCRA3 Technical Report provides a detailed description of the assessment of each risk and opportunity, including a) the current and future magnitude of impact* under different climate and socioeconomic scenarios, b) an assessment of current and planned adaptation, and c) an assessment of the benefits of further adaptation in the next five years. We do not summarise all of the detailed analysis for each risk and opportunity in this Advice Report but encourage readers to use the Technical Report and accompanying Summaries (see Figure 5 in the 'About this Report' section) to see the full analysis for specific risks and opportunities. The Technical Report runs to nearly 1,500 pages, with further evidence presented in a series of accompanying research reports. In total, the independent assessment consists of 3,500 pages of analysis.

The risk assessment has identified 61 key risks and opportunities to the UK from climate change.

The Technical Report authors consulted with government, external stakeholders and the CCC on which risks and opportunities to consider in the risk assessment, resulting in a shortlist of 61 risks and opportunities to assess in detail for this CCRA. For each risk and opportunity, an assessment of the urgency of further action has been conducted. This assessment includes three questions:

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 action in the next five years, over and above what is already planned?

Using the answers to these three questions, each risk and opportunity has ultimately been awarded an 'urgency score' using one of four categories as shown in Table 2.1.

61 risks and opportunities have been assessed related to the natural environment; infrastructure; health and built environment; business; and international dimensions.

The scores are split out in the Technical Report by UK nation. Although 'more action needed' and 'further investigation' are deemed the higher urgency categories, adaptation action is needed across all four categories of urgency; what varies is the type of action and how far it diverges from current adaptation. 'Sustain current action' and 'watching brief' are categories that suggest a continuation of current adaptation effort and monitoring, but there will still be costs associated with these actions as they continue. In addition, further research and monitoring are needed across all of the risks and opportunities in the assessment. This need for research does not just apply to the 'further investigation' category.

* See Annex for criteria for magnitude categories

Table 2.1
CCRA3 urgency categories

Urgency category	Definition of urgency category
More Action Needed	New, stronger or different Government action, whether policies, implementation activities, capacity building or enabling environment for adaptation – over and above those already planned – are beneficial in the next five years to reduce climate risks or take advantage of opportunities. This will include different responses according to the nature of the risks and the type of adaptation, but include: • Addressing current and near-term risks or opportunities with low and no-regret options (implementing activities or building capacity). • Integrating climate change in near-term decisions with a long life-time or lock-in. Early adaptation for decisions with long lead-times or where early planning is needed as part of adaptive management.
Further Investigation	On the basis of available information, it is not known if more action is needed or not. More evidence is urgently needed to fill significant gaps or reduce the uncertainty in the current level of understanding in order to assess the need for additional action.
Sustain Current Action	Current or planned levels of activity are appropriate, but continued implementation of these policies or plans is needed to ensure that the risk or opportunity continues to be managed in the future.
Watching Brief	The evidence in these areas should be kept under review, with continuous monitoring of risk levels and adaptation activity (or the potential for opportunities and adaptation) so that further action can be taken if necessary.

Source: Watkiss, P. and Betts, R.A. (2021) Method. In: The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London

Table 2.2 sets out the urgency scores for each risk and opportunity, using the highest score awarded across the UK to derive a 'UK-wide' urgency table. These denote the primary results of the assessment and direct government to how it should approach adaptation action for each risk and opportunity in the next iterations of the National Adaptation Plans for England, Northern Ireland, Scotland and Wales (full urgency scores by UK nation are provided in the CCRA3 National Summaries and Technical Report).

Table 2.2
CCRA3 Risks and Opportunities by Urgency Score (UK-wide scores)

N1 Risks to terrestrial species and habitats	N2 Risks to terrestrial species and habitats from pests, pathogens and INNS	N4 Risk to soils from changing conditions, including seasonal aridity and wetness	N5 Risks to natural carbon stores and sequestration from changing conditions	N6 Risks to and opportunities for agricultural and forestry productivity
N7 Risks to agriculture from pests, pathogens and INNS	N8 Risks to forestry from pests, pathogens and INNS	N11 Risks to freshwater species and habitats	N12 Risks to freshwater species and habitats from pests, pathogens and INNS	N14 Risks to marine species, habitats and fisheries
N16 Risks to marine species and habitats from pests, pathogens and INNS	N17 Risks and opportunities to coastal species and habitats	I1 Risks to infrastructure networks from cascading failures	I2 Risks to infrastructure services from river and surface water flooding	I5 Risks to transport networks from slope and embankment failure
18 Risks to public water supplies from reduced water availability	I12 Risks to transport from high and low temperatures, high winds, lightning	H1 Risks to health and wellbeing from high temperatures	H3 Risks to people, communities and buildings from flooding	H4 Risks to people, communities and buildings from sea level rise
H6 Risks and opportunities from summer and winter household energy demand	H8 Risks to health from vector-borne diseases	H11 Risks to cultural heritage	H12 Risks to health and social care delivery	H13 Risks to education and prison services
B1 Risks to business sites from flooding	B2 Risks to business locations and infrastructure from coastal change	B6 Risks to business from disruption to supply chains and distribution networks	ID1 Risks to UK food availability, safety, and quality from climate change overseas	ID5 Risks to international law and governance from climate change overseas that will impact the UK
ID4 Risks to the UK from international violent conflict resulting from climate change	ID9 Risk to UK public health from climate change overseas	ID7 Risks from climate change on international trade routes	ID10 Risk multiplication from the interactions and cascades of named risks across systems and geographies	N3 Opportunities from new species colonisations in terrestrial habitats
N9 Opportunities for agricultural and forestry productivity from new species	N10 Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	N15 Opportunities for marine species, habitats and fisheries	N18 Risks and opportunities from climate change to landscape character	I3 - Risks to infrastructure services from coastal flooding and erosion
I4 Risks to bridges and pipelines from flooding and erosion	I6 Risks to hydroelectric generation from low or high river flows	I7 Risks to subterranean and surface infrastructure from subsidence	I9 Risks to energy generation from reduced water availability	I10 Risks to energy from high and low temperatures, high winds, lightning
I13 Risks to digital from high and low temperatures, high winds, lightning	H2 Opportunities for health and wellbeing from higher temperatures	H5 Risks to building fabric	H7 Risks to health and wellbeing from changes in air quality	H9 Risks to food safety and food security
H10 Risks to health from poor water quality and household water supply interruptions	B3 Risks to businesses from water scarcity	B5 Risks to business from reduced employee productivity – infrastructure disruption and higher temperatures	B7 Opportunities for business - changing demand for goods and services	N13 Opportunities to marine species, habitats and fisheries
I11 Risks to offshore infrastructure from storms and high waves	B4 Risks to finance, investment, insurance, access to capital	ID8 Risk to the UK finance sector from climate change overseas	ID2 Opportunities for UK food availability and exports	ID3 Risks to the UK from climate-related international human mobility
ID6 Opportunities (including Arctic ice melt) on international trade routes				

