Grantham Research Institute on Climate Change and the Environment

Turning up the heat

Learning from the summer 2022 heatwaves in England to inform UK policy on extreme heat

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Evidence report

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Summary

The 2022 summer heatwaves in context

The UK experienced five heatwave periods during summer 2022 with record-breaking temperatures of over 40°C in England. The Government declared a national emergency following the Met Office's first ever issuance of a red 'extreme heat' warning. Forty-six temperature monitoring stations across England breached previous temperature records. The heatwaves were associated with a total of 2,985 excess deaths in England.

The temperatures seen during the July heatwave were made 10 times more likely due to anthropogenic climate change, according to the World Weather Attribution group. Research by the Met Office suggests that summers which see temperatures above 40°C somewhere in the UK occur about every 100–300 years at present, but without efforts to mitigate greenhouse gas emissions, this could become as frequent as once every 3.5 years by 2100.

Summer 2022 was not an anomaly: it was part of a warming trend in which extreme heat events are projected to become more likely as the climate continues to change. 2022 was the warmest year on record for the UK, 2023 was the second warmest, and the 10 hottest years the country has experienced have all occurred since 2002.

Decision-makers and practitioners working on the frontline of the heatwave response in England consider the country to be ill-prepared for future extreme heat events and that the 2022 heatwaves stretched the health response to its limit; these include emergency responders, medical professionals, third sector and local government actors. It is therefore vital to learn from the experience of the summer 2022 heatwaves and ensure that England and the wider UK are better prepared for extreme heat in the future.

This evidence report shares some of those lessons to inform future preparedness and responses to extreme heat in the UK, and recommends that the Government develops a new Heat Risk Strategy.

Photo: Fire at Shirley Hills, Croydon, 19 July 2022. Peter Trimming/Geograph

The impacts of increasing heat risk in the UK

Under a high greenhouse gas emissions scenario and without adaptation, heat-related deaths in the UK are estimated to increase by almost 166% in the 2030s (4,266 total deaths per year), 580% in the 2050s (10,889 deaths per year) and 1,244% in the 2070s (21,545 deaths per year), compared with a 2007–2018 baseline. Heat is a particular risk for those with pre-existing health conditions.

Aside from causing additional deaths, heatwaves exacerbate existing health, social and economic inequalities, and there are differences in regional heat vulnerabilities and exposure. The impacts of heat exposure to the UK economy are significant, currently estimated at £260–300 million per year, a figure that could rise to £720–950 million per year by 2050. Over 11 million potential labour hours were lost in 2022 because of heat exposure across the agricultural, construction, manufacturing and service sectors. The UK does not have a statutory maximum working temperature for indoor environments, so indoor workers are not protected from the adverse health-related impacts of heat. Heat is known to impact cognitive capacity, affecting worker productivity and the educational attainment of students. Many heat adaptation measures offer high value for money in the context of these large losses.

Over half of UK homes are at risk of overheating, which is projected to increase to 90% of homes under a 2°C global warming scenario. Buildings in the UK have been designed to protect from the cold rather than the heat, and few domestic buildings are appropriately equipped with measures such as external shading. Building regulations now address overheating risk in new-build homes, but existing homes and buildings are excluded. This is especially concerning given the UK's building stock is one of the oldest and most inefficient in Europe. Further, energy policies for buildings in the UK have no explicit focus on reducing demand for cooling.

High temperatures cause damage and disruption to infrastructure including railways and roads, leading to delayed and cancelled journeys, road closures and congestion, causing further heat exposure risks to travellers. Water and energy infrastructure can be affected by a surge in demand for water and energy for cooling, and power cuts can result from overheating. Infrastructure assets will be around for decades to come and therefore must be adapted to withstand future impacts of climate change and extreme heat.

Heat affects the natural environment in a range of ways. Heat stress affects animals, plants, trees and ecosystems while drought conditions, exacerbated by heatwaves, intensify water scarcity and dry out the natural environment, further increasing the risk of grass and wildfires. Heat affects the provision of essential ecosystem services including water, impacting food production, disrupting supply chains and affecting food prices. Heat and drought can reduce the shading and cooling capacity of trees, plants and green spaces and networks – which need to be designed to function under these conditions. Dry conditions can also reduce the capacity of land to absorb heavy rainfall, leading to soil erosion and increasing the risk of flash flooding.

Policies and governance for heat

While the most effective way to minimise the longer-term impacts of extreme heat is through cuts in greenhouse gas emissions, the severity and frequency of heatwave periods around the world, including in the UK, will continue to grow in the short term even once global emissions reach net zero. Therefore, management of heat risk and adaptation will be required to protect the population from more frequent and longer heatwaves of greater magnitude.

There is a governance gap when it comes to managing the risk of extreme heat in England, with no clear coordination between policies, or across government departments at local, regional or national scales. The Heatwave Plan for England applicable between 2004 and 2022 was concerned first and foremost with preparing the National Health Service (NHS) for the impacts of extreme heat, thus policy in this area was primarily owned by the Department for Health and Social Care. Focus on prevention, such as how to modify homes to prevent overheating, was lacking, and policymaking on heat has not greatly involved other government departments. This

unintegrated approach continues, as reflected in the Adverse Weather and Health Plan which predominantly focuses on the health impacts and responses to extreme heat, introduced in 2023 in place of the Heatwave Plan.

Existing policies related to managing extreme heat are fragmented and do not adequately address the severity or urgency of this risk, as highlighted by the Climate Change Committee's Adaptation Progress Reports to Parliament. Accelerating adaptation efforts offers significant economic benefits, and there are cost-effective early adaptation investments to be made, such as heat alert and heatwave planning, capacity-building and making new infrastructure heat-resilient.

The Third National Adaptation Programme recognises the risks to human health from extreme heat, but fails to offer actions of sufficient scale and urgency to significantly improve heat preparedness. For example, it suggests that more research is needed on the ways in which overheating in buildings occurs while failing to recommend that immediate action is taken to improve the homes of people with underlying health conditions.

Measures to tackle overheating such as greater use of air conditioning, as well as efforts to reduce emissions through improvements to home insulation without improving ventilation and cooling, could lead to increased energy consumption and further contribute to climate change. The cost of some actions to reduce overheating risk can be shared with those that also improve energy efficiency. Increased use of passive cooling methods that do not consume energy (e.g. planting trees, and employment of certain architectural design practices) should also be used where possible. Combining adaptation and mitigation efforts is required to effectively tackle the growing and urgent risk of extreme heat.

Limited progress has been made to address the risks of heat, drought and wildfires in the natural environment – and to harness the opportunities of nature-based solutions. There is strong and growing evidence that enhancing natural systems and processes can provide numerous co-benefits for climate mitigation and adaptation; more consistent approaches need to be developed to costing these benefits.

The severity of extreme heat risks and impacts in the UK are often underestimated by the population. Public engagement and targeted advice can support individuals to better understand the measures they should take to keep themselves and others safe during an extreme heat event. Greater coverage in the media of heat risks and impacts can help to build awareness.

Recommendations

Develop a National Heat Risk Strategy for the UK, strengthen the National Adaptation Programme and build a new vision for leadership.

To address the UK's weak and scattered heat risk policy, a National Heat Risk Strategy should be developed that works alongside a strengthened National Adaptation Programme, to ensure a step change in progress on addressing heat risk at all geographical levels. This would build on ongoing work on resilience to heat and broader adaptation such as the London Climate Resilience Review and findings from the Environmental Audit Committee's Inquiry on Heat Resilience and Sustainable Cooling.

The strategy should be coordinated by a single government department with involvement of the Department for Environment, Food and Rural Affairs (Defra) and the Cabinet Office, and support from regional and local government, in close collaboration with the UK Health Security Agency (UKHSA) and the Department for Energy Security and Net Zero (DESNZ).

A broad range of other government departments should also contribute to ensure cross-sectoral coverage, including the Department for Education (DfE), Ministry of Justice (MoJ), Department for Levelling Up, Housing and Communities (DLUHC), and other practitioners and local authorities. The strategy would require a clear vision with a set of short- and long-term actions and priorities, co-produced with a wide range of decision-makers from across the public, private

and third sectors and prioritising those must vulnerable to extreme heat. This would be a long-term strategy, integrating and aligning with other policy priorities relating to climate adaptation and mitigation as well broader considerations for issues relating to inequality, justice and fairness.

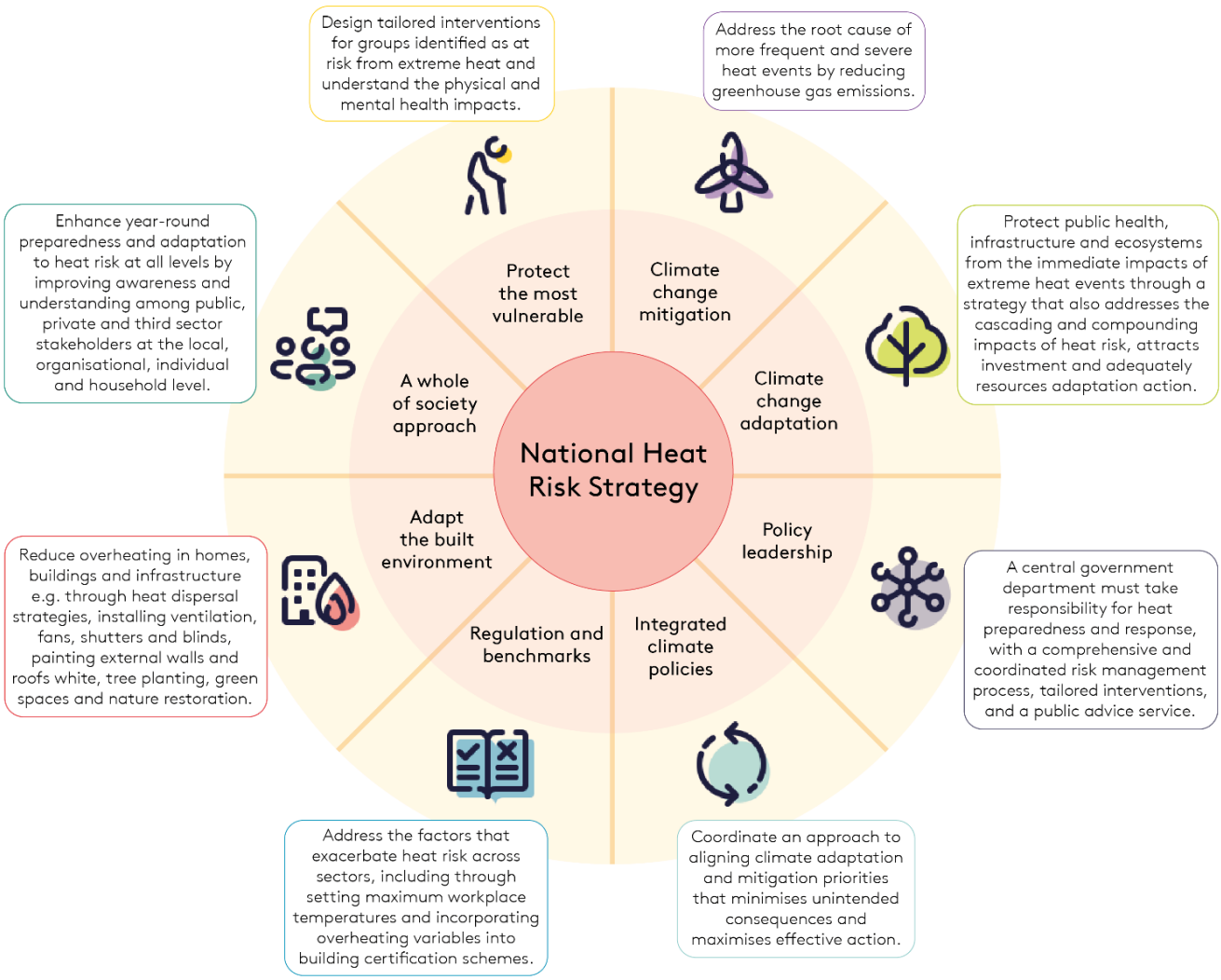
Our research into the 2022 heatwave response and its shortcomings points to **eight core priorities** for the National Heat Risk Strategy, detailed in the figure below.

