

Climate and health

Protecting people in the UK from extreme heat



Climate and health: protecting people in the UK from extreme heat

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Summary

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Successive governments have failed to implement effective programmes to protect people in the UK from the growing risks.”

The UK’s weather is becoming more extreme as the climate changes, with hotter summers and warmer, wetter winters. Heatwaves are becoming more frequent and intense. Following the record number of heat-related deaths in the summer of 2022, extreme heat should now be a major public health concern.

Successive governments have failed to implement effective programmes to protect people in the UK from the growing risks, leaving our towns and cities ill-equipped as temperatures rise and weather becomes more erratic. As the urban population expands and the effects of climate change increase, this is a present and future threat to people and the economy that can no longer be ignored.

The new government brings new opportunities for action. It has promised a “decade of national renewal” with a mission led approach that frames growth, clean energy and health as central priorities. Mitigating heat risks to health should be factored into government plans for these missions to succeed. This is more vital given Labour’s pledge to build new towns and 1.5 million new homes which should be planned with heat resilience in mind.

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Acting now to limit and adapt to rising temperatures will save lives.”

Acting now to limit and adapt to rising temperatures will save lives, reduce NHS costs, avoid building retrofits in future and improve the overall health and wellbeing of society, as well as making our towns and cities greener, more pleasant places to live.

We recommend the government introduces the following package of measures to revitalise the UK’s approach to heat resilience and climate adaptation:

- 1 Review and update the National Adaptation Programme
- 2 Set clear targets to improve the heat resilience of infrastructure
- 3 Improve government cross departmental co-ordination and accountability
- 4 Empower local action to improve heat resilience
- 5 Factor heat resilience into plans for new towns and housebuilding

Introduction

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What is now classed as a very hot British summer is projected to be the norm by 2050.”

The record-breaking heatwave and drought the UK experienced in the summer of 2022 should have been a wake up call for policy makers. Temperatures surpassed 40°C in parts of the country for the first time, prompting the first ever Level 4 Heat-Health Alert (HHA). Travel was disrupted, reservoirs ran low, wildfires were sparked and overheated electricity networks led to power cuts.¹ The UK saw its highest recorded number of heat related deaths and a fifth of hospital operations had to be cancelled.²

What is now classed as a very hot British summer is projected to be the norm by 2050.³ Towns and cities are particularly affected by these changes due to the urban heat island effect. Around 84 per cent of the population lives in towns and cities and urban populations are projected to rise.⁴

UK infrastructure does not cope well with extreme weather. Our homes, public buildings and transport infrastructure were not built for the climate we are now experiencing. The third Climate Change Risk Assessment carried out by the government estimated that economic damage could reach £5 billion to £10 billion a year by the middle of the century from nine key public risks.⁵ The Office of Budget Responsibility (OBR) has said that coping with damage from rising temperatures and more extreme weather will put pressure on public finances.⁶

Our weather is changing



Global surface temperatures have already increased by at least 1.1°C above pre-industrial levels (measured as an average between in 2011-2020) and are pushing towards the 1.5°C globally agreed threshold of the 2015 Paris Agreement.⁷

The UN estimates that the world is currently on track for between 2.5°C and 2.9°C global temperature rise by the end of the century if existing climate action pledges are met. There is a risk that temperature rises could be significantly higher.⁸

Globally, 2023 was the hottest year ever recorded by a significant margin. In 2023, the Northern Hemisphere experienced its warmest summer in 2,000 years.^{9,10}

What a hotter climate means for health in the UK



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In the July 2022 heatwave, there were 387 heat related deaths in London.”

While countries in the global north are shielded from some of the worst impacts of climate change due to their location and wealth, higher temperatures in the UK are still expected to have major impacts on public health. Extreme heat significantly increases the incidence of illnesses, premature deaths and threats to mental health and wellbeing.

Heat related deaths without adequate adaptation and with only limited action to slow down the pace of climate change, are projected by the UK Health Security Agency to increase almost 166 per cent in the 2030s, to 4,266 per year in the UK by 2039, rising in the 2050s to 10,889 deaths per year.¹¹

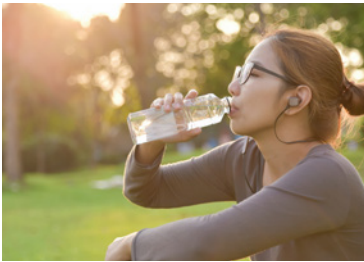
Impacts are not evenly distributed, with geographical, sociodemographic and health differences.