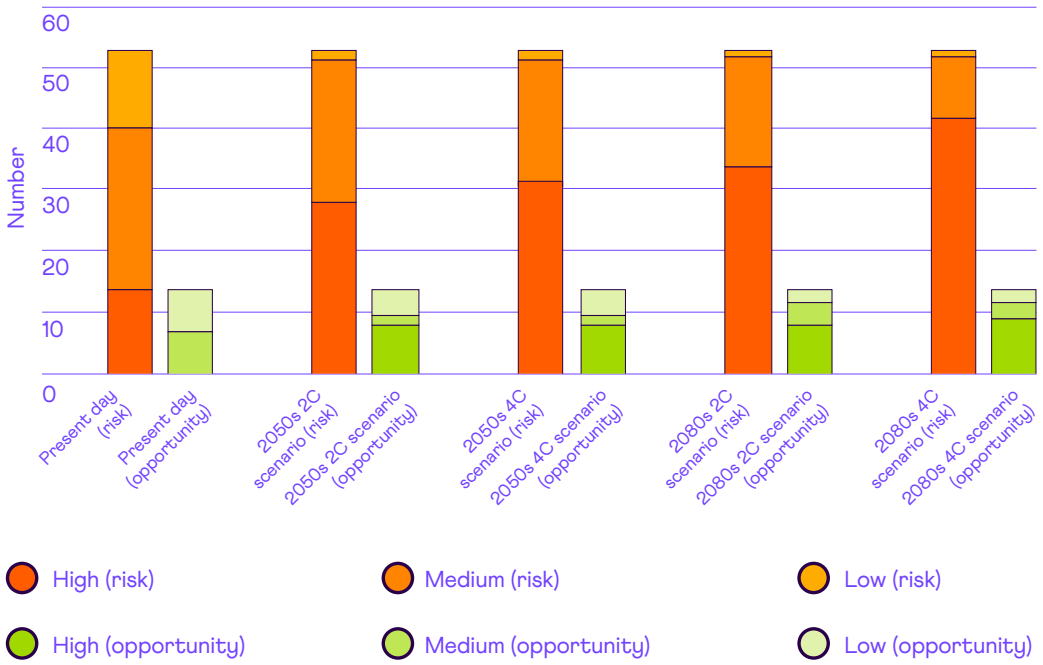
More Action Needed
Further Investigation
Sustain Current Action, Watching Brief

Source: The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London
Notes: A UK-wide score has been derived using the highest urgency score awarded across the four UK nations for each risk or opportunity.

The proportion of high magnitude risks increases significantly in the future. The risk assessment has assigned magnitude categories (low, medium, high or unknown*) for each risk and opportunity for the present day, and the 2050s and 2080s for both a 2°C and 4°C scenario. Figure 2.1 shows the changes in magnitude of the risks and opportunities. The percentage of 'high' magnitude risks increases from 26% of the total in the present day (14 risks), to 79% in the 4°C scenario in the 2080s (42 risks). Even in the 2°C pathway there is still a significant proportion of high magnitude risks by the 2080s (64%, or 34 risks).† There is a large increase in the magnitude of risk compared to the present day in all future scenarios.

The percentage of 'high' magnitude risks (red bar) increases from 26% of the total in the present day, to 79% in the 4°C scenario in the 2080s.

Figure 2.1 Changing magnitude of risks and opportunities



Source: Based on The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.
Notes: Figure shows how the number of low, medium and high magnitude risks and opportunities changes from the present day to the 2080s, in both 2°C and 4°C scenarios. See Annex for the criteria for the different magnitude scores. The highest magnitude across the four UK nations has been used. For risk numbers that are listed as both a risk and opportunity (e.g. N5 – risks and opportunities for natural carbon stores) the magnitude has been counted under both the risk column and the opportunity column.

While the Technical Report has used magnitude categories to assess the size of impact for each risk and opportunity, this semi-quantitative scoring needs to be improved in future assessments.

* See Annex for the criteria used for each magnitude category. At the UK level, monetised impact categories are a) high (£hundreds of millions in annual damages), b) medium (£tens of millions in annual damages), c) low (<£10 million in annual damages).

† Some of the difference in actual impact between the 2°C and 4°C scenarios is masked due to the high category including every risk with an impact over the equivalent of £hundreds of millions in annual costs.

In almost no cases has it been possible for the Technical Report to give quantified estimates of annual impact for the future 2°C and 4°C scenarios. There are three reasons for this lack of quantification:

- For many of the risks, the literature available provides only qualitative descriptions of changing risk, which the authors have then used to assign a magnitude score based on expert judgement. This is particularly the case for the business and international dimensions chapters.

- Some of the risk evidence is based on specific emissions scenarios that are not easily comparable with global warming levels. For example, the SRES A1B* scenario has been a popular scenario of choice in studies prior to 2017, but this scenario spans a global temperature rise of between 2.6°C and 4.2°C by the 2080s.[1] Often, a range of regional projections within such a scenario have been used that then each represent a different warming level. This issue is frequently seen in the natural environment, health and infrastructure chapters.

- Some studies where it is possible to translate an emissions scenario into a warming level provide results that either fall between, or outside of the 2°C - 4°C pathway range.

In most cases, the only quantitative information for specific warming levels of 2°C and 4°C scenarios is from the CCRA3 water availability and flooding projects, where the methods were specifically designed to assign risk magnitudes in these scenarios.

These gaps in the evidence base highlight an important area of consideration for CCRA4 and beyond; further work is needed to quantify estimates of risk for the likely range of future warming levels on the basis of current and planned global emissions reduction pathways.

* The 'medium' scenario used in 2009 UK Climate Projections

The UK is already experiencing significant weather-related damages in the current climate.

The UK is vulnerable to a large range of risks from climate change, and these are projected to grow in the future. Table 2.3 shows some single-event, local or regional examples of the monetised and non-monetised impacts from extreme weather events in the UK over the past 10 years.

Table 2.3
Examples of impacts from extreme weather in the UK, 2017 - 2020

	Economic damages	Deaths	Other environmental impacts
Summer heatwaves	£770 million[2] - total estimated productivity loss in the 2010 heatwave	2,500+ heat-related deaths were recorded during the summer of 2020 in England; the highest number since 2003	Localised fish die-offs due to de-oxygenation of streams and rivers were observed during the 2018 heatwave
Flooding	£1.6 billion - overall cost of the 2015-16 winter floods	10 – 15 deaths recorded as a direct result of flooding in 2007	30% increase in topsoil degradation during winter 2015/16 floods in a sample of Scottish catchments
Drought	Economic costs of the 2012 drought were estimated at £165 million in revenues and £96 million in profit.	None recorded due to drought in the last 10 years	A net reduction in carbon uptake of ecosystems was observed during the 2018 drought across Europe
Wildfire	£32 million - agriculture sector losses from wildfire in 2020	No direct deaths caused by wildfire in the last 10 years	174,000 tonnes of carbon estimated to have been lost from the Flow Country wildfire in Scotland in 2019[3]

Source: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London

The summer of 2018 in the UK illustrates how multiple sectors can be impacted by a single extreme weather event (Figure 2.2). It is expected that a summer heatwave like that experienced in 2018 will occur on average one year in two by 2050, and in a 4°C scenario, would occur in every nine years in ten by 2100 (see Chapter 1).

Figure 2.2 2018 heatwave in numbers

1053%
increase in gorse fires compared to 2017 in Northern Ireland

84%
reduction in export value of UK wheat due to yield losses

137%
increase in farm fire costs from 2017 (£32 million)

Net reduction
in carbon uptake of natural ecosystems across Europe

864
heat-related deaths

28°C
overheating threshold exceeded in hospitals

500
emergency call-outs from private water supply failures

10,000
subsidence claims costing £64 million

40– 50%
increase in rail asset failure

7%
reduction in hydroelectric generation compared to 2017 (costing £tens of millions)

- Natural environment
- Health and built environment
- Infrastructure

Source: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London.

A standalone valuation report has been prepared as part of the CCRA3 Independent Assessment.

Estimates of current and future monetised impacts from climate change have been included in the CCRA3 magnitude scoring.
CCRA1 included a detailed monetary valuation that estimated the effects of climate change on the market economy, human health and wellbeing, and environmental costs or benefits. A valuation analysis was not undertaken for CCRA2 due to lack of resources. In CCRA3, a separate Valuation Report has been prepared as an accompanying document to the Technical Report, synthesising the evidence on economic costs (market and non-market) of climate change impacts. The valuation fed into the magnitude scoring for each risk and opportunity.