We recommend that the strategy mandates risk assessments across institutions, businesses and social sectors. More broadly, it would contribute to the Levelling Up agenda by prioritising resources for reducing heat risk where the risk is most acute, for example among vulnerable groups and in buildings or locations with high heat risk exposure.

The National Adaptation Programme's contribution to addressing overheating risk should be reviewed, supported by the development of data capture mechanisms for future heatwaves, including precise documentation of heat-related fatalities.

It is possible to unlock the leadership, ambition and action needed to move from reactive response to proactive action but this will require a step change in leadership and commitment to act at all levels.

Eight core priorities for a National Heat Risk Strategy



Source: Authors

1. Introduction

Climate change is increasing the frequency and severity of extreme heat events in the UK, yet the country is not taking the necessary action fast enough to withstand the impacts. The 2022 heatwaves serve as a warning to policymakers and practitioners – but also offer an opportunity to reflect on what is needed to better prepare for heat in the future.

This report presents insights on heat resilience policy and practice in the UK to inform future preparedness and responses to extreme heat, incorporating the experiences and views of decision-makers and practitioners who worked on the frontline of the 2022 heatwaves across England. The report is intended for policymakers, adaptation and heat practitioners, not-for-profit and voluntary organisations, academics and first responders. [1]

In this introduction we briefly set out the context of heat impacts on the UK. We then go on to outline the current policy environment for managing extreme heat in Section 2, highlighting the gaps and opportunities to strengthen it, before turning to the experience of the 2022 heatwaves in England in detail. Section 3 presents summary perspectives of decision-makers and first responders on how well the response was managed and on current levels of preparedness. Section 4 shares the participants' more in-depth insights into the different challenges alongside suggestions for how the country can be better prepared to handle the impacts of extreme heat. Section 5 concludes, putting forward the case for a new National Heat Risk Strategy for the UK.

Impacts of climate change on the UK's summers

2023 was the warmest year on record globally, with a global average temperature of 14.98°C: 1.48°C above the 1850–1900 baseline (Copernicus, 2024). In the UK, 2022 was the warmest year on record (Met Office, 2024). Due to climate change, heat risks are increasing in severity and intensity across the world, impacting the built and natural environment, people and wildlife, and posing ever greater risks to health, wellbeing and productivity (IPCC, 2022).

The UK's average summer is expected to be around 1.5°C warmer by the 2050s compared with 1981–2000 and 10% drier (CCC, 2023). Hot summers in the UK are expected to become 50–60% more likely by mid-century, and periods of extended heat – with maximum daily temperatures exceeding 30°C for two or more consecutive days – are projected to increase by 2070 (Met Office, 2022b). By 2100, temperatures exceeding 40°C, as experienced in 2022, could occur every 3.5 years under a high-emissions scenario (Christidis et al., 2020). But temperatures do not need to exceed 40°C or even 30°C before the impacts of heat are felt: a large proportion (76%) of heat-related deaths under 1.5°C of warming are not attributed to heat extremes, but instead to moderate increases in temperature, such as at between 1–5°C above regional thresholds (Jenkins et al., 2022). Once temperatures reach 25°C, the number of heat-related deaths increases by around 30% in England and 60% in Wales (ONS, 2023), and the average duration of a heatwave (i.e. three or more consecutive days with temperatures at or above 25°C) has increased over time (CCC, 2021).

Impacts of heat on the UK's population and environment

Heat does not affect everyone equally and is compounded by and exacerbates health, social and economic inequalities (Howard Boyd et al., 2024). Heat risk has a number of consequences beyond the direct impacts on human health and other living things, including cascading impacts across a range of settings and interdependencies between society, the economy and nature, as summarised below.

[1] The report builds on an initial policy brief published in June 2023, available at www.lse.ac.uk/granthaminstitute/publication/the-2022-heatwaves-englands-response-and-future-preparedness-for-heat-risk/ (Howarth et al., 2023)

Health and wellbeing

Heat exposure can lead to serious health risks, particularly for those aged under one and over 65 years old, people with underlying chronic health issues and those living in urban areas with limited options available to cool themselves (Romanello et al., 2023). Under a changing climate, globally these groups are now directly exposed to twice as many heatwaves compared with the period 1986–2005 (ibid.). Other groups that become physiologically vulnerable during periods of extreme or prolonged heat include pregnant people, people with underlying health conditions, rough sleepers and workers directly exposed to heat (e.g. road workers, builders, farmers).

As outside temperatures increase, so does the temperature of people's close surroundings. This, combined with factors such as humidity levels, air movement and exposure to sun, as well as people's age, clothing worn, fitness and pre-existing medical conditions, increases their exposure and vulnerability to heat. Heat can lead to heat cramps, heat exhaustion and heat stress which can increase hospitalisations and become life-threatening (UKHSA, 2023c). Overall, an average of 8,000 extra hospital admissions per year are associated with warm days (Census, 2021).

Heat affects mental as well as physical health. Research suggests that during a heatwave there is an almost 10% higher incidence of hospital attendance or admissions for mental illness (Thompson et al., 2023). Extreme heat is linked to an increase in mental health issues as medication used to treat mental health conditions can affect the body's ability to cool. A meta-analysis of suicide incidents showed than a 1°C increase in mean monthly temperature was linked to an increase in suicide rates of 1.5%. Heat can also increase rates of violence and research from the US suggests that maltreatment of children increases during hot periods due to the impacts of heat on child and adult behaviour and parents' work hours (Evans et al., 2023).

There are around 2,000 heat-related deaths each year in the UK, both during and outside heatwave periods when non-extreme heat can also have adverse impacts on health. Without adaptation and under a high emissions scenario, UK heat-related deaths are estimated to increase by almost 166% in the 2030s (4,266 total deaths per year), 580% in the 2050s (10,889 deaths per year), and 1,244% in the 2070s (21,545 deaths per year), compared with a 2007–2018 baseline (UKHSA, 2023c). Higher temperatures are not solely attributed to heatwave periods during the summer months (Hajat et al., 2007), so it is crucial that heat is not just considered a seasonal issue in the UK, but a year-round risk (Hajat et al., 2014; Williams et al., 2019). However, the majority of heat-related deaths and health impacts are preventable using simple measures (Physiological Society, 2023).

Heatwave in London, 2022. Photo: VictorHuang/iStock

The economy

The impacts of heat exposure to the UK economy are significant, currently estimated at £260–300 million per year, a figure that could rise to £720–950 million per year by 2050 (CCC, 2022; Watkiss et al., 2021).

In 2022, 11.4 million potential labour hours were lost in the UK as a result of heat exposure across the agricultural, construction, manufacturing and service sectors (Romanello et al., 2023). Nearly two-thirds of UK workers could be working in temperatures above 35°C by 2030, and over 27 million workers could be at risk of dangerously high temperatures by 2050, with some sectors such as construction particularly affected (McIndoe and Garcia, 2023). The UK does not have a statutory maximum working temperature for indoor workplaces, putting indoor workers – in addition to outdoor workers – at risk. Heat is known to impact concentration and productivity, as well as students' cognitive capacities and educational attainment: hotter days potentially impact learning and worsen educational inequalities (Park et al., 2021).

Buildings

Buildings in the UK have primarily been designed to protect from the cold rather than mitigate the impacts of heat (Taylor et al., 2023), and very few domestic buildings are appropriately equipped with measures to deal with heat (BEIS, 2021). High temperatures make buildings impractical and uncomfortable to work, live and sleep in, which in turn can affect productivity and cognitive function, and even lead to death. Over half of UK homes suffer from overheating risk, with London and the Southeast at particularly high risk. This is projected to increase to 90% of homes under a 2°C warming scenario, and all homes under a 4°C warming scenario (Bouhi et al., 2022).

Data shows that 90% of existing dwellings in the UK require some form of intervention to address overheating risk in a 2°C or higher warming scenario (Bouhi et al., 2022). The Construction Leadership Council estimates that it would cost at least £500 billion over the next two decades to retrofit the UK's housing stock (ibid.). There are opportunities to minimise these costs, for example where the cost of some actions to reduce overheating risk can be shared with those that also improve energy efficiency. Failure to incorporate overheating risk into existing retrofit programmes could also lead to unintended consequences. For example, energy efficiency measures can negatively affect overheating if the specific characteristics of individual buildings and their year-round heat performance are not fully considered. Further, Energy Performance Certificate (EPC) assessments would benefit from additional performance outcomes related to heat risk, such as thermal comfort, ventilation and indoor air quality.

A number of factors influence overheating in homes and buildings, including the building fabric, standards of insulation and air tightness, the urban heat island effect and occupant behaviour (Taylor et al., 2023). South- and west-facing properties, especially those with greater direct exposure to the sun (e.g. top-floor flats), and ground-floor dwellings with restricted options for openable windows due to security concerns, are at high risk of overheating (Sharifi et al., 2019; DCLG, 2012). Considering most buildings have a long lifespan, typically between 50 and 100 years, it is important to address how the existing building stock will cope with the future impacts of heat (de Wilde et al., 2008).

Heat can also affect the structural integrity of buildings; for example, when the materials that form the solid foundations of buildings dry out, this can cause subsidence and in turn lead to increased insurance claims (Centrick, 2022).

Research has shown that certain settings, such as care homes, are particularly at risk of overheating but that passive cooling methods such as night ventilation and external shutters are effective in reducing indoor temperatures (Gupta et al., 2021), especially in cities (Kolokotroni et al., 2012). If initiatives aimed at increasing the energy efficiency of homes do not also take into account summer thermal performance, they can increase indoor temperatures if there is no adequate external shading (Ferguson et al., 2023) or other cooling means. Homes in

neighbourhoods with a high proportion of ethnic minorities and low-income individuals tend to be worse affected, thus inequality in the adverse experience of heat in the home is exacerbated.

Actions to reduce overheating risk could drive up energy consumption if they involve the increased use of conventional cooling technologies such as air conditioning (Miranda et al., 2023). If generated by fossil fuels, this increased energy consumption will increase greenhouse gas emissions, further contributing to climate change and putting pressure on energy supply and household bills (Khosla, 2023).

Infrastructure

The impacts of heat on the UK's rail infrastructure can cause significant disruption: railway lines begin to buckle at air temperatures of 26°C (Arnell et al., 2021) and greater speed restrictions are put in place when the air temperature reaches 30°C (as rails can heat up to 46°C in these conditions) (Network Rail, 2021). Heat can also cause overhead wire systems to fail (Jaroszweski et al., 2021) and train carriages to overheat. Hot conditions prevent maintenance from taking place and increase the risk to staff of fatigue, heat stroke and being struck by trains while undertaking maintenance duties (Pitcher, 2022). These problems cause significant financial costs for train operating companies. On top of maintenance, between 2016 and 2021 Network Rail spent £51 million on compensation payments due to high temperatures, associated with nearly 850,000 minutes of delay (Network Rail, 2021).

Roads are usually highly resilient to heat but have been known to buckle or even melt under extreme high temperatures, leading to road closures and congestion and further exposing road users to extreme heat in stationary vehicles. Wildfires taking place close to roads can also lead to road closures, and local road networks are considered more vulnerable to extreme weather (Jaroszweski et al., 2021).

Water and energy infrastructure can be affected by heat, with a surge in water demand at the household level as residents try to stay cool, water plants and fill paddling pools. High temperatures create increased energy demand for cooling while energy infrastructure itself is put under greater pressure from possible power cuts from pole-mounted transformers and overhead conductors overheating; components in the national gas grid have a maximum operating temperature of 40°C (UK Climate Risk, 2021).

Infrastructure assets such as water, energy, transport and telecommunications networks will be around for decades to come, and hence need to be adapted to withstand the projected and unexpected shocks from heat related to climate change (National Infrastructure Commission, 2023). The interconnected nature of infrastructure in the UK means that impacts of heat on one area (e.g. energy demand) can have knock-on effects on others (e.g. telecommunications).

Natural environment

Heat affects the natural environment in a range of ways. The Wildlife Trusts have reported incidents such as bird nesting failures, mammals and birds of prey suffering from dehydration and having to travel much greater distances to find food, and plants producing less nectar. Habitats that need wet conditions, such as peatlands and freshwater wetlands, can be severely impacted by extreme heat, and wildfire risk increases (The Wildlife Trusts, 2022a). Urban trees across Europe are experiencing negative impacts from the increase in heatwaves and droughts. Trees react to stress as they age through crown defoliation, early wilting, shedding of branches and lowered resistance to pests. As a result, massive tree death in parks and streets has been observed in many cities (Haase and Hellwig, 2022).