Manchester and Birmingham have experienced temperatures up to 5°C higher than their surrounding areas, and London has been 7°C higher.¹² In the July 2022 heatwave, there were 387 heat related deaths in London.¹³ In the same month, the London Fire Brigade received 2,490 calls on one day, 740 related to wildfires endangering life, property and infrastructure. It was the busiest the service had been since the second world war.¹⁴ During the same month extreme heat led to IT system failure in three London hospitals.

While urban areas are more prone to extreme heat, urban residents do not experience it equally. The poorest fifth of families in England are three times more likely to live in homes likely to overheat than the richest fifth. Over half of families from black and ethnic minority backgrounds live in the highest risk category of homes prone to overheating.¹⁵

The health effects of extreme heat

Even healthy people are at greater risk



Symptoms of heat stress, which can affect even healthy people, include dizziness, headaches, low blood pressure, faintness, tiredness and lethargy.¹⁶

Humidity and air pollution make it worse



Humidity makes the effects of heat worse as it limits the body's ability to sweat. This can be more prominent in UK coastal communities in particular. The combined effect of pollution, heat and humidity is thought to threaten cardiovascular, respiratory, maternal and neonatal health and overall mortality, although additional research is needed to understand this better in a UK context.¹⁷

Some ages are more vulnerable



Babies' and young children are more vulnerable to extreme heat for a number of reasons, including having a lower sweat rate and higher heat production than adults.¹⁸

Older people are more likely to have co-morbidities that could worsen health outcomes in a heatwave. The UK Health Security Agency has observed that there were significant excess deaths in those 65 years and older during the summer of 2022.¹⁹ The UK population in this age range will rise from 12.5 million in 2020 to 17.9 million in 2050.²⁰

Maternal health is affected



Exposure to extreme heat can increase the risk of premature birth, stillbirths and congenital birth defects.²¹ Maternal health can also be affected, with temperature changes affecting blood pressure during pregnancy.²²

Pre-existing conditions can be aggravated



Those with existing medical conditions are particularly at risk from high temperatures for both physiological and behavioural reasons. Those with disabilities, who are bed bound or who have dementia are less able to adapt to keep cool, and conditions such as diabetes and alcoholism impair the ability to sweat.²³ Extreme heat worsens symptoms of cardiovascular and respiratory conditions, and psychosis and it heightens suicide risk.²⁴ During heatwaves, hospital admissions for mental health problems increase by almost ten per cent.²⁵

It affects medication



Heat affects how some medications like antidepressants work, impairing the ability to regulate body temperature.²⁶ Additionally, some medication must be stored at low temperatures which will become increasingly challenging with more frequent periods of higher temperatures.²⁷

The economic costs

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The financial impact on the UK overall is estimated at between £260 and £300 million a year.”



High temperatures are associated with lower economic productivity, as they reduce the intensity of work and increase the frequency and length of breaks workers need to take.²⁸

High night time temperatures cause poor sleep quality and quantity, reducing concentration and cognitive performance.²⁹

Outdoor workers are even more exposed. An estimated eleven million hours of labour were lost due to heat exposure in 2022, across the agricultural, construction, manufacturing and service sectors, with construction hardest hit, losing 69 per cent of potential labour hours and 74 per cent of potential income.³⁰

Extreme heat affects the educational attainment of students in poorly adapted environments. Research shows a potential ten per cent reduction in exam passes at 32°C than at 22°C degrees, with poor exam results linked to lower lifetime earning potential and poorer health outcomes.^{31,32}

The financial impact on the UK overall is estimated at between £260 and £300 million a year, rising to between £720 and £950 million a year by 2050.³³

Unequal impacts

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People from the most deprived areas have less power to adapt their homes.”



Those already suffering from inequalities or who are marginalised in society are likely to be more exposed and vulnerable to climate change in the UK, including extreme heat. People from the most deprived areas already have lower life expectancy and spend more of their lives in ill health than those in less deprived areas.³⁴ They are disproportionately affected by high temperatures, not just because of poorer quality housing and community infrastructure, but also because they have less power to adapt their homes.³⁵

In 2021-22, almost half (47 per cent) of social renters in England were in the lowest income quintile, equivalent to 1.9 million households.³⁶ In 2020, one in eight households in Britain did not have access to a private or shared garden.³⁷

Homeless people and rough sleepers may live in temporary accommodation like tents or vehicles which are prone to overheating. This lack of autonomy and financial means to adapt accommodation increases health risks.

Buildings and infrastructure

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An estimated 90 per cent of hospitals in England have been assessed as vulnerable to overheating.”

In a healthcare setting, 26°C or more is classed as overheating affecting human health and comfort. Hospital in-patients are particularly at risk as an estimated 90 per cent of hospitals in England have been assessed as vulnerable to overheating.³⁸ There are similar concerns for social care settings as the UK's growing population ages.