The number of risks with very high annual damage costs could triple by the 2080s even in the 2°C scenario.

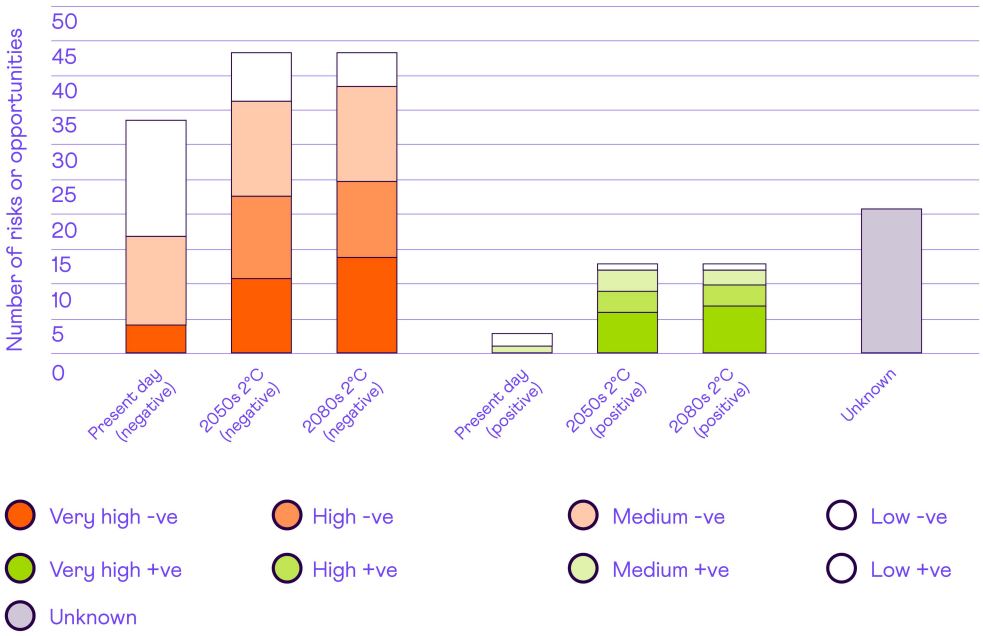
The analysis of economic costs to the UK from climate change suggests that the number of individual risks with very high annual damage costs (£billions/year) could triple in the 2°C scenario compared to the present day.
In the Valuation Report, an order of magnitude of the economic cost (or benefit) has been assigned to each risk (and opportunity) where possible. The categories used are low (<£10 million per year), medium (£tens of millions per year), high (£hundreds of millions per year) and very high (£billions per year).

Figure 2.3 shows the range of categories of monetised negative or positive impacts for the present day, 2050s and 2080s in a 2°C scenario, giving a sense of the scale of increase in costs without additional adaptation at the low end of the possible range of future climate change.

The number of risks with very high estimated damage costs increases significantly in the future; from four in the present day to 14 in the 2080s 2°C scenario. The estimated damage costs from these risks alone, assuming they are mutually exclusive would be at least in the £tens of billions per year. A significant number of the risks also have very high projected costs by 2050. These include the impacts to communities from all types of flooding (coastal, river and surface water), extreme heat risks to human life and productivity, risks to the natural environment from both slow-onset climate change and extreme events, and risks to financial services.

Indirect risks and cascading impacts all have potentially very high damage costs, but the evidence base for quantifying these effects remains limited. Chapter 3 looks at the benefits that adaptation brings in reducing these costs.

Figure 2.3 Change in monetised costs or benefits for CCRA3 risks and opportunities



Source: Based on Watkiss, P., Cimato, F., Hunt, A. (2021). Monetary Valuation of Risks and Opportunities in CCRA3. Supplementary Report for UK Climate Change Risk Assessment 3, prepared for the Climate Change Committee, London.
Notes: Values denote the number of risks and opportunities categorised by low, medium, high or very high costs (-ve and +ve) Low - <£10 million per year loss (negative) or gain (positive) Medium - £tens of millions per year in losses (negative) or gains (positive) High - £hundreds of millions per year in losses (negative) or gains (positive) Very high - £billions per year in losses (negative) or gains (positive).

It is important to consider any opportunities to the UK from climate change, alongside the risks.

Alongside the risks, there are potentially large opportunities from climate change, including a growing adaptation goods and services sector.
The Valuation Report also quantified benefits from climate change opportunities as well as the risks.

Some examples of potentially high benefits have been identified from warmer winters leading to reduced winter heating demand (and potentially a reduction in associated inequalities from winter fuel poverty), and opportunities for the adaptation goods and services industry.

However, potential positive economic effects from direct climate impacts do not 'cancel out' negative impacts because they affect different geographical areas and groups of people. In addition, negative climate impacts may mean the benefits are not realised (or that they are not deliverable) as they act as a barrier to realising the opportunity. An example is reduced water availability and soil erosion blocking potential opportunities for increased agricultural productivity due to longer growing seasons. Adaptation is needed both to take advantage of opportunities, but also to reduce the risks in order to make these opportunities feasible in the first place.

While CCRA3 provides a wide range of examples of damage costs from climate change, it does not estimate the effect of climate change risks on the UK economy as a whole.

It has not been possible to calculate a total cost of climate change to the UK, but cost estimates for specific hazards are provided in the Valuation Report, reaching £tens of billions per year by the 2080s.

Because CCRA3 is a synthesis exercise of the available literature, it draws upon a very diverse evidence base for different risks and opportunities. The different methods, scenarios, time periods, and assumptions used in the primary studies cannot be combined to provide an aggregate monetised value for the UK, i.e. a total cost of climate change (£) or a % of GDP, or to estimate the total benefit of adaptation actions. Much of the evidence available for assessing risks and opportunities is qualitative, and often risks are not quantified in a comprehensive way.

Some risk areas are also particularly challenging for valuation, making it difficult to derive a single national estimate of climate change cost to the UK. For example, for five of the 18 natural environment risks, it was not possible to derive valuation estimates from the literature. There are also very large uncertainties in the evidence on the magnitude of the costs to the UK from systemic global changes, such as changing food availability, conflict or migration. Finally, there are very few cost estimates to the UK of low-likelihood, high impact events (see Chapter 1). Understanding more about the risks from these events is critical to understand the full implications to the UK of climate change, including the benefits of mitigation in the long-term.

Instead of UK-wide coverage of costs and benefits, examples from specific events are given in the Technical Report to highlight the existing evidence and encourage further work by potentially impacted policy areas and economic sectors. The Valuation Report shows that annual damage costs for selected hazards increases ten-fold by the 2080s from today in the 4°C scenario, reaching £tens of billions for eight selected risks where quantified estimates are available.

Research work by the 'Co-designing the Assessment of Climate Change Costs' (COACCH) project, which has supported the CCRA3 valuation analysis, has assessed the potential economic costs of climate change in the UK using economic models. These models indicate very large potential costs to the UK, with a very large increase in higher warming scenarios (most notably in the 4°C scenario as would be expected). It is stressed that these numbers do not include all climate risks (especially non-market impacts) and do not consider the potential for low-likelihood, high impact outcomes.

Climate change does not just affect the current 'business as usual'. It also affects the achievement of government and societal ambitions, now and in the future, and what kind of a country is left to future generations.

Climate change affects all parts of society and economy, albeit in different ways, to different extent and in different times. Thus, it poses challenges to delivering on a large number of Government and wider societal goals. The Committee has identified 11 key societal goals that map against priority government policies and the UN Sustainable Development Goals to illustrate this point. Table 2.4 exemplifies how climate change risks and opportunities could affect these goals.

Climate change affects every part of UK society and the natural environment.