Heatwaves, combined with periods of drought, affect the ability of natural systems to provide essential ecosystem services such as water. One of the impacts of water shortages is on crop production, with the potential to disrupt supply chains and affect food prices. Nature also helps to keep places cool, such as through natural shading provided by trees, but heat and drought can reduce this cooling capacity. Dried-out soils can also reduce the ability of land to absorb heavy

rainfall from convective summer thunderstorms (Met Office, 2021), leading to increased soil erosion and risks of flash flooding (Quinton and Fiener, 2023).

The ways in which the natural environment responds to heat can contribute to compounding and cascading risks. For example, drought conditions, exacerbated by heatwaves, intensify water scarcity and the drying out of the natural environment, in turn increasing the risk of grass and wildfires. This occurred in London in summer 2022 (see Section 3).

Economic and social benefits of acting on heat

Extreme heat and its impacts on human health, wellbeing and productivity is a priority risk identified by the Climate Change Committee (CCC) as requiring urgent action (HM Government, 2022). Furthermore, the third UK Climate Change Risk Assessment (CCRA3) identified potentially high economic benefits from further adaptation and high value for money from investments such as heat alert systems and heatwave planning, capacity-building and making new infrastructure resilient. The benefit-cost ratios typically range from 2:1 to 10:1 – i.e. every £1 invested in adaptation could result in between £2 and £10 in net economic benefits (Watkiss et al., 2021).

River Wye, Bakewell, Derbyshire. Photo: Oscarhill/iStock

2. Current policies and strategies to manage extreme heat in the UK

To be prepared for heat risk requires developing comprehensive and multi-hazard strategies for emergency response, infrastructure resilience, environmental conservation, community safety, and long-term adaptation. The current policy response to addressing heat risk in the UK is weak and scattered. There is no national vision for addressing heat risk and no targets or mechanisms for measuring success, or indicators of preparedness against which to measure progress on heat resilience. Nor is there consideration of how addressing heat risk fits into broader policy on climate change adaptation. While the National Risk Register recognises that extreme heat has become more likely in the UK (HM Government, 2023), the National Adaptation Programme (NAP), the strategic programme for addressing all aspects of climate adaptation, lacks a strong platform for addressing heat risk and does not include mechanisms for taking action. Instead, commitments focus on research and signposting to other policies as delivery mechanisms, many of which lack any substantial, detailed guidance or actions. Some important overarching policies and some of their current shortcomings are highlighted in Box 2.1.

Box 2.1. Summary critique of key overarching policies for heat risk in the UK and England

UK Government Resilience Framework (Cabinet Office, December 2022)

- This framework covers the UK's ability to anticipate, mitigate and respond to a range of known and unknown risks that have a domestic or international root.
- The framework's core principles – developing a shared understanding of risk; prevention rather than cure; and involving the whole of society – suggest the creation of an enabling environment for stronger action to address heat risk. However, the framework identifies the National Adaptation Programme (NAP) as the delivery mechanism for a significant increase in efforts to adapt. In practice, the third NAP ('NAP3') does not deliver on this commitment for heat risk (see below).

Third National Adaptation Programme (NAP3) (Department for Environment, Food and Rural Affairs [Defra], 2023)

- NAP3 outlines the actions that government and others will take to adapt to the impacts of climate change over the period 2023 to 2028.
- It does not provide the leadership or policy needed to address heat risk. Its major policies, such as the National Planning Framework, do not deliver as mechanisms for addressing heat risk. New commitments to addressing heat risk instead focus on research and measuring heatwaves.
- NAP3 calls for further research but fails to recommend that immediate action is taken to improve the homes of people with underlying health conditions.

National Planning Policy Framework (Department for Levelling Up, Housing and Communities)

- This framework outlines the Government's planning policies for England and sets out how these are expected to be applied. Section 14, 'Meeting the challenge of climate change, flooding and coastal change', includes just a single reference to heat risk and no specific policies.

Adverse Weather and Health Plan [England] (UK Health Security Agency [UKHSA], 2023)

- The Adverse Weather and Health Plan (AWHP) is the overarching policy framework for heat response in England, providing a single framework for responding to adverse weather. The plan is a significant improvement on the previous Heatwave Plan for England. It covers a wider range of delivery partners and vulnerable groups and introduces a new heat alert method.
- The plan signposts to training on climate change and notes that existing regional and local channels can be used to shift towards prevention and longer-term planning on climate adaptation. It highlights that such a shift would require clear governance with clarity on local policy and delivery across the system, standards to be delivered, and levers to build support.

Health Effects of Climate Change in the UK: State of the evidence (UKHSA, 2023)

- This report provides important new insights on the health risks and adaptation responses to heat. It is designed to influence net zero and adaptation policy across departments, sectors and locations and provides important evidence to build the case for further research and action.

Below we review current UK- and England-level policies relating to heat risk in specific areas, including buildings, health and the natural environment. See Appendix 2 for a full list of these policies.

Buildings and the built environment

The National Adaptation Programme outlines the plans the Government and others will take to adapt to climate impacts. However, current responses to overheating risk in buildings in the NAP do not go far enough, or at the required speed. For example, they include an assumption that existing energy efficiency retrofit programmes will adequately address overheating risks. Future responses must better consider how to increase access to passive cooling methods that do not consume energy (e.g. through planting trees and architectural design), raise energy efficiency standards for existing cooling technologies (e.g. air conditioners), and phase out climate-warming refrigerants (such as hydrofluorocarbons or HFCs) which have a greater warming impact on the climate than carbon dioxide (ibid.).

The Heat and Buildings Strategy (DESNZ, 2021) also lacks specific actions and policy commitments to address overheating risk for existing homes and buildings. This omission was flagged by the Climate Change Committee (CCC) in its independent assessment of the first edition of the strategy in 2022 and remains unaddressed in the current version. The strategy fails to incorporate additional overheating measures as part of retrofit programmes or integrate climate resilience into planning for energy technology and infrastructure. While Building Regulations in England – specifically Document O – introduced standards for addressing overheating in 2022 (DLUHC, 2022), the Heat and Buildings Strategy only addresses new residential buildings and not the existing building stock – which is significant considering the majority of the UK's housing stock is already built. The time lag in addressing overheating risk in existing buildings is a serious concern. Failure to systematically integrate climate adaptation, and specifically overheating risk, into once-in-a-generation investment programmes could have high social and economic costs in the years ahead.

There is a lack of accountability and progress on addressing heat risk in buildings across the public sector estate, including in the NHS and Ministry of Justice. The NHS published guidance in 2021 that specified that green plans should include a section on adaptation and referred to heatwaves as a risk (NHS, 2021). However, it is unclear how this guidance is being implemented by NHS Trusts and concerning to note that NHS Property Services, which manages around 10% of the NHS estate, does not include overheating risk in its 2022–2025 Green Plan. The NAP states that the Department for Health and Social Care (DHSC), NHS England, and the UK Health and Security Agency (UKHSA) will support NHS Trusts and Integrated Care Boards to incorporate climate change adaptation into their Green Plans by 2027 – six years after the initial guidance was issued. Much stronger targets are needed to drive progress, ensure that heat risk is properly factored into adaptation planning, and ensure that there are no further delays in progress.

The CCC emphasises the importance of considering the net zero interdependencies of planned adaptation (e.g. unintended consequences which could have subsequent effects on infrastructure, nature and socioeconomic processes) in plans for decarbonising the UK's building stock. Such efforts should ensure buildings stay warm in the winter and cool in the summer, but current plans to reduce emissions from buildings do not adequately consider effective adaptation for reducing future overheating (CCC, 2023; Lizana et al., 2022; Khosla et al., 2020).

The wider built environment also has an important role to play in reducing overheating risk. The NAP signposts the National Planning Policy Framework as a key delivery mechanism for reducing overheating risk, yet Section 14 of this framework, 'Meeting the challenge of climate change, flooding and coastal change', includes a single reference to heat risk and no specific policies (DLUHC, 2012). It is largely silent on overheating risk and as such cannot be considered an effective mechanism for reducing overheating risk. Factors such as the role of green and blue infrastructure in reducing heat risk in urban areas and identifying wider opportunities to reduce

heat risk through planning are crucial issues that need to be addressed alongside designing interventions relevant to specific groups of people and places.

The NAP does include a commitment to furthering existing knowledge of the building tenures, dwelling types, locations and groups most vulnerable to extreme heat. This includes a commitment to carry out research to determine the specific adaptation measures required to retrofit the existing building stock, with results expected in 2028.

Health

In 2023 the UKHSA met commitments made in the NAP to deliver an Adverse Weather and Health Plan (AWHP) and an evidence report on the health effects of climate change in the UK. This replaced the Heatwave Plan for England which ran from 2004 to 2022. The Heatwave Plan for England was concerned first and foremost with preparing the NHS for the impacts of extreme heat, thus policy in this area was primarily owned by the Department for Health and Social Care. Focus on prevention, such as how to modify homes to prevent overheating, was lacking, and policymaking on heat has not greatly involved other government departments. The AWHP is now the main policy framework for responding to heat risk in England, providing a single framework for adverse weather events. It introduces a heat-health alert system, over a period running from 1 June to 30 September each year. If adverse weather is forecast outside of the core alerting period, an extraordinary alert would be issued (UKHSA and Met Office, 2023).

In introducing the new heat-health alert method and in covering a wider range of delivery partners and vulnerable groups, the AWHP is a significant improvement on the previous Heatwave Plan for England. The AWHP and evidence report could pave the way for enhanced action on climate adaptation in the context of human health, but they cannot drive progress alone. The UKHSA notes that the existing regional and local channels established to support adverse weather and health planning could be used to shift towards longer-term planning on climate adaptation, but this would require stronger governance with clarity about local policy, delivery and standards.

The 2023 evidence report is the first major update on the impacts of climate change on health since 2012 and is designed to influence net zero and adaptation policy across government departments, sectors and locations. It provides important, robust insights to build the case for action and further research to address heat health risks. Some of the needs for action and evidence it identifies are in the direct control of the UKHSA, but many are not. Making progress across all aspects will therefore require enhanced engagement and commitment to addressing heat health risks, across government, agencies and partners. These include the Health and Safety Executive (HSE), which is Britain's regulator for health and safety in the workplace, and hence should consider the vulnerability of frontline and outdoor workers to heat, including those in the construction sector, who will become more exposed to high temperatures. However, the HSE's guidance on temperature in the workplace does not address the increased risk of heat in this setting or provide advice on assessing future climate risk or developing actions to increase resilience and adapt to heat.

Natural environment

The Third Climate Change Risk Assessment (CCRA3) identified 65 adaptation actions and policy gaps related to heat, drought and wildfires in the natural environment. The NAP considers 13 of these, leaving 52 unaddressed (Brown, 2023), and it does not address the specific adaptation gaps identified in CCRA3. For example, climate change will impact the ability of the natural environment to store carbon but there is limited consideration of adaptation to climate change in plans for natural carbon stores. The NAP does consider wildfire and climate risk forecasting in tree planting plans but has nothing specific on including adaptation in greenhouse gas assessments for peat, which is also at risk of wildfires. There is a need to stress-test the net zero strategy against a range of future climate scenarios to assess the extent to which the natural environment

will be able to withstand the different manifestations of heat (e.g. longer and/or more frequent heatwaves, more acute temperature extremes).

The risks and opportunities of extreme heat for agricultural productivity are not fully addressed in the NAP. This includes, for example, a lack of action to address wildfire risks for farms and failure to address heat risk as part of an overarching approach to climate adaptation. Similarly, for freshwater species and habitats, policies do not address the risks of heat and drought. For example, policies are needed that focus on reducing water temperature and avoiding the drying up of water bodies.

The role of trees in supporting society to adapt to increased heat risk is recognised in England's Tree Action Plan (Defra, 2021), which commits to ensuring that new streets are tree-lined. Updates were made to the National Planning Policy in 2023 to reflect this. The Environmental Improvement Plan (Defra, 2023) reiterates existing commitments to extend the Urban Tree Challenge Fund and to build more parks and incorporate green infrastructure in towns and cities. However, these commitments are not backed by clear legal requirements or progress indicators.