Impacts from climate change on natural assets (soil, water, biodiversity) and the services they provide will have effects on all of the goals listed, from food supply to health protection to reliable services to Net Zero. Impacts on infrastructure assets and services also have a significant number of (largely negative) impacts across the goals. Policies and plans related to health, sustainable businesses and social stability need to consider a large number of risks across different sectors (and different government departments). Importantly, many of the risks are not 'owned' by the departments that will be affected, such as the risks to health from overheating in homes, where health departments own the impact (mortality and morbidity), but planning and business departments own the policy response (building regulations and planning). Cross-departmental working is critical to ensuring the Government can achieve its aims in the face of climate change.

Table 2.4
Examples of how climate change risks and opportunities will affect societal goals

Risks	Risks to natural assets (soil, water, biodiversity)	Risk to ecosystem services (agriculture, forestry, fisheries, cultural services)	Risks to physical infrastructure assets and services	Risks to health, wellbeing and community viability	Risks to supply chains and trade routes	Risks from conflict, governance breakdown or economic shocks	Opportunities from new species, supply chains, trade routes	Opportunities for health from warmer temperatures
Goal: Reliable Food and Fibre Supply	N1, N2, N4, N11, N12. N14, N16, N17 Example: Productivity losses from soil and water degradation are estimated to be £150 million per year [N1]	N6, N7, N8, N10 Example: the 2018 hot dry summer led to 20-40% losses of yields for onions, carrots and potatoes [N6, N14]		H9	B6, ID1, ID2 Example: Price rises of 45-132% for imported vegetable crops in 2016/17 due to severe weather across Europe [B6]	ID5, ID10	N3, N9, N13, N15 Example: 160% increase in area of vineyards over last ten years in England and Wales [N9]	

Goal: Reliable Water Quantity and Quality	N4, N11, I8 Example: 16.7 million people live in water scarce regions across the UK [I8]	N10	I1, I2, I3, I4, I7, I8 Example: Around 650 clean water sites and 1,400 sewage treatment works are located in areas at significant flood risk [I2]	H10		ID10		
Goal: Reliable Energy Supply	I7 Example: One-third of high voltage subterranean electricity cables and 12% of high pressure natural gas pipelines in England are located in areas of high susceptibility to shrink-swell subsidence [I7]		I1, I2, I3, I4, I6, I9, I10, I11, H6 Example: 178 power stations and 575 substations across the UK in areas of significant surface water flood risk [I2]		ID7 Example: renewable energy generation e.g. PV relies on sourcing minerals such as cobalt from overseas supply chains [ID7]	ID10		H6
Goal: Reliable ICT Supply	I7 Example: 15% of small telecomm-unications masts are located in areas of high susceptibility to shrink swell subsidence [I7]		I1, I2, I3, I4, I6, I9, I10, I11, Example: loss of electrical power in Birmingham in 2011 led to the loss of broadband connection to hundreds of thousands of customers in the UK [I1]			ID10		
Goal: Safe and Reliable Transport	I7 Example: 22% of category 1 rail lines and 29% of major train		I1, I2, I3, I4, I5, I7, I12 Example: over 3,500km of rail length in areas at		I1 Example: Storm Desmond in 2015 left Lancaster with no	ID10	ID6, ID7 Example: Opening of Arctic trade routes could increase	

	stations are located in areas of high susceptibility to shrink swell subsidence. Network Rail reported £40million in costs from subsidence between 2006-2016 [I7]		significant risk of surface water flooding [I2]. Network Rail reported £15 million in annual payments to passengers for delays from flooding for 2006-2016 [I2]		power for >30 hours, leading to loss of traffic lights and closure of petrol stations [I1]		importance of UK ports, but also lead to an increase in global tensions on access and ownership [ID6, ID7]	
Goal: Thriving Plants and Wildlife	N1, N2, N4, N11, N12, N14, N16, N17 Example: Present day: annual control costs for invasive signal crayfish are about £9 million, and for zebra mussels are about £19 million [N12]	N1, N5, N6				ID10	N3, N13, N15 Example: Warmer winters likely to be leading to increased over-wintering survival of Dartford warblers, great tits, robins, dunnocks and wrens [N3]	
Goal: Public Health Protection	H1 Example: 'Cool roofs' (green roofs) installed in the West Midlands estimated to offset 25% of heat-related mortality [H1]		H12, H13 Example: Up to 90% of hospital wards at risk of overheating, and around 10% of hospitals are located in areas at significant flood risk [H12]	H1, H3, H4, H7, H8, ID9 Example: In summer 2020, a record 2,500 heat-related deaths were recorded during the summer heatwave [H1]	H9 Example: Emergency food parcels distributed by the Trussel Trust to families struggling to afford food rose from 500,000 in 2014 to more than 800,000 in 2019. Future climate change likely to affect food prices [H9]	ID4, ID10 Example: Food riots more likely to occur globally when the Food Price Index exceeds 140 (e.g. as happened in 2008, 2010 and 2012) [ID4]		H2, H6 Example: Future reductions in cold-related mortality [H2] and winter fuel poverty [H6] due to warmer winters
Goal: Protecting Natural and Cultural Heritage	N18, H11 Example: Coastal erosion is affecting	N1 Example: Severe impacts on survival	H11 Example: 23% of listed buildings and 18% of					H7 Example: Present day - warmer days

	15% of the Northern Ireland coastline including Strangford Lough, the Foyle Estuary and dune system at Murlough [H11]	beech and oak from summer drought stress in a high emissions scenario in the SE of the UK [N1]	scheduled monuments in England are at risk of flooding [H11]					encourage greater engagement with cultural heritage [H7]
Goal: Sustainable Businesses	B3 Example: Projected changes in incidence of low flows of up to 50% by 2080 are projected in a 4C pathway [B3]	N6 Example: Reduction in the area of grades 1 and 2 (excellent and very good quality agricultural land), by 2050, downgraded primarily to grade 3a/3b [N6]	B2 Example: Expected annual damages for UK-wide non-residential properties from coastal flooding is expected to increase by 30% by 2050 in a 2C scenario [B2]	H3, H4, H5, B5 Example: global studies show up to 80% reductions in labour capacity in peak months by 2050 [B5]	B6 Example: Over half of businesses reported productivity losses in the previous year due to supply chain disruption [B6]	ID4, ID5, ID10	N9, B7, ID2, Example: UK vineyards now cover over 2500 hectares, representing a 160% increase in 10 years [N9]	
Goal: Net Zero	N1, N2, N4, N5, N17 Example: In 2018, a net reduction in carbon uptake of global ecosystems was detected due to drought [N1]	N6, N8	I1, I2, I3, I4, I5, I6, I7, I8, I9, I10, I11, I12, I13 Example: Increases in maximum storm wave of up to 2 metres by 2070-2100 (RCP8.5) could reduce stability and increase degradation of offshore wind turbines [I11]		ID7 Example: Net Zero targets are resulting in greater dependence on narrow supply chains of rare earth metals e.g. cobalt [ID7]	ID5	N9 Example: CO_2 fertilisation effects suggest annual biomass increments could increase by 15-25% by 2050, but only if water and nutrients are not limiting [N9]	

Source: Based on The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London.

Notes: Table shows which risks and opportunities (columns) will affect the different societal goals identified by the Committee (rows). Risk numbers and some examples are provided to show the specific risks and opportunities that are relevant; see Table 2.2 for a key to the different risks and opportunities. Unless stated otherwise, examples are UK-wide.

Threshold effects

Threshold effects can change the level of impact from climate change but are usually ignored by risk assessments that rely on linear models of change.
A threshold is the point at which a 'non-linear' change in a system occurs as a result of change in a climate driver – such as temperature. For example, algal blooms in rivers start to occur above temperatures of 17°C.