There is strong and growing evidence that interventions that harness or enhance natural systems and processes can provide multiple co-benefits for climate mitigation (e.g. carbon sequestration) and adaptation (e.g. increased shading and cooling). Building the economic case for nature-based solutions is made more challenging by the complexities and inconsistencies in valuing nature in economic models. In many cases, assets such as street trees are perceived as a cost rather than a benefit, not factoring in the environmental and health benefits of cooling or carbon storage. There is a need to develop more consistent approaches to valuing ecosystem services and nature-based solutions to climate change and heat risk – and where possible assigning them a monetary value.

Local response

There is a lack of integration between national and local heat risk policies. A number of plans for heat preparedness exist at the regional, city and local levels, representing the localisation of heat risk, but plans vary in quality and delivery between localities. In London, for instance, several plans and policy documents refer to heat, including the London Plan, City of London Local Plan, London City Resilience Strategy, London Environment Strategy, London's Health Inequalities Strategy and Climate Action Strategy 2020–2027, but there is no explicit heat resilience plan. In Yorkshire and Humber, while heat plans exist for some cities (heat resilience is discussed in Leeds Council's Climate Adaptation and Resilience Plan, for example), and a regional-level Climate Action Plan is in place, there is not yet a clear regional heatwave or heat risk strategy for managing public health.

Finance

In 2023 the National Audit Office found that the Government was unable to identify any examples of funding and investment to manage the risk of high temperatures and heatwaves (NAO, 2023). The UK Government's Green Finance Strategy (2023), published prior to the NAO report, addresses the need to adapt to overheating risk in broad terms but makes no specific commitments to overcoming barriers and developing new funding and finance mechanisms to address heat risk. There is a commitment to enhancing the evidence base on adaptation finance generally through the Climate Change Risk Assessment cycle, but it is unclear if and how heat risk will be prioritised through this process, and results are not expected until 2026.

3. Views from the frontline on the 2022 summer heatwaves in England

To understand England's response to the 2022 heatwaves as a way to inform wider UK policy on heat, this section provides insights from the perspectives of local authorities, emergency response personnel, community organisations, and utility providers from London, Manchester and the Yorkshire and Humber region, and from government departments. These are stakeholders who had direct experience of the heatwaves and thus whose reflections can shine a light on the successes and failures of the heatwave response, perceived preparedness for extreme heat, and improvements that should be made.[2] This research was conducted through focus groups (21 participants) and interviews (38 participants).[3] Direct quotes from the research participants are included in this section and Section 4. See Appendix 1 for more information on our methodology. Two separate annexes provide further detail of the participants' perspectives.[4]

The 2022 heatwaves: background

In July 2022, the UK Government declared a national emergency following the Met Office's first ever 'red' extreme heat warning and the first Level 4 heatwave alert since the Heatwave Plan for England was introduced in 2004 (Met Office, 2022a). A record temperature of 40.3°C was recorded at Coningsby, Lincolnshire on 19 July 2022 – an historic climate milestone for the UK, breaking previous temperature records by a margin of 1.6°C. Multiple additional weather stations across England also recorded temperatures exceeding 40°C. Temperatures over much of England exceeded 37°C (ibid.).

During five heat periods that look place over the course of summer 2022 (16–19 June; 10–25 July; 30 July–5 August 8–17 August; 23–25 August), 2,985 excess deaths were recorded in England (excluding COVID-19 deaths) with the majority of these deaths (2,839) occurring among those aged 65 years and over (UKHSA, 2023b) (see Figure 3.1). This is the highest excess mortality figure recorded during a heat period since the Heatwave Plan for England was introduced in 2004. Further analysis for the whole of 2022 indicates that more than 4,500 people died in England due to high temperatures, the highest figure on record. Since 1988 there have been over 50,000 deaths in England associated with hot days (ONS, 2023).

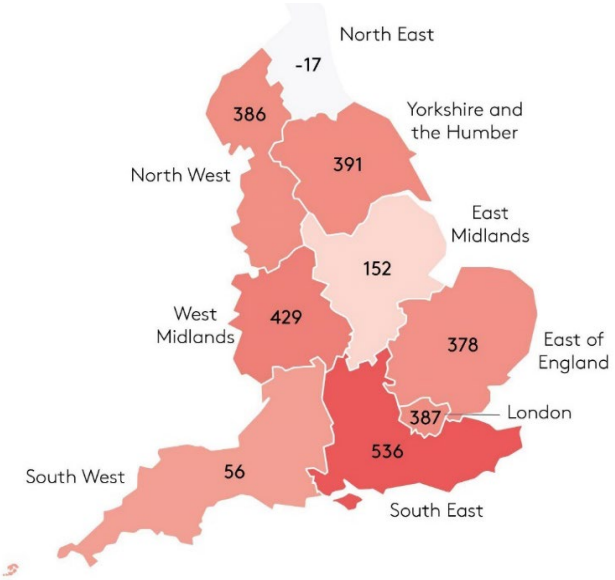
Met Office weather radar station, Shropshire. Photo: Mat Fascione Geograph

[2] These insights complement a range of important guidance material supporting heat preparedness, such as advice published by non-governmental organisations and charities (e.g. the British Red Cross *Feeling the Heat* reports [British Red Cross, 2021; 2023]).

[3] Fourteen of the interviewees also attended the focus groups.

[4] Annex 1 details perspectives by sector and role, and Annex 2 by region. They are available to download from www.lse.ac.uk/granthaminstitute/publication/turning-up-the-heat

Figure 3.1. Estimated all-cause excess mortality by region during the five heatwave periods of summer 2022, England



Note: The negative figure for the North East suggests there were 17 fewer deaths than expected; however, these figures are not precisely estimated, and the North East region may not have been particularly hot during those identified periods. The figures are cumulative across the five heatwaves experienced from June to August, as detailed in the table below.

Heat period	16 to 19 June	10 to 25 July	30 July to 5 August	8 to 17 August	23 to 25 August	Total
North East	1 (-49-52)	8 (-119-135)	-5 (-80-71)	-37 (-125-52)	15 (-29-58)	-17 (-189-155)
North West	38 (-43-119)	30 (-167-227)	-6 (-124-112)	304 (156-452)*	20 (-49-89)	386 (112-661)*
Yorkshire and the Humber	-21 (-88-47)	236 (63-409)*	20 (-80-120)	137 (15-258)*	18 (-40-76)	391 (156-625)*
West Midlands	35 (-38-107)	193 (17-369)*	10 (-97-116)	209 (78-339)*	-17 (-76-41)	429 (184-674)*
East Midlands	14 (-45-73)	96 (-48-239)	-54 (-138-30)	70 (-32-172)	25 (-24-75)	152 (-45-348)
East of England	20 (-42-82)	144 (-10-298)	26 (-64-116)	188 (76-301)*	0 (-52-52)	378 (166-590)*
South East	58 (-37-154)	270 (33-507)*	-82 (-221-57)	324 (152-497)*	-34 (-112-44)	536 (211-862)*
London	38 (-30-107)	184 (19-349)*	1 (-96-99)	174 (53-295)*	-11 (-67-45)	387 (158-615)*
South West	-2 (-74-70)	101 (-78-281)	-57 (-163-50)	243 (108-377)*	49 (-15-114)	335 (85-585)*

Notes: Figures represent estimated all-cause excess mortality by region for each individual heat period and total cumulative excess mortality across all heat periods. Statistically significant values are indicated by an asterisk (*) and 95% confidence intervals are in brackets. Source: UKHSA (2023b).

Other impacts and widespread disruption felt across the UK from the heatwaves included:

- **A record number of outdoor fires**. Several fire services declared major incidents after multiple fires broke out, destroying homes and nurseries. The London Fire Brigade (LFB) experienced its busiest days on record, with 2,496 calls to Control, 359 incidents recorded, 106 fires attended, and 822 fire engines sent out in under 24 hours on 19/20 July (LFB, 2023a). The Brigade declared a major incident (LFB, 2023b).
- **A spike in 999 calls,** increasing pressure on the NHS. Care services supporting the elderly and vulnerable were also put under increased stress.
- **Several fatalities associated with open water swimming.**
- **Failure of clinical IT systems** at Guy's and St Thomas' and Eveline Hospitals in London due to cooling system failures.
- **Shortened school days** in many parts of the country.
- **Substantial travel network disruptions:** Network Rail issued a 'do not travel' warning, rail services were severely disrupted due to damaged tracks and overhead cables, some airports suspended flights and roads were damaged in the excessive heat.
- **Damage to the natural environment and wildlife,** through wildfires, water stress, concentrated pollution in low-flowing rivers, heat stress affecting species such as bats and toads, and drought and high temperatures devastating populations of young trees (The Wildlife Trusts, 2022b; National Trust, 2022).

Summary of perspectives from our different research locations

The participants were asked to reflect on their region of experience, and on England as a whole. London, Manchester and Yorkshire and Humber were selected as the research regions because they were particularly affected by the heat (see further Appendix 1).

The research participants expressed a range of concerns about the 2022 heatwave response. Common themes included a lack of preparedness for the heat, a lack of specific resources and funding, and the need for better communication, public engagement and education. All groups spoke about necessary improvements to policy and governance, the importance of learning from past experience, and collaborating via existing networks.

In summary:

- **England (national level):** Participants saw that the country's resources were severely stretched during the heatwaves. They reported struggling to keep on top of tasks during the response. Participants largely felt that preparedness was not sufficient to match the scale of the issue and there were reports of stakeholders such as local authorities being taken by surprise, slow decision-making, and avoidable impacts.
- **London:** Resources were described as being extremely stretched and capacity to adequately respond during the heatwave as limited, given the challenge of multiple stressors including a large number of fires in the Greater London region, transport disruption and significant impacts to health and wellbeing.
- **Manchester:** The heatwave was described as unprecedented in the North West, taking decision-makers from across the stakeholder groups by surprise, and some felt there was a lack of preparedness and urgency to deal with the heat. Working in silos, a lack of joined-up thinking, and disjointed processes were mentioned as key issues.
- **Yorkshire and Humber:** Public services were viewed as being placed under severe pressure. Participants spoke about a lack of resources and suffering from crisis fatigue or 'disaster exhaustion' while there was pressure to deliver. They also mentioned the need for better public campaigns to increase education and preparedness about heat risks.

Photo: TraceyAPhotos/iStock

Summary views from different stakeholder groups

First responders commented on how operational and strategic on-the-ground resources to respond to the extreme heat were seriously stretched and the ambulance and fire services were under "severe pressure". The fire service described 19 July 2022, when temperatures reached 40 degrees across much of the country, as its busiest day since World War II. Participants thought there was an overall a lack of preparedness which led to avoidable impacts, further compounded by inadequate resources, funding and capacity. The heat led to a number of avoidable, cascading risks, such as wildfires that were made worse by wind conditions and a period of prolonged drought.

> *Within the public sector, we're always expected to pick everybody up and we're underfunded on every front. We're not prepared either.*
>
> *- First responder*

> *The way the fires behaved are unlike other fires in London. And that made it very difficult. [The London Fire Brigade] are very well-trained [but] what they are not expert on is climate-related fires and fires that behave differently. So the type of fires we had were ones you might find in places like Italy and Greece, where the climate's very different.*
>
> *- First responder*

National government department and local authority representatives said that heat preparedness and strategies were inadequate to deal with the extreme heat, and that responses were limited by issues such as slow and reactive decision-making processes. Several issues relating to heat risk governance were raised, including a lack of prioritisation of heat risk both seasonally (i.e. in the summer) and all year round, and a lack of ownership and responsibility for such risks. Some government departments and local authorities managed to deploy resources to members of the public and stakeholders they worked with, but in general a lack of resources, funding and capacity made heat risk responses insufficient.

> *We all ended up working probably 12-hour shifts throughout most of the heatwave. […] When the heatwave was really starting to kick in, we get all of a sudden this surge in Parliamentary Questions, […] and you have to answer them within a very rapid turnaround, like 24 hours or so. […] You basically have to drop everything, and just focus on answering the PQ.*
>
> *- Policy professional*

Communities and civil society organisations said the UK is not prepared for heat events more extreme than those experienced in 2022. This experience of multiple heat events highlighted the vulnerability and exposure of key members of society. It was crucial for them to work together to support responses to the extreme heat, and they said they found it helpful to build on existing networks and learn from previous and similar experiences of crises, such as the COVID-19 pandemic. These networks provide a way to ensure that vulnerable groups are included in preparedness and responses to extreme heat.

> *Ordinarily you would have a protocol in place year-round for something like this and we didn't have. We don't really have a hot weather protocol, we kind of have a series of steps that we would have taken in the past. But it's very much low-level interventions.*
>
> *- Civil society participant*

> *People are a bit apprehensive about saying: 'no, I'm going to have to finish early because I've got to get home to my parents' or 'I just can't work in this condition.'*
>
> *- Civil society participant*

Water and utility providers presented mixed opinions on how well prepared England was for the heatwaves. Participants highlighted multiple stressors, along with compounding and cascading risks, such as drought, which added pressure to the water sector at the same time that demand for water increased. They raised issues relating to public perceptions and dangerous behaviours such as trespassing on land to swim in reservoirs, and emphasised the need for better heat risk communication and educational campaigns to help tackle these.

> *I think the forward planning really helps us and [...] it's a very well-oiled machine, the incident management process.*
>
> *- Utilities sector participant*

> *Had we got another two or three days of really hot weather, I don't think we would have lost supply but we would have got maybe some low pressure in some areas [...] We might have seen more impact and certainly we would have lost storage, because it depletes a little bit every day. But we then get to the point where recovery is really difficult [...] So after a big event like that, it's not just the event, it's managing the system afterwards.*
>
> *- Utilities sector participant*

Summary of views by theme

England's readiness for extreme heat

There was an overwhelming sense from participants that heat policies in England at the national and local level are not adequate to prepare for and respond to the impacts of heat events, especially in the event of more episodes of 40°C-plus extreme temperatures as experienced on 19 July 2022, and that they need updating. Twenty-five of our 38 participants said that current national and local policies were inadequate for responding to such conditions, three said responses were 'ok' or adequate (all of whom were from the policy sector), three stated they were unsure, did not know or could not say, and three participants gave mixed responses highlighting both positives and negatives.

> *I don't think we are ready for [more 40-degree days in England] as a regular, recurring thing.*
>
> *- Policy professional*

> *We're not very good at coping with extreme weather now, let alone what we'll see ... in our lifetimes. And if we get to even a 2- degree or 1.5- degree world, well [that is] not a nice world.*
>
> *- Policy professional*

Some geographical variations were evident across the groups. Participants working at the national level and in London seemed to have made more progress in their roles or organisations in addressing heat risk compared with other regions, mentioning specific policies and guidance. By contrast, participants implied a notable lack of policies related to heat risk in Manchester and the Yorkshire and Humber region, although there were exceptions, with some cities (e.g. Leeds) and sectors (e.g. water and rail) having comparatively more advanced heatwave planning and policy (see Annex 2).

Impacts of the heat

Decision-makers from local authorities and first responders discussed a range of heat-related impacts experienced during the 2022 heatwaves, including direct impacts on mortality and on physical and mental health. They emphasised the strain that extreme heat placed on healthcare and emergency services and raised the risks to vulnerable groups as a key concern.

Participants highlighted several social and economic impacts of extreme heat, including to work and productivity, e.g. heat disrupting people's ability to work effectively, particularly during the hottest parts of day, which were observed in both workplaces and educational institutions. Participants noted how the quality of education and school hours were affected by the heatwaves, which could potentially lead to inequalities in educational attainment. They also highlighted the negative repercussions of heat for transport infrastructure, such as disruptions to train services and excessive heat experienced in sections of the London Underground network. Concerns were raised too about the agricultural sector and the wellbeing of livestock. Discussions touched on the potential future impacts of longer and more severe heatwaves, such as the deterioration of the natural environment and biodiversity and animal health issues.

Participants mentioned several secondary hazards – i.e. indirect hazards or impacts related to or exacerbated by heatwaves – and highlighted a lack of preparedness for them. These included wildfires, air pollution, drought or water scarcity, risks to food supply chains and impacts on the natural environment.

While most of the impacts discussed were negative, one participant mentioned potential benefits for the tourism sector. However, when discussed further, this potential benefit was tempered by the challenge of managing the trade-off between increased visits and the resulting pressure on tourist destinations.

Positive aspects of the response

When we asked participants what went well in the 2022 heatwave response, many spoke about the most effective aspects of governance and planning. These included the presence of strong teams, effective decision-making processes, a considered approach to managing the heat response, and prioritising vulnerable groups. Some also discussed the adoption of a flexible work culture and practices, which facilitated agile decision-making.

> *In terms of our staff, we altered some of the times that people were working [...] we let them start earlier in the morning. We didn't set the targets that they would normally have. [...] We basically let them have more time to do work and at a slower pace.*
>
> *- Civil society participant*

Many participants praised communication and engagement strategies as positive aspects of the response. They highlighted successes in forecasting and early warnings of the heatwaves, the amplification of warnings and messages to key audiences, effective knowledge-sharing between organisations such as the Met Office, local authorities and first responders, and streamlined communications channels. Some participants mentioned that the deployment of the national heat alert system was a success, saying that the process worked well and had noticeably catalysed action.

Participants mentioned the value of the availability of high quality, credible data, and data-sharing and storage. Other positive comments related to preparedness and strategy, including the fact that first responders were well prepared through forward planning. Collaboration was also highlighted, including strong local networks, the successful formation of emergency groups, and positive inter-organisational relationships. Some of this collaboration was made possible by prior experience, existing networks and local knowledge of heat impacts and vulnerable groups, some of which had emerged in response to the COVID-19 pandemic. Flexibility was also mentioned as being necessary in certain situations, in order to adopt discretionary approaches to deploy targeted resources.

> *We had the political and professional authority to make a discretionary decision to provide additional resources... we wanted to make sure that we had an accommodation and support offer for everybody during that short period of extremely hot weather. And I think we confidently came away from it knowing that we had done well.*
>
> - *Civil society participant*

Finally, a few participants acknowledged the "heroic" efforts of individual people and groups that worked behind the scenes to manage and carry out the response successfully.

Negative aspects of the response

The 2022 heatwave was widely perceived as unexpected, and while some felt that given this fact preparation was sufficient and the response handled well, there was unanimous recognition that much more needed to be done and there were substantial shortcomings to the response.

> *Our ability to cope with multiple different things at once is still really tested... we were busy dealing with COVID and a spattering of industrial relations issues when we were then presented, in the coming week, [with] these kinds of temperatures.*
>
> - *Policy professional*

Heat risk reduction and preparedness were by far the most frequently raised issues. Participants pointed to organisational unpreparedness and a lack of strategic planning, particularly the inability to handle multiple crises concurrently. For instance, some respondents bemoaned slow decision-making in the management of the heatwaves, which impacted preparedness, and a lack of foresight and predictive capacity on risks and impacts such as wildfires. Other governance issues were raised, such as a lack of heat-specific plans and misuse of resources, which interviewees said posed problems for the heat response. Participants also cited a lack of resources, capacity and funding, and problems with organisational culture such as resistance to change and inflexibility (contradicting some of the positive reflections made about the response). It was felt that such failures led to avoidable impacts to people and property.

Participants raised concerns about certain public attitudes and behaviours, which they felt could have been managed more effectively to increase salience of the issue and enable citizens to better understand their own heat vulnerabilities and the appropriate measures they could take to stay cool. Issues included a lack of awareness and usage of cooling facilities (when these were available), antisocial behaviour, people overusing and not conserving water, and overexposure to heat in the workplace. Participants saw that these behaviours stemmed from a lack of understanding of heatwave risks and of heat protection measures.

> *[...] information, knowledge, behaviour change techniques are going to be the main thing that we rely on [...] when there's a big [heat] event, then everyone needs to know the drill.*
>
> - *Policy professional*

Physical and structural issues were also noted, such as buildings and infrastructure being ill-suited to cope with heatwave conditions and staff being ill-equipped to cope with the needs of vulnerable people, such as rough sleepers not having a safe space to sleep.

I think most local authority services are Monday to Friday, nine to five... So, we're sort of scrabbling around on Friday night or evenings to make sure that we had places for people to go to and over the weekend, and that there would be covered over the weekend. So, to me, that was chaotic and unplanned maybe in a way that emergency responses always are.

- *Civil society participant*

We need to look at what our firefighters are wearing in summer. We had 18 people who overheated, and that's not acceptable. We had several people in hospital, although everyone's thankfully recovered.

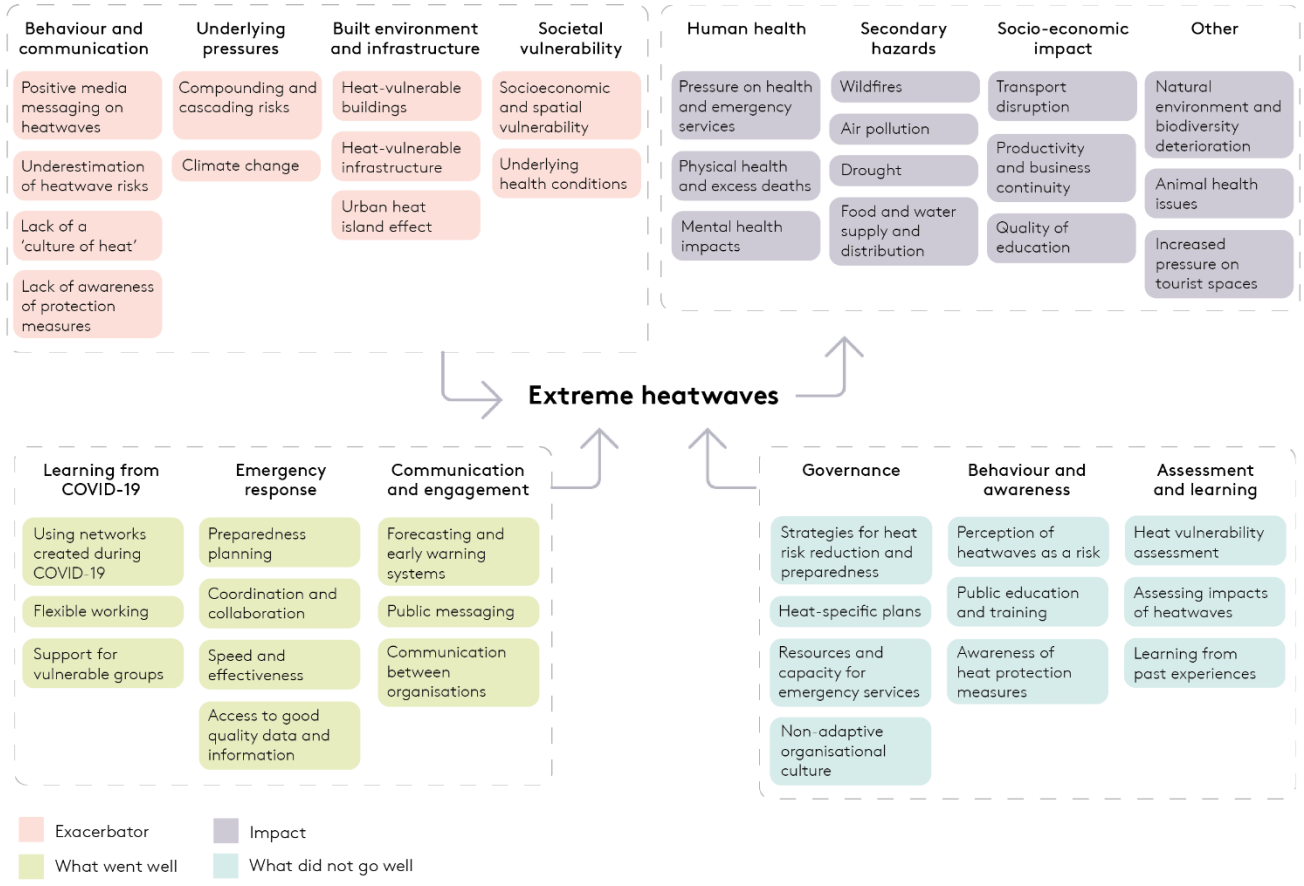
- *First responder*

The 2022 heatwaves response in England: a summary of views

Drawing on the analysis above, we have created a systems map (see Figure 3.2) that details the impacts and exacerbators of the 2022 heatwaves in England and perceptions of positive and negative aspects of the actions taken, deriving from our interviews and focus groups.