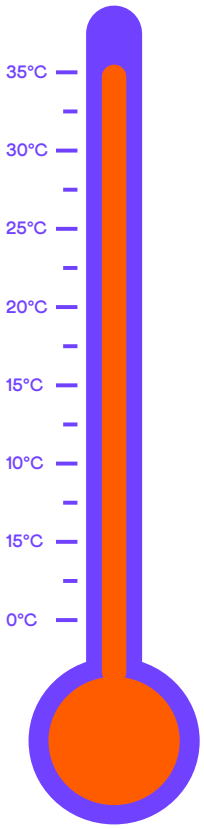
There is a lack of consideration of thresholds in adaptation planning.

Understanding where these thresholds exist and how likely they may be in the future is important for understanding the size of a given risk, and at what point a different approach to adaptation might be required. The Technical Report has demonstrated a general absence of consideration of thresholds in the literature on adaptation. Risk assessments that look at average changes over time give a gradual increase in risk, and by their nature miss specific points that 'tip' the system or asset into a different state. This should change and emphasis be given in future national adaptation plans on how threshold effects be accounted for.

The assessment for each risk and opportunity in the risk assessment has considered the potential for key threshold points to be crossed between the present day and 2100. Such threshold effects can be of different types. The Technical Report has mainly considered biophysical thresholds where an impact occurs or increases significantly following an exceedance of a temperature or rainfall level. But other thresholds have also been identified. Engineering or design thresholds represent chosen points that infrastructure and built assets are designed to perform up to (for example, critical national infrastructure tends to be designed to withstand a 1 in 200-year flood). Policy or social thresholds are those beyond which a human-derived unacceptable limit is reached. These can include public-defined or business-defined thresholds of acceptable risk (e.g. numbers of deaths, profit losses) or behavioural changes that occur beyond a threshold, for example rioting has been observed to increase globally when the Food Price Index (FPI) exceeds 140.

Most of the evidence that has been collected from the literature for the assessment involves biophysical thresholds. Some of these, in relation to temperature, are illustrated in Figure 2.4, as well as the quantified impacts in a 2°C and 4°C scenario where these are available.

Figure 2.4 Biophysical thresholds identified in CCRA3 Technical Chapters



27°C
Increased risk of rail buckling

18°C
Declines in vendace (cold water fish species). No change to today (2°C), tripling of risk of loss (4°C)

14.5°C
(average temperature of warmest month per year). Peatland degradation. Annual economic losses £318million (2°C), £1.3 billion (4°C

35°C
(3 days or more exceedance). Winter wheat grain filling declines. No change to today (2°C), annual economic damages of £42 million (4°C)

23°C
Increased heat stress in cattle. Annual economics damages of £3.8 million (2°C), £15.9 million (4°C)

17°C
(Daily max). Algal blooms in lakes and rivers. Annual economic losses of £295 million (2°C), £481 million (4°C)

9°C
(daily mean) Increases in sheep parasite *Haemonchus contortus*. Increase in development season by 30 days (2°C), 60 days (4°C)

Sources: UKCEH (2020) Climate driven threshold effects in the natural environment; Jaroszweski, D., Wood, R., and Chapman, L. (2021) Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London.
Notes: While a number of potential threshold effects have been identified throughout the CCRA, only those with a specified temperature value are presented here for illustrative purposes.

Interacting risks pose one of the biggest challenges when assessing climate risks and climate change impacts can have significant, far-reaching consequences. System resilience to climate change goes beyond individual risks and opportunities. All infrastructure sectors are connected, meaning that vulnerabilities on one network can cause problems for others, and impact beyond the infrastructure system itself, affecting the economy, health and wellbeing. The Committee has identified risks to people and the economy from climate-related failure of the power system as one of the top priorities for Government, given the potentially far reaching consequences of a power failure across society and the growing importance of electricity in the whole infrastructure system in the transition to a Net Zero economy.

We highlight cascading impacts from the power sector as one of the Committee's eight priority areas for urgent action.

All of the major climate hazards considered in CCRA3 could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms. Interactions with other risks within and across sectors have been considered for each of the 61 risks and opportunities in the Technical Report. Given the wide-ranging nature of the linkages within and across sectors, a full understanding of the impacts of cascading failures is difficult to ascertain and the Technical Report concludes that the vulnerability of interconnected systems may be significantly underestimated. To support the assessment of interdependent risks in the Technical Report, a project was commissioned to assess how climate change affects the interaction of risks across the infrastructure, built environment and natural environment sectors (WSP, 2020).[4] The project developed baseline 2020 scenario pathways and then considered how the risk levels within pathways and the drivers of overall risk changed under 2050 and 2080 2°C and 4°C climate scenarios. Table 2.5 shows the most significant risk pathways modelled for CCRA3. In 4°C climate scenarios, several cross-sector interactions become significant drivers of overall risk in the mid and late century.

Table 2.5
Summary of the most significant risk pathways modelled in the CCRA3 Interacting Risks project, by climate driver with risk ratings in 2020 and 2080

Hazardous events	Main impact cascades		2020	2080
Climate driver: Increase in summer temperatures and reduction in summer mean rainfall				
Heatwaves and very hot days	Building overheating leading to building productivity loss		Medium	High
	Transport infrastructure overheating, or disruption to IT and comms services	Travel and freight delays	Low	Medium
		Transport infrastructure damage	Medium	Medium
Low summer river flows, and increase in river water temperatures	Environmental water shortages, more algal	Habitat degradation	Medium	High
	Reduction in water quality		N/A	Medium
Increase in soil desiccation	Soil condition and quality impact			Medium
Climate driver: Extreme winter rainfall events and increase in winter mean rainfall				
River, surface and groundwater flooding	Power supply disvding		Low	Low
	Water/sewerage infrastructure flooded, reduced water quality or power supply disrupted	Water supply disrupted	Low	Medium
		Sewer flooding	Low	Medium
	Transport hubs or infrastructure flooded or damaged, or power supply disrupted	Travel and freight delayed	Medium	High
	Damaging water flows, slope or embankment failure	Transport infrastructure damaged	Medium	High
	Building flooded	Building productivity loss	Medium	High
		Building damaged	Medium	High
	Increase in run-off	Reduced water quality	Low	Low
Climate driver: Sea level rise and storms				
Coastal flooding and erosion damage	Loss of natural flood defence		N/A	Medium
	Coastal squeeze		N/A	High
	Saline intrusion		N/A	High
	Near shore environmental impact		N/A	High
	Coastal building flooded/eroded	Coastal building productivity loss	N/A	Medium
		Coastal building damage	N/A	High

Source: WSP et al. (2020). Interacting risks in infrastructure and the built and natural environments: research in support of the UK's third Climate Change Risk Assessment Independent Assessment.
Notes: Shows the most significant risk pathways and the magnitude of risk in 2020 and 2080, considering the impact and probability of the interaction occurring.

A better understanding of interacting risks and incorporation into adaptation planning will help reduce the impacts of these interactions on UK citizens and business.

Interruptions to power supply and disruptions to IT and communication services were identified by the Interacting Risks project as having the highest number of knock-on impacts across sectors. Most business functions depend on reliable infrastructure, with disruptions being a key risk for site operations, access to markets, supply chain and distribution networks, and employee productivity.

The impact of flooding on infrastructure can have several significant cascading impacts to all infrastructure assets, including buildings, and all the sectors they serve. For example, power or IT outages caused by extreme weather can affect the ability to provide health and social care in hospitals and care facilities, and disruption to transport infrastructure (for example roads being flooded) can cause transport delays impacting ambulance and emergency vehicles.