Section 4 then reviews in more detail the lessons learned and possible ways forward, as indicated by our research participants.

Figure 3.2. 'Systems map' of participants' views of heatwave resilience in England



Source: Authors' own research via a literature review and feedback from our research with stakeholders (see Appendix 1).

4. Detailing the lessons of summer 2022 to enhance heat preparedness in the UK

That the UK is not sufficiently prepared for heatwaves and rising heat risk associated with climate change was a major finding of our research with decision-makers and first responders, as described in the previous section. To draw out more detailed lessons to improve preparedness and responses in the future, this section drills down into insights our participants provided across the following seven areas for action:

- Improve heat risk preparedness
- Strengthen heat policy and governance
- Increase protection mechanisms for the most vulnerable
- Improve communication to shift attitudes and behaviours
- Make buildings and infrastructure heat-resilient
- Address knowledge gaps and improve data-sharing
- Integrate climate change mitigation and adaptation measures.

Improve heat risk preparedness

Issues related to heat risk preparedness highlighted by our research participants included a lack of resources, funding and capacity to implement responses and cope with the magnitude of the hazard, a sense of 'crisis fatigue', a lack of staff, sometimes of specific personnel with relevant experience of heatwaves, and thus limitations in skills and staff capacity. Financial issues were also raised, such as cuts to public budgets and insufficient funding at different government levels and in certain sectors. This overall lack of resources and capacity led to overstretched services exacerbated by unanticipated impacts.

> *It's difficult enough finding funding to improve the energy efficiency [of properties] from a thermal performance perspective without trying to find the resources for adaptation around heat.*
>
> *- Policy professional*

> *[The fire brigade] would be limited to the number [of officers]. They are running the whole of the brigade from a command or control perspective. So they would be answering the calls from the public as well as mobilising resources to attend incidents. So capacity has got to be an issue.*
>
> *- First responder*

> *The barrier is perhaps more an ability to invest in the resilience of our assets to ensure we can continue to respond. That then plays into the investment required to make sure that those assets stay resilient and what that means in terms of customer bills and affordability. But I guess those are longer-term strategic planning issues rather than acute issues that occur at the point of the heatwave actually happening.*
>
> *- Utilities sector participant*

A number of ways to improve preparedness and strategy were highlighted. It was acknowledged that much could be learned about how to improve England's heat resilience from cities in Europe with more experience of coping with heat risks. Participants suggested setting timely and coordinated responses for vulnerable, at-risk groups, people working in offices and schools, the emergency services and others during heat events. Given that the magnitude, intensity and prolonged period of heat was viewed as a surprise, putting additional strain on emergency services and other sectors, participants suggested a greater understanding of these risks was needed.

One important aspect of the perceived lack of preparedness was the conflict between short- and long-term measures for tackling heat risk, which was raised as complex and difficult to resolve: this aspect is discussed further in the following sub-section.

Strengthen heat policy and build holistic governance

The need to strengthen policies, legislation and regulation came through in discussions. There was a perceived lack of forward-looking, long-term planning, insufficient processes for dealing with heat and a tendency to view heatwaves in the UK as exceptional events when they no longer are. Focus groups mentioned a lack of planning and joined-up thinking, over-reliance on short-term solutions, knowledge gaps and conflicting priorities. Specific challenges related to the Adaptation Reporting Power (which requires infrastructure operators and public bodies to report to Defra on their plans to address current and future climate impacts, which is resource-intensive), planning and building regulations, and balancing present and future needs.

One participant gave the example of air conditioning as a short-sighted solution to heat, as the waste heat contributes to the urban heat island effect and carbon emissions, undermining longer-term responses. Participants believed that political and organisational short-sightedness could result from disciplinary silos and a lack of coordination between actors. For example, the construction industry and planners are responsible for long-term planning supported by appropriate policies but public health practitioners and local authorities focus on short-term, emergency responses. The loss of useful information over time due to a lack of institutional memory among staff caused participants to acknowledge the need to ensure that short-term and long-term planning are complementary.

> *For that week or 10-day period we managed, [but] if this almost becomes a permanent issue throughout a long hot summer I think our focus would definitely have to change. We deal really well with major incidents that are short, sharp shocks.*
>
> *- First responder*

> *Use of air conditioning can increase the urban heat island [effect] by putting more waste heat back out into the external environment and, of course, use more energy which [contributes] to climate change. So that conflicts with the longer-term strategy.*
>
> *- Policy professional*

> *I think at the meta level, we make loads of decisions that are short-term that increase our long-term risk, if we're talking climate change. That happens constantly.*
>
> *- Utilities sector participant*

> *Each heatwave is going to be different... Because it's not a frequent enough occurrence, nobody's built up that kind of knowledge. If we look back through historic periods, you're probably talking five to 10 years of stuff, so that institutional knowledge of what we did in that event isn't there.*
>
> *- First responder*

Participants also discussed there being a lack of political will, a lack of flexibility in governance approaches, disconnected solutions, slow internal processes that create bottlenecks, competing climate agendas and mismatched levels of experience between different organisations.

Policies recommended by participants included a maximum safe working temperature threshold for workers, maximum temperature thresholds for tenants, the provision of cooling solutions, better regulation around overheating for schools, health and social care facilities, and putting legislation in place to ensure immediate heat responses are in place. Specific issues noted were that local authorities are not covered by the Adaptation Reporting Power (while water companies are), and that sectoral 'resilience standards' would help to ensure compliance with adaptation goals and needs (e.g. in the water sector).

Participants said that governance of heat risk needs to take clearer ownership and responsibility of problems. Disjointed processes should be avoided (both nationally and regionally), and mismatches between strategic and operational (or "reactive") perspectives should be addressed. One interviewee (from the utilities sector) spoke about "unresponsive, clunky and inflexible" drought management processes and said there was "inflexibility with the way that we are regulated", which complicated the process of updating the organisation's strategy.

The importance of the local context was also raised as participants acknowledged that a one-size-fits-all approach is often insufficient and that more detailed, precise and concise plans with better community integration are required. This includes adapting and tailoring strategies to different scales and contexts to reach vulnerable groups more effectively.

However, there was an awareness of important regional and institutional inconsistencies in institutional capacity across the country to govern heat risks, given that organisational resources are often very limited. Therefore, the required improvements to preparedness, governance and accountability noted above depend to an extent on greater funding and resourcing to ensure there is capacity to prepare for and respond to heat risk.

Participants also agreed that the interconnectedness of climate agendas needs to be improved to avoid some policy measures being prioritised over others. For instance, there was acknowledgement that net zero and decarbonisation efforts have gained a lot of attention and policy focus, while adaptation tends to be a secondary consideration. Interviewees felt that both agendas were equally important and that much more could be done to align cross-cutting themes, impacts and actions.

Increase protection mechanisms for the most vulnerable

An important area discussed by participants was vulnerable people and at-risk groups. It was noted that more attention is typically paid to building design than how to protect the most vulnerable. Suggestions made to improve protection mechanisms for vulnerable people included encompassing more at-risk groups in strategies, and acknowledging the risks of heat to the over-65 age group, instead of the over-75s as has been the focus previously. This would better capture mortality risk from heat, which increases substantially among those aged over 65 years old.

A need for specific policies and guidance for rough sleepers was noted to address the risks this group faces from heat. Strategies often focus on the risks of cold winter conditions and public concern about homelessness tends to increase during winter. There is a prevailing perception that it is less bad to sleep rough in hot weather than in the cold, despite heat also being harmful to health. Furthermore, a lack of public facilities for homeless people to meet their basic hygiene needs is an important consideration during hot as well as cold periods.

Photo: Tatiana Stepanishcheva/iStock

Participants noted that there are limited vulnerability indices or assessments for those at risk from heat, such as those that exist for other hazards like flooding – and where data does exist, it may not be easy to use due to the need to overlay socioeconomic data. Local authorities would greatly benefit from knowing where the most vulnerable are located and how they can be identified. Heat vulnerability requires a different measurement to cold vulnerability, understanding the different scenarios where vulnerability to heat is exacerbated, for example.

> *We don't have a vulnerability index or a kind of vulnerability assessment of those that are at risk in heatwaves. We have it for flooding because we know the extent of flooding. We have it for cold because we know who is [in] fuel poverty, but for heat it's a completely different ball game.*
>
> *- First responder*

Better planning for heat across the education and business sectors was mentioned too, and participants made practical suggestions such as ensuring appropriate school or work uniforms.

People can be vulnerable to heat outside heatwaves or periods of extreme heat and so improved planning for heat mortality at relatively lower temperatures is also needed. Overheating should therefore be considered as a potential year-round problem and assessments and monitoring of this risk in care homes and schools was highlighted as a priority in this context.

Improve communication to shift attitudes and behaviours

The need to shift attitudes and behaviours related to extreme heat was a prominent topic for discussion. Participants raised how people in the UK associate hot weather with being on holiday and relaxation, which is at odds with how other nations that have historically been more exposed to heat risk tend to view heat. They also noted that there is a huge gap in public understanding of the severity and immediacy of climate risk in the UK and the impacts on people and society, which are already happening.

> *There is a huge gap around the public understanding of their climate risks. How severe they are. How soon they are. They're impacting on us, they're happening now, and we need a big public education campaign so that the public understand what their climate risks are.*
>
> *- Utilities sector participant*

There was a broad consensus on the lack of targeted approach to building awareness and understanding of heat risk and the range of uncoordinated messaging approaches, overloading of warnings, and need for more engaging communications were highlighted. Participants raised the need for improvements in how the media conveys heat risk, as news stories have tended to welcome excessive heat as a positive occurrence, undermining the severity of heat. [5] Participants indicated an absence of emotional engagement surrounding overheating and the deaths that occurred during the 2022 heatwave. To enhance empathy and understanding, and nurture a deeper societal connection to the issue, it was suggested that the human story could be conveyed more effectively across various media channels, including through documentaries, campaigns, marketing and public relations initiatives.

Participants also suggested the use of targeted, strategic communication to address gaps in public understanding by providing better education about heatwaves and water scarcity, and improving health and safety guidance in the countryside on the risks of wildfires and wild swimming. They also highlighted listening closely to community members' concerns and feedback relating to their needs as being important enablers of better heat responses.

[5] For a discussion of visual portrayals of heatwaves in the media see O'Neill et al. (2022).

Make buildings and infrastructure heat-resilient

Buildings were highlighted as a key aspect of heat resilience that could be improved. Issues that were raised included how poor housing stock contributes to temperature-related mortality, morbidity and thermal discomfort, the lack of a national framework for retrofitting in buildings that considers both summer and winter performance, and a lack of regulation to prevent 'maladaptation' (e.g. increased energy use due to uncontrolled uptake of air conditioning, and insulation measures increasing the risk of overheating).

Participants noted that temperature-related impacts need to be considered all year round because both excessive summer heat and winter cold can be linked to greater energy usage and the fabric of homes in the UK is typically not suited to extreme temperatures. Discussions also raised the need for building requirements to consider a wider range of impacts of heat on health (including sleep, productivity and mental health), and regional adaptation plans should include a better understanding of short- to long-term health impacts relating to buildings. They suggested that advocacy and lobbying organisations could play an important role to ensure that mitigating heat risk in buildings is high on the Government's agenda, given that there is currently no clear policy framework or ringfenced funding for retrofitting, and that retrofitting is embedded as a key part of adaptation efforts. This was also viewed as a possible way to help prevent the risks of overheating and cooling measures getting lost among other priorities, and ensure they are aligned with ambitions to better integrate adaptation and mitigation efforts.

Participants spoke about the need for urban design and planning requirements to ensure sufficient focus on overheating, shading/cooling, and 'blue' and 'green' nature-based cooling measures, such as ponds and parks. Transport networks were also discussed as being vulnerable and disrupted during periods of extreme heat, with train carriages overheating (particularly where no air conditioning was in place) and rail services slowing down or being cancelled, often leading to passengers being stranded on train platforms with limited shading. The London Underground was mentioned as having made progress in communicating to travellers the need to stay cool and carry water but participants also commented that the health of both passengers and staff was at risk in certain tunnels and lines that are particularly prone to overheating.

Finally, it was argued that physical and structural factors can be key enablers when they are conducive to effective heat responses. Participants acknowledged that only so much can be done without the right infrastructure or equipment in place. The importance of heat-resilient architecture, civil engineering, retrofitting and provision of tools or equipment was acknowledged as critical to people's ability to carry out adaptive heat responses.

Address knowledge gaps and improve data-sharing

Poor understanding among the public and across sectors about heat mortality risk was raised as an issue, including the precise physiological causes of death during heat episodes – for instance, people often think deaths occur because of heat stroke or heat exhaustion but while these are contributing factors, cardiovascular conditions most commonly cause death. There was also a lack of understanding of compounding risks. While there was an awareness that COVID-19 deaths spiked in the mid-July heatwave (UKHSA, 2023b), participants suggested that more research is required to understand exactly why this was the case. Participants also highlighted a lack of knowledge that risk to life can increase as soon as temperatures start to rise above 18°C (ONS, 2023). And fire service participants said that the service needs to improve its understanding of the risk of winds during heatwaves, and its impact on emergency responses to wildfires. [6]

As well as addressing knowledge gaps through improving communication, as discussed above, participants recommended doing more to translate data on heat vulnerability and exposure into usable information, collecting more timely and specific data to improve the knowledge base,

[6] For instance, on 19 July 2022, London experienced unexpected squally winds, which increased the risk to the public and fire service personnel responding to the wildfire. It is not known if this is a normal occurrence during very high temperatures and therefore if there is a need to anticipate it in operational response tactics.

improving data sharing, and doing more to understand compounding risks (e.g. associations between heat and COVID-19 infections). There were no specific recommendations on who should be responsible for this but it was identified as a notable gap.

> *Especially during the mid-July heatwave we saw that the number of COVID deaths spiked, and we're investigating what's going on there because we're not counting COVID deaths towards the ones that we're thinking are heat related.*
>
> - *Policy professional*

> *We're starting to understand some of the more insidious ways in which [overheating] affects education; not just that a school has to shut down, but that it actually slows down your thinking.*
>
> - *Policy professional*

Some participants mentioned the importance of building on experiences and networks that were established when people faced the challenges of the COVID-19 pandemic. The impact of having motivated individuals acting as champions and leaders was noted for having power to catalyse change. One third-sector participant highlighted that it is "generally one person" who spearheads a set of changes in an organisation. With this in mind, participants raised the need for dedicated posts in local authorities, government departments and civil society organisations that focus on heat risks. This resourcing should ideally include operational leads across key organisations and regional authorities, funding to better establish cross-local authority working groups on heat, and dedicated staff that bring together knowledge on heat from multiple contexts and are able to engage with different stakeholders and audiences on heat-related issues.

Integrate climate change adaptation and mitigation measures

Participants discussed the need to better integrate, or combine, climate change mitigation measures (bringing down greenhouse gas emissions) with adaptation measures (tackling the negative present and future impacts of climate change), into UK heat risk responses. Discussions centred on how feasible this would be.

Generally, participants viewed the integration of mitigation and adaptation as an essential part of the response to climate risks such as heat – with some going so far as to state it was "unquestionable". However, some queried what integration meant in practice, and it appeared to be a challenging topic for many participants to discuss in tangible terms, such as in relation to specific local responses. The majority of respondents reflected that while it was easy to conceptualise the relationships between mitigation and adaptation, applying an operational lens was far more challenging.

Some of the main challenges raised around integration were prioritisation, in that mitigation is typically given precedence over adaptation and integration is not at the forefront of planning and strategies; differences especially in terms of the timescales on which climate mitigation and heat adaptation operate; and a lack of understanding of how integration could work.

However, participants were able to point to several possible enabling factors for integrating adaptation and mitigation, many of which overlap with the enablers of wider heat resilience. For example, communication was seen as key, with participants discussing how heat responses need to be better connected to other agendas (e.g. net zero and air quality) to highlight the co-benefits and enable it to be seen more clearly as an issue with relevance to other agendas. As a local government participant noted, "I think [mitigation and adaptation] do go hand in hand, but it's our responsibility to keep communicating it and putting it out there". Participants also saw funding and finance as essential to promoting synergies between mitigation and adaptation action and stated that integration and heat adaptation need to be considered higher priorities to attract wider and longer-term investment. Participants noted a need to learn from lived experiences to nurture synergies, and to embed integrated adaptation and mitigation approaches into organisational and wider culture in the UK.

5. Conclusions and recommendations: preparing the UK for extreme heat

The risks posed by extreme heat are clear and well documented, and recent experience in England demonstrates the need to improve preparedness, responses and heat governance, as our firsthand research with stakeholders on the ground confirms. The Government and wider society have not responded seriously to the heat risks set out in the Third Climate Change Risk Assessment (CCRA3). Many aspects of heat risk are habitually ignored until crisis events such as the 2022 heatwaves occur. Failure to prepare, increase resilience and adapt is costly, not least to those who suffer as a result.

Opportunities to address heat risk are being missed, and the timeline for building heat resilience is being squeezed. Addressing heat risk at scale will take decades to implement due to the magnitude of the challenges, such as retrofitting existing buildings, adapting the built environment and establishing mature trees and green and blue infrastructure to help address overheating risk in urban areas. While there is a need for further research to scope out detailed options and build the economic case for specific interventions, we have already waited too long to implement measures that match the seriousness of the risks that the country faces.

Heat risk policy in the UK is in general weak and scattered, and many of the stakeholders we spoke to in this research are worried about a lack of readiness for extreme heat events. Better heat governance would balance short- and long-term goals, improve integration across climate policies, make use of better designed and targeted communication and public engagement, and include action to tackle key knowledge gaps to better understand heat vulnerabilities and the efficacy of different measures. Moving from a position of reactive response to progressive action is possible but requires leadership and commitment to act at all levels.

Our research points to the following specific challenges that need to be overcome:

- **Capacity and finance for addressing heat risk are lacking.** This issue underpins the challenges set out in this report. The National Audit Office recently found that the Government was unable to identify any examples of funding and investment to manage the risk of high temperatures and heatwaves (NAO, 2023). A stronger business case must be made for investment in reducing overheating risk that highlights the economic cost of overheating and the benefits of measures to tackle it. Public, private and blended finance must be raised to enable cross-sector heat risk preparedness and responses nationally, regionally and locally. Policy and mechanisms for funding and finance, including consideration of overheating risk in nature-based finance, and net zero policy and investment can deliver adaptation and mitigation co-benefits and protect against unintended consequences.
- **Adaptation mechanisms lack ambition and urgency,** including the National Adaptation Programme (NAP). The new Adverse Weather and Health Plan aims to support local and national organisations to prepare, build and respond to adverse weather events and should enable stronger coordination and response to heatwave events, but it does not address the need to proactively adapt. There is frequent slippage in timelines across policy areas for progressing research, risk assessments and planning. Precise documentation of heat-related fatalities is required, highlighting where, why and how people die, to facilitate the development of data capture mechanisms for future heatwaves.
- **The fabric of our built environment is not resilient to heat risk.** While there are current commitments to research to identify priorities for retrofitting, there is a lack of action to develop funding and finance mechanisms, which will further delay action once evidence to support its prioritisation is released. The slow pace of progress means that the opportunity to factor overheating risk into once-in-a-generation built environment retrofit programmes may be missed, locking in future heat risk at a significant economic cost.

- **The health sector and employers must prepare better for the future.** Policies and plans are not in place to enable health and wider emergency response services to address the impacts of heat, increase resilience and adapt to future heat risk. The UKHSA has identified that clarity on governance, local policy, delivery across the system, standards to be delivered and existing levers to build support are needed to enable progress. Further, policy and action to reduce heat risk must make the connection between future heat risk and avoidable inequalities in health outcomes. There is a lack of guidance and legislation to address health, safety and wellbeing at work during heatwave events, and no legal maximum working temperature despite heat impacting workers' physical and mental health and productivity.
- **Local knowledge and lived experience need greater acknowledgment.** Current approaches to developing adaptation strategies and plans, nationally and sub-nationally, draw heavily on peer-reviewed science and formal sources of data and evidence. This knowledge needs to be enriched by the lived experience and knowledge of those who are most vulnerable to impacts.
- **Communication and engagement on heat risk can be inconsistent.** Mismatched or confusing advice during heat events can lead to a minimisation and underestimation of the severity of heat risks and individuals' perceived vulnerability. A 'culture of heat' does not exist in the UK: citizens, community groups, employers and businesses across all sectors are not fully attuned to the severity of the impacts of extreme heat.
- **Risks to the natural environment from extreme heat need to be better addressed while recognising the role of nature-based solutions to heat risk.** The vast majority of natural environment risks identified in CCRA3, including risks related to extreme heat, have not been addressed by the NAP (Brown, 2023). Installing green and blue infrastructure has huge potential for supporting society to adapt to heat risk, and enabling policies can support such initiatives, such as tree planting. Greater awareness of the potential for greening measures at the household level can help people to manage indoor temperatures during heat events.
- **The risks of heat and wildfire to nature have profound implications for a wide range of policy priorities.** For example, increases in these risks affect the assumptions behind the role that nature can play in enabling the UK to achieve net zero targets. Stress testing should be carried out, with consideration of scenarios that include multiple, overlapping wildfire events across different geographies and landscapes. New policy and investment may be needed to protect crucial carbon sinks, address wildfire risks to agriculture, and reduce water temperature, protect important fish spawning sites and reduce the risk of water bodies drying up.

Recommendations

Develop a National Heat Risk Strategy for the UK, strengthen the National Adaptation Programme and build a new vision for leadership.

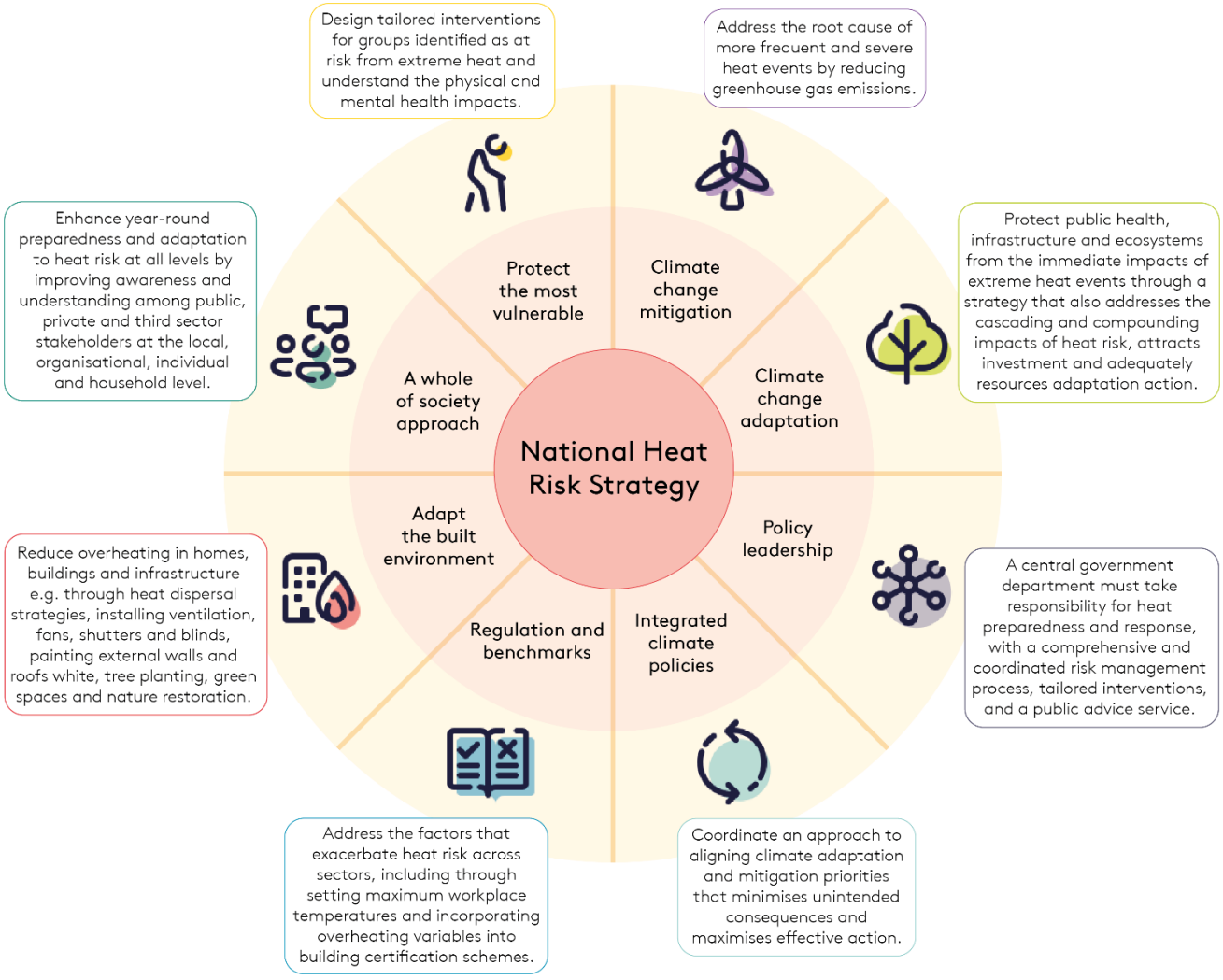
A strategy should be developed that works alongside a strengthened National Adaptation Programme, with regional and local deployment, to ensure a step change in progress on addressing heat risk (Ward, 2020). The strategy should be coordinated by a single government department with involvement of the Department for Environment, Food and Rural Affairs (Defra) and the Cabinet Office, and support from regional and local government, in close collaboration with the UK Health Security Agency (UKHSA) and the Department for Energy Security and Net Zero (DESNZ). A broad range of other government departments should also contribute to ensure cross-sectoral coverage, including the Department for Education (DfE), Ministry of Justice (MoJ), Department for Levelling Up, Housing and Communities (DLUHC), and other practitioners and local authorities. The strategy would require a clear vision with a set of short- and long-term actions and priorities, co-produced with a wide range of decision-makers from across the public, private and third sectors and prioritising those most vulnerable to extreme heat. This would be a