The combined effect of increased winter rainfall and extreme rainfall events leads to ground saturation and slope or embankment failures. A passenger train derailment in Scotland in 2020, caused by embankment failure following a period of heavy rainfall, tragically led to a loss of life and subsequently the closure of the railway line between Aberdeen and Dundee for almost 3 months. Interaction between climate hazards adds further complexity, for example combinations of drought and periods of intense rainfall can exacerbate embankment stability issues.

Increased drought stress in the natural environment can lead to soil desiccation impacting soil condition and quality. This can lead to structural stability issues and pipeline movement. Soil condition is also crucial for a range of related ecosystem services including plant growth, water quality and greenhouse gas mitigation.

There are implications for water supply from drought, reduced water quality in the natural environment and sewer infrastructure flooding which will all increase the likelihood of water supply disruptions, though changes in drought frequency are highly uncertain.

These are just some examples of the types of interactions and potential impacts on society that will be exacerbated by climate change. There is a need for a systematic assessment of interdependency risk across the UK, to complement the many examples of best practice adaptation within individual infrastructure sectors and improve resilience across society more generally. Major businesses also have an important role to play, being responsible for infrastructure resilience in key sectors including energy and water.

The natural environment plays an important role in moderating many climate change risks.

The natural environment is central to understanding and reducing the effects of cascading climate change impacts across all sectors.

The natural environment is the source of the majority (54%) of knock-on impacts on other sectors, followed by infrastructure (32%) and the built environment (14%).[5] This is not surprising given how dependent human life, society and the economy are on nature. It also leads to the conclusion that being highly connected, a well-managed natural environment could contribute significantly to systems resilience across the UK. The assumption that nature is freely available, will recover from pressures, or is someone else's responsibility to fix was never valid and is increasingly being replaced by placing nature in the heart of business and policy activity.

Acknowledging natural assets as capital that can keep on giving, only if properly maintained, is the basis of a natural capital approach. It encourages all business and policy decision makers to assess their impacts and dependencies on nature

and take the necessary steps to maintain natural assets and be prepared for risks like those from climate change. This is reflected in recommendations for business and investors from the Task Force on Climate-related Financial Disclosures and the ongoing Task Force on Nature-related Financial Disclosures.[6]

Many of the services the natural environment provides are also key to climate change resilience. For example, water purification and regulation, fluvial/pluvial flood hazard alleviation, coastal flood and erosion hazard alleviation and natural control of pests, pathogens and Invasive Non-Native Species.

Ecosystem-based adaptation and nature-based solutions aim to recognise and work with the natural resilience and adaptability of the natural environment to preserve natural assets and ecosystem services, and in doing so, maintain the resilience of the core underpinning services they provide. To be effective, these solutions require the reduction other current pressures on the natural environment, such as over-extraction and pollution – in addition to reducing the pressures from climate change.

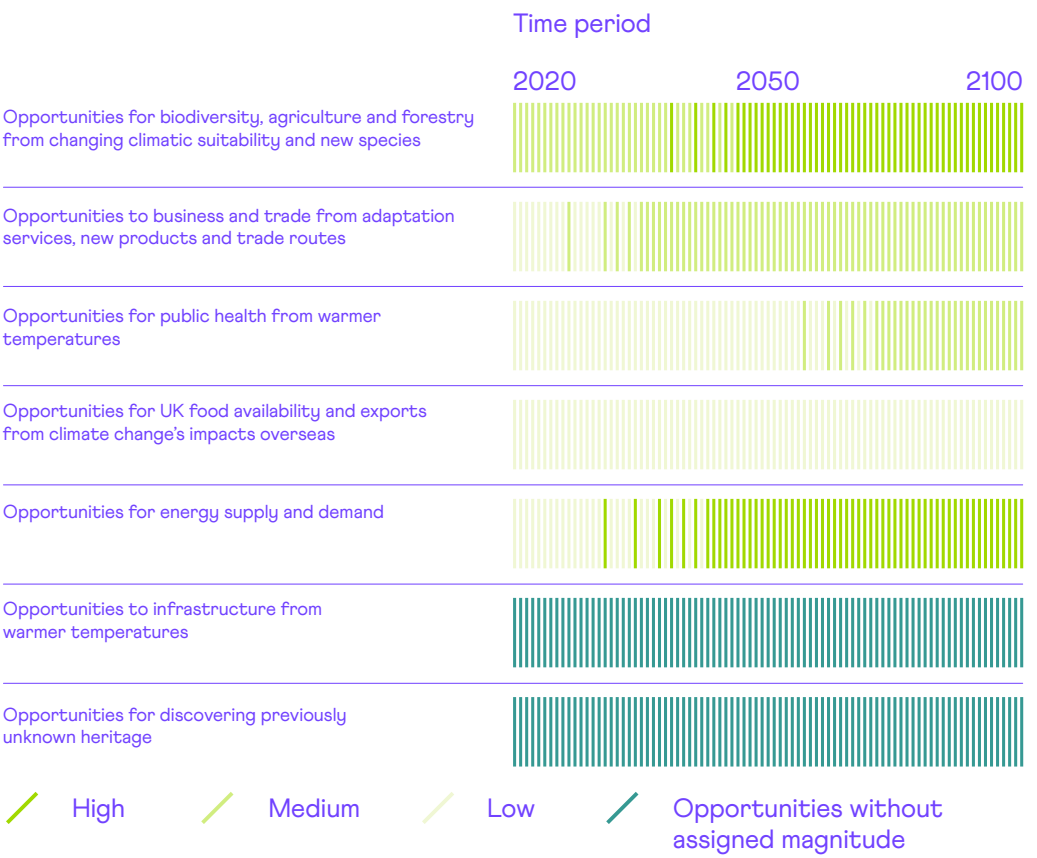
The direct benefits from adaptation action in the context of nature-based solutions are set out in Chapter 3.

Action to minimise the risks from climate change is also important for realising any potential opportunities, such as longer growing seasons.

Although climate change for the UK is associated mainly with risks, there may be opportunities, if appropriate adaptation action is taken in time to minimise the risks and to put in place any necessary support to take advantage of the benefits from warmer temperatures, in particular.
This section summarises the direct opportunities from climate change identified within the Technical Report. Chapter 3 discusses the benefits from further adaptation action.

Figure 2.5 summarises the different opportunities identified in the Technical Report, followed below by a summary for each.

Figure 2.5 Opportunities from climate change identified in the CCRA3 Technical Report



Source: Based on The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London
Notes: Figure shows the changing magnitude score of opportunities according to the Technical Report. Magnitude is shown as a colour gradation from today (left) to 2100 (right) for the highest scenario assessed in the Technical Report (reaching 4°C increase in annual average global temperature from 1850-1900 levels by 2100). Opportunities for energy supply and demand show magnitude for demand only, as the opportunity for supply has not been assessed individually.

Opportunities for biodiversity, agriculture and forestry from changing climatic suitability and new species

Climate change, especially increasing temperatures, could lead to some increasing populations of different species of plants and animals, as well as leading to species movement and expansion of their ranges.

New species could enhance species richness and contribute to community adaptation to climate change, if they do not pose negative impacts to existing ecosystems as is the case for invasive species:

- **Fish.** New opportunities are developing for fish species such as Atlantic bonito, jack, bluefin tuna, sardines and Northern hake, which has been largely absent from the northern North Sea for the past 50 years.

- **Crops.** Climate change provides potential benefits for both arable agriculture and horticulture, through reduced incidence of frost damage for vulnerable crops, CO_2 fertilization, and increasing the intensity and speed of the growing season, assuming sufficient water and fertile soil are available. It can open a range of opportunities for growing new crops such as chickpeas, quinoa, vines, soya, lentils, peaches, apricots, tea, sunflowers, sweet potatoes, watermelons, walnuts, and truffles. In addition, for some crops, reduced times to reach maturity may be providing new opportunities for increased production by enabling multiple crops in a year, such as for lettuce and an increasing variety of salad crops. While climate change could open a range of opportunities for growing different varieties of grapes, which are currently cultivated in Europe, the level of warming will affect the type of opportunity. However, water scarcity and poor state of soil can be the limiting factors for this opportunity.

- **Livestock.** Warmer temperatures throughout the year also imply opportunities for livestock to be outdoors more during winter months, though high rainfall could prevent this due to an increased risk of soil erosion and soil poaching from livestock.

At present, it is likely that most of this benefit will not be realised in the absence of additional government intervention. This intervention could be in the form of: grants providing support to overcome potential technological barriers; provision of information about suitable crops; enabling knowledge exchange; co-ordination of initiatives; and outreach activities such as demonstration projects to build adaptive capacity.

Government policies which lead to new habitat creation, either through expanding existing sites or creating new ones, or increasing the connectivity between habitats (e.g. through Nature Recovery Networks) could help species to colonise new areas. Managing sites better to improve their condition can also help support larger numbers of species and facilitate colonisations. Large-scale habitat creation and improvement usually depends on government action and often is supported by direct government funding, such as agri-environment schemes.

Opportunities to business and trade from adaptation services new products and trade route

There are economic opportunities for adaptation products and services - adaptation finance, increased tourism, agricultural products and trade.

The changing climate could bring opportunities to some sectors and localities leading to new markets for goods and services, better growing conditions or an increased demand for adaptation finance. UK businesses have the potential for market leadership, competitive advantage through early adaptation and being first movers, attracting clients and talent aligned to climate objectives and improved reputation. Specific opportunities discussed in the Technical Report include:

- **New products and services.** There is a growing adaptation sector including environmental monitoring, consultancy and adaptation advice; engineering and manufacturing products to manage climate risks, construction, professional, scientific and technical activities to incorporate climate resilience into new developments and existing infrastructure

- **Finance sector.** New insurance products, investment in various new asset classes such as green bonds, sustainable public or private equity and sustainable infrastructure.

- **Tourism.** Further opportunities might arise from extending the local tourist season due to warmer summers, increasing beach and summer tourism on British Isles from climate change, which in some scenarios is estimated to grow by up to 0.3% of GDP per year.

- **Agriculture.** New business activities in agriculture, horticulture, viticulture and food products, such as wine production, soft fruits or salad crops.

- **New trade routes.** The UK could benefit from increased access to Arctic shipping routes because of climate change (though noting that there are threats to Arctic ecosystems and geopolitical risks that are orders of magnitude larger), as well as increased tourism and the provision of maritime services in addition to trade.

Given the low level of understanding of the opportunities to businesses from climate change, and the likely barriers to small businesses in particular to enter new markets, there is likely to be a role for Government in providing evidence and supporting businesses to transition to new functions as the climate changes.

Opportunities for public health from warmer temperatures

Warmer winters could reduce cold-related mortality, though the effect is likely to be relatively small in the context of an ageing population. As UK summer temperatures are likely to rise with a longer summer season, there are also opportunities for an increase in use of outdoor space for physical activity, leisure activities, cultural activities, and domestic tourism. This could bring physical and mental health benefits of increased physical activity and contact with nature as well as increased Vitamin D exposure which is important for bone health and the immune system.

Increasing temperatures could also potentially lower the risk of mould growth in homes, provided there is sufficient ventilation to remove moisture from the indoor air. However, in some regions, heavier rainfall may offset this benefit. There is scope for policy intervention to capitalise on the opportunities of warmer winters and hotter summers to encourage physical activity.

These could be strategies to increase green infrastructure, opportunities for outdoor recreation and active travel (walking and cycling).

Opportunities for energy supply and demand

Climate change will reduce future household heating demand in winter, which will have benefits in reducing household costs related to space heating. In a medium emissions scenario, the marginal economic benefit could be over £1 billion per year for the UK by the end of the century, assuming that households react to warmer winters by using less energy for heating.

From an energy supply point of view, hydroelectric power could benefit from increased output under moderate increases in river flows but is vulnerable to both low and extremely high river flows.

Impoundment schemes (hydropower facilities that utilise dams to impound water in a reservoir) have the greatest ability to benefit from increased winter river flows and to absorb the impact of decreased summer flow although this depends on reservoir capacity.

For impoundment schemes to take advantage of higher winter rainfall, increases in reservoir sizes and or turbine capacity will be necessary. For new hydroelectric installations, the turbine needs to be designed to maximise output under both current and future flow duration curves and to be resilient to peak flows they may be exposed to - taking into account any flood alleviation schemes in the area.

Opportunities for UK food availability and exports from climate change impacts overseas

Climate change will alter global patterns of food production, creating, at least in theory, potential new opportunities for imports and/or exports for the UK. If longer-term climate change results in a comparative advantage for UK agriculture relative to other food-producing regions, there might be opportunities for increased exports, if production in the UK is maintained.

Actions over the next five years could focus on increasing UK access to a broad range of international markets, via goods, finance & markets transmission pathways, in order to ensure that any opportunities can be capitalised upon.

Opportunities to infrastructure from warmer temperatures

Opportunities may arise from fewer snow and ice days reducing winter maintenance costs, travel time delays and accidents. However, such benefits could be offset by an associated reduction in preparedness or increased complacency in the future to cold weather impacts, which although declining in frequency will still occur from time to time (see Chapter 1).

Opportunities for discovering previously unknown heritage

Climate change could enable new discoveries of UK heritage sites. As an example, The Royal Commission on the Ancient and Historical Monuments of Wales identified approximately 100 new historic assets during the severe summer drought of 2018 due to the different soil moisture patterns exposing previously unknown sites.

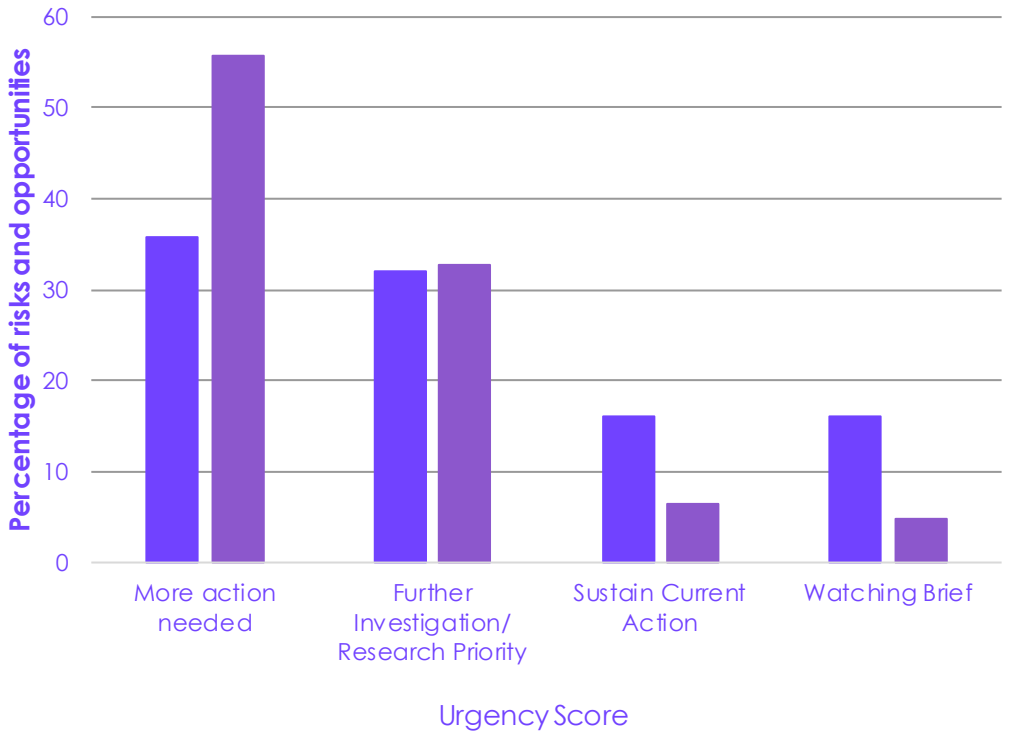
This section briefly summarises some key differences in the CCRA3 assessment of risk and opportunity compared to the two previous CCRAs, CCRA1 (2012) and CCRA2 (2017).