long-term strategy, integrating and aligning with other policy priorities relating to climate adaptation and mitigation as well broader considerations for issues relating to inequality, justice and fairness.

Our research into the 2022 heatwave response and its shortcomings points to eight core priorities for the National Heat Risk Strategy, set out in Figure 5.1. We recommend it mandates risk assessments across institutions, businesses and social sectors. More broadly, it would contribute to the Levelling Up agenda by prioritising resources for reducing heat risk where the risk is most acute, for example among vulnerable groups and in buildings or locations with high heat risk exposure.

The National Adaptation Programme (NAP) does not yet adequately address heat risk. A review is needed of the contribution of the programme to addressing overheating risk and how the current approach can be strengthened. This should be supported by the development of data capture mechanisms for future heatwaves, including precise documentation of heat-related fatalities.

Figure 5.1. Eight priorities for a National Heat Risk Strategy



Source: Authors

A new vision for facing up to heat risk in the UK is required, that builds on ongoing work on resilience to heat and broader adaptation such as the London Climate Resilience Review and findings from the Environmental Audit Committee's Inquiry on Heat Resilience and Sustainable Cooling. Such a vision should consider the following questions:

1. **What is the vision for a heat-resilient UK?**
    - What does success look like?
    - What are the co-benefits of addressing overheating risk?
    - How can this be linked to other climate adaptation and mitigation priorities?
    - How can we implement a culture of accountability?

2. **Who can influence heat resilience and adaptation across scales and sectors?**
    - How can they be engaged?
    - Who should 'own' this issue?
    - What level of commitment is required across sectors and scales?

3. What are the windows of opportunity to act in 2024?
    - What are the levers of change and opportunities to influence progress?
    - How should action be prioritised and resourced?
    - What are the implications of not acting?

It is possible to unlock the leadership, ambition and action needed to move from reactive response to proactive action but this will require a step change in leadership and commitment to act at all levels.

Greenwich Park August 2022. Photo: Alisdare Hickson/Flickr

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Appendix 1. Methodology for interviews and focus groups

Interviews

A total of 38 semi-structured interviews were conducted between October and December 2022. These were conducted online, using a video-conferencing platform, with audio data recorded and transcribed verbatim. Interviewees represented England-wide (N=9), London (N=12), Manchester (N=8) and the Yorkshire and Humber region (N=9). These four locations were chosen because they were areas where extreme and prolonged heat occurred in the summer of 2022 that affected the locations in notable ways.

Participants held a range of roles across the Government, local authorities and agencies (N=18), first response services (N=9), utilities companies (n=4) and civil society (N=7). Interviewees were approached due to their role in responding to extreme heat events at the national and regional level, in particular the UK heatwaves of summer 2022.

Focus groups

Four focus groups were carried out in November 2022 online via a video-conferencing platform, each lasting 90 minutes and were recorded. Each focus group represented one of the regions corresponding with the interview samples (England-wide, London, Yorkshire and Humber and Manchester). Participants (N=21) were selected to represent a range of sectors in each region, covering government and agencies, first responders, utilities and civil society. A number of the interviewees (N=14) also attended the focus groups.

The focus groups were held online to ensure greater participation. Two focus groups were held on 15 November 2022 (London and England) and two on 23 November 2022 (Manchester and Yorkshire and Humber region). Each focus group lasted 90 minutes. Informed consent was obtained from participants and anonymity ensured. The focus groups started with an overview of the research findings so far, then time was divided into three sections (overview and assessment of policy responses; the systems map; and the integration of mitigation and adaptation). The three sections started with a brief presentation by the facilitators followed by facilitated discussion and/or activities that used interactive presentation software and an online whiteboard.

Prior to the focus groups, the research team conducted preparatory research as follows:

- A literature review analysing literature relevant to the UK's exposure to climate risks, and how mitigation and adaptation can be integrated together (including the potential for synergies, trade-offs and conflicts), to address this.
- An overview and assessment of policies, guidance and media coverage: between September and October 2022 a rapid review was conducted of existing policy, practitioner and non-academic literature and media coverage on heat risk vulnerability and responses related to England, London, Manchester and Yorkshire and Humber.
- Systems map: a preliminary map was created based on the literature review and was shared with participants during the focus groups. This is provided in Section 4 above.
- Semi-structured interviews with 38 individuals representing organisations from the four locations that were directly affected by the 2022 heatwaves and had to deploy immediate responses.

Appendix 2. Overview of UK Government policies and strategies to manage heat risk

Department	Policy	Summary of response to heat risk
Cabinet Office	The UK Government Resilience Framework (December 2022)	The core principles that guide the framework (developing a shared understanding of risk; prevention rather than cure; involving the whole of society) imply the creation of an enabling environment for stronger action to address heat risk. However, the framework identifies the National Adaptation Programme (NAP) as the delivery mechanism for a significant increase in efforts to adapt.
Department for Environment, Food and Rural Affairs (Defra)	Third National Adaptation Programme (NAP3) (2023)	The NAP3 does not provide the leadership and policy needed to address heat risk. Major policies included in the NAP as mechanisms for addressing heat risk, such as the National Planning Framework, do not deliver. New commitments to addressing heat risk focus on research and supporting the measurement of heatwaves.
Defra	Environmental Improvement Plan (2023)	The Environmental Improvement Plan Goal 8 focuses on "reduced risk of harm from environmental hazards" and includes a commitment to "reduce risk from heat". It emphasises the value of green infrastructure in reducing heat risk in urban areas and reiterates existing commitments to extend the urban tree challenge fund, build more parks, and incorporate green infrastructure into towns and cities. These commitments are not backed up by clear legal requirements or progress indicators.
Defra	England's Tree Action Plan 2021–2024	The action plan recognises the need to enhance urban tree cover to provide shade and reduce the urban heat island effect. It includes a commitment to ensure new streets are tree-lined, which has been included in the updated National Planning Policy of 2023. The plan does not address the need for large-scale action, such as including trees as part of wider green infrastructure investment, to address overheating risk in urban areas.
Department for Energy Security and Net Zero (DESNZ)	Heat and Buildings Strategy (2023)	The strategy includes a principle focused on "no and low regrets action now" which addresses the need for climate resilience. This is not backed up by specific actions or policy commitments to address overheating risk for existing homes and buildings.
DESNZ	UK Green Finance Strategy (2023)	The strategy sets out the need for climate adaptation finance, including to address overheating risk. It recognises barriers to adaptation finance and includes a commitment to improving the evidence base for action as part of the current UK Climate Change Risk Assessment cycle (due for publication in 2027). Specific commitments for research and innovation funding focus on addressing flood risk and coastal change risk – heat risk is not included. Other adaptation commitments relate to improving the approach to climate resilience assessment and

		disclosure, including publishing adaptation metrics and guidance.
Department for Levelling Up, Housing and Communities (DLUHC)	National Planning Policy Framework	The National Policy Framework Section 14, 'Meeting the challenge of climate change, flooding and coastal change', includes a single reference to heat risk and no specific policies.
DLUHC	National Model Design Code (2021) – Part 2 guidance	The guidance makes several references to overheating risk related to windows, lighting aspect, orientation of new buildings and street trees. It includes one mention of climate change and increased overheating risk, but this should be emphasised more clearly throughout. The link between addressing overheating risk and blue and green infrastructure (e.g. ponds and parks) should also be strengthened.
DLUHC	Overheating: Approved Document O	The strategy's major contribution to reducing overheating risk is a commitment to a new building standard regulation (Overheating: Approved Document O) to address overheating risk in new-build homes, which is a significant step forward. The standard was introduced in 2021 and took effect in June 2022.
Ministry of Justice (MoJ)	Climate Change Adaptation Strategy (2020)	The strategy identifies that prison buildings require detailed climate risk assessments. The MoJ committed in its 2022 annual report to publishing a climate risk assessment for prisons in the same year, which the 2023 annual report confirmed was completed. The report also commits to updating the strategy and publishing an action plan in 2023/2024. However, the climate risk assessment is not publicly available, so it is not possible to evaluate how it addresses overheating risk. Delays with publishing the updated adaptation strategy also mean that it is not possible to assess whether adequate action is being taken.
Department for Education (DfE)	School Building Requirements (2019), updated May 2022	The requirements state that new school buildings must demonstrate resilience to 2 degrees of warming and the ability to adapt to 4 degrees of warming. Retrofit requirements for existing school buildings require resilience to 2 degrees of warming. It is unclear whether resilience is based on daily maximum temperatures or average temperatures, which could make a big difference to the heat risk profile.
Health and Safety Executive (HSE)	Temperature in the workplace guidance	Guidance does not mention climate resilience or adaptation. It deals with current heat risk response and outlines responsibilities for employers relevant to workplace temperatures. It specifies there is no law for a maximum working temperature.
National Heath Service (NHS)	NHS Green Plan guidance (June 2021).	The guidance notes that green plans should include a section on adaptation. It mentions heatwaves as a risk. It is unclear how this guidance is being implemented by NHS Trusts and it is concerning to note that NHS Property Services, who manage around 10% of the NHS estate, do not include overheating risk in their 2022–2025 Green Plan. The National Adaptation Plan states that the Department for Health and Social Care (DHSC), NHS England and UKHSA will support NHS Trusts and Integrated Care Boards to

		incorporate climate change adaptation into their green plans by 2027 (six years after the initial guidance was issued).
The UK Health Security Agency (UKHSA)	Adverse Weather and Health Plan (2023)	The UKHSA established a Centre for Climate and Health Security in 2022 and have since developed important policy and evidence to address heat risk to health. The Adverse Weather and Health Plan (AWHP) is the overarching policy framework for heat response in England, providing a single framework for responding to adverse weather events. The plan is a significant improvement on the previous Heatwave Plan for England. It covers a wider range of delivery partners and vulnerable groups and introduces a new heat alert method. The plan signposts to training on climate change and notes that existing regional and local channels can be used to shift towards prevention and longer-term planning on climate adaptation. It highlights that such a shift would require clear governance with clarity on local policy and delivery across the system, standards to be delivered, and the levers that exist to build support.
UKHSA	Health Effects of Climate Change in the UK: State of the evidence (2023)	The report provides important new insights on the health risks and adaptation responses to heat risk. It is designed to influence net zero and adaptation policy across departments, sectors and locations and provides important evidence to build the case for further research and action.