Changes in urgency scores

A larger number of 'More Action Needed' risks and opportunities have been identified in this assessment compared to CCRA2.
The highest urgency category, 'more action needed', has been given to 34 of the 61 (56%) risks and opportunities, compared to 20 out of 56 (36%) for CCRA2 (Figure 2.6).

56% of the risks and opportunities in CCRA3 have been given the highest 'more action needed' urgency score, compared to 36% in CCRA2.

Figure 2.6 Changes in urgency scores between CCRA2 and CCRA3



Source: The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London; CCC (2016) UK climate change risk assessment 2017 – Synthesis Report: Priorities for action in the next five years

Box 2.1 describes the main changes in the urgency scores between CCRA2 and CCRA3.

Box 2.1
Description of changes in urgency scores between CCRA2 and CCRA3

A small degree of the increase in the 'more action needed' category is due to splitting of risks from CCRA2 into more groups.

However, much of the change derives from risks that were classified in CCRA2 as further investigation (i.e. needing more research to assess the need for action) moving into 'more action needed', signalling that further evidence has been gathered in the preceding five years that now classes these risks as needing additional adaptation over what is currently planned. At the UK-level, nine risks fall into this category:

- Risks to freshwater habitats from changing climatic conditions
- Risks to marine species, habitats and fisheries
- Risks to cultural heritage
- Risks to transport from changing temperatures, high winds and lightning (from further investigation/ sustain current action)
- Risks to coastal community viability from sea level rise
- Risks to health from vector-borne diseases
- Risks to businesses from coastal change
- Risks to the UK from international violent conflict
- Risks to international law and governance

Another ten risks and opportunities have increased in urgency score due to an assessed need for further action or investigation compared to the CCRA2 assessment:

- Risks to the natural environment from pests, pathogens and invasive species (sustain current action to more action needed)
- Risks to businesses from supply chain disruption (sustain current action to more action needed)
- Risks and opportunities to changes in landscape character (watching brief to further investigation)
- Risks to hydroelectric generation (watching brief to further investigation)
- Risks to infrastructure from subsidence (watching brief to further investigation)
- Risks to food safety and security (watching brief to further investigation)
- Risks to health from poor water quality (sustain current action to further investigation)
- Risks to businesses from water scarcity (sustain current action to further investigation)
- Opportunities for businesses from new services and products (watching brief to further investigation)
- Risks to finance, insurance and investment including access to capital (watching brief to sustain current action)

A smaller number have also dropped in urgency as follows:

- Opportunities to health from warmer temperatures (from more action needed to watching brief)
- Opportunities for new species colonisations (more action needed to further investigation)
- Risks to offshore infrastructure from storms and high waves (further investigation to sustain current action)

In addition, a small number of additional risks that were not covered in CCRA2 are included in this assessment:

- Risks and opportunities from changes to summer and winter household energy demand (more action needed)

- Risks to education and prison services (more action needed)
- Risks to public health from climate change overseas (more action needed)
- Risk multiplication from cascade effects across systems and geographies (more action needed)
- Risks to international trade routes (not just opportunities) (more action needed)
- Risks to the UK finance sector from climate change overseas (sustain current action)
- Opportunities for UK food availability and exports from climate impacts overseas (watching brief).

Source: CCC analysis.

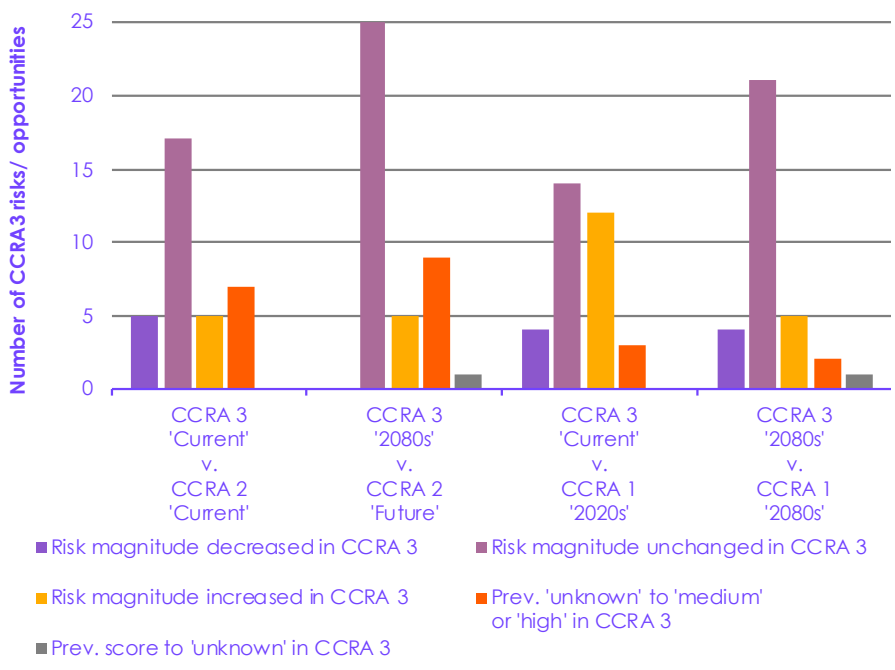
Changes in magnitude scores

There has been an increase in the magnitude of risk between CCRA2 and CCRA3.

The magnitude of the risks and opportunities has also altered compared to previous CCRAs.
Although the list of risks assessed has changed between CCRA1, CCRA2 and CCRA3, some comparisons in the magnitude scores can be made for those risks that are comparable between the three assessments. Fourteen risks have increased in magnitude category compared to the last assessment in 2016 (Figure 2.7), while none have decreased and 25 have remained unchanged. Notably, the present-day magnitude scores for 15 risks in this independent assessment are higher than the magnitude categories predicted for the 2020s in CCRA1.

The valuation assessment for the Technical Report has also demonstrated a much larger number of 'high' and 'very high' categories of damages for individual risks and opportunities, where there is a similar risk assessed in CCRA1 and CCRA3.

Figure 2.7 Changes in risk magnitude in CCRA3 compared to previous assessments



Source: CCC analysis

Endnotes

[1] Murphy, J.M., Sexton, D.M.H., Jenkins, G.J., Boorman, P.M., Booth, B.B.B., Brown, C.C., Clark, R.T., Collins, M., Harris, G.R., Kendon, E.J., Betts, R.A., Brown, S.J., Howard, T. P., Humphrey, K. A., McCarthy, M. P., McDonald, R. E., Stephens, A., Wallace, C., Warren, R., Wilby, R., Wood, R. A. (2009), UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter.

[2] Baglee, A., Haworth, A. and Anastasi, S. (2012) Climate Change Risk Assessment for the Business, Industry and Services Sector.

[3] 'Single Scottish wildfire could have doubled Scotland's climate emissions for the six days it burnt'. Report by WWF.

[4] WSP et al. (2020). Interacting risks in infrastructure and the built and natural environments: research in support of the UK's Third Climate Change Risk Assessment Independent Assessment

[5] WSP et al. (2020). Interacting risks in infrastructure and the built and natural environments: research in support of the UK's Third Climate Change Risk Assessment Independent Assessment

[6] See https://www.fsb-tcfd.org/ and https://tnfd.info/ respectively.