The quality of many other public buildings, like schools and prisons, is deteriorating and they are also not well adapted to extreme heat.^{39,40,41} Over three quarters of prisons in England and Wales are at “high risk” of overheating in the summer months over the next 15 years.⁴² There is a direct association between extreme heat and suicide risk in prisons.⁴³

Britain has some of the oldest housing stock in Europe, with poor insulation and limited airflow. By 2070, it is predicted that over a third of England's homes will be at risk of overheating, a rise of 80 per cent compared to 2021.⁴⁴ Urban housing types increase exposure; for example, the upper floors of blocks of flats are less able to dissipate heat as it rises, making residents more susceptible. This is particularly true of tall multi-storey buildings with large windows and inadequate ventilation, where windows cannot be opened wide. Solutions like effective cooling and ventilation, and the use of certain building materials can reduce these risks.

Heat and travel

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Heatwaves affect transport infrastructure and how people choose to travel which can have health consequences.”



Heatwaves affect transport infrastructure and how people choose to travel which can have health consequences.

UK buses and trains, and their stations, often do not have adequate shade, ventilation or air conditioning, exposing passengers and staff to overheating.⁴⁶

Hot weather can affect the performance of brakes, tyres, engine oil and coolant in petrol and diesel vehicles, and can damage road surfaces, causing safety risks and additional traffic.

Cycling increases during the summer months in UK cities, with record numbers of cyclists on the road during the 2018 heatwave.⁴⁷ Data on ill health due to heat on public transport and the net effect of warmer weather on active travel is not available though, so the links between transport, heat and health effects need further investigation.

Gaps in action and governance

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Slow progress has been made, despite the growing risks.”

The UK is making limited progress in adapting to climate change.⁴⁸ Part of the problem may be a misplaced sense that the risks are over the horizon and in the future. Governance structures that are in place for adaptation also appear to be failing.⁴⁹

The framework for governing how the UK adapts to rising temperatures is not as effective as one that oversees emissions reductions. There are no clear, quantifiable and easily understood targets for adaptation. The independent body advising government on adaptation, the Climate Change Committee (CCC), is doing its best to monitor progress against indicators it has devised, but there are no statutory targets to drive progress.

Multiple organisations have roles in delivering adaptation measures and the hierarchy of responsibility is not always clear. Compared to other areas, accountability and purpose are not well defined through a central mission overseen by a dedicated government department and secretary of state. This means that slow progress has been made, despite the growing risks.

Progress has been limited

Under the Climate Change Act, the UK government is required to publish a risk assessment every five years to inform its National Adaptation Programme. The CCC's latest progress report to parliament on adapting to climate change found that the first two National Adaptation Programmes, covering the decade 2012 to 2022, had failed to prepare the UK for the risks the government itself had identified. In short, no sector is ready.

In 2023, the previous government published the third National Adaptation Programme (NAP3) covering 2023 to 2028. This was an improvement on previous programmes and has made some progress. It tripled international climate adaptation finance, led to a transport adaptation consultation and strategy and set out a plan for a new cross government Climate Resilience Board to oversee action on adaptation and resilience. However, it has been criticised for repackaging existing policies and for not addressing the full range of risks. Overall, it fell “far short of what is needed” according to the CCC.⁵⁰ The government has been taken to court by campaigners who argue that the National Adaptation Programme “fails in its legal duty to protect people, property and infrastructure”.⁵¹

Action by the UK government on heat and health is not yet joined up. The table overleaf describes the roles of different government departments in managing the heat and health intersection and the gaps in coverage that still exist.

Departmental adaptation responsibilities and gaps in action⁵²

Department	Role in managing health and heat intersection	Progress so far	Gaps in action
Department for Environment, Food and Rural Affairs (Defra)	<p>Responsible for water supply and overall responsibility for adaptation</p> <p>Sponsors the Environment Agency</p>	<p>Published NAP3 in 2023.</p> <p>Launched a new £15 million joint research initiative with UK Research and Innovation to examine climate risks.</p> <p>£2.2 billion of investment is being made in water quality and resilient supply through the Plan for Water.</p>	<p>No adaptation and heat resilience strategy exists for agriculture.</p> <p>The water sector has credible adaptation planning but delivery and implementation is falling short.</p> <p>Although the department has overall responsibility for adaptation, it has no powers to enforce action by other departments or local government.</p>
Ministry for Housing Communities and Local Government (MHCLG)	<p>Responsible for planning and buildings</p>	<p>National Planning Policy Framework (NPPF) contains section on planning for climate change.</p> <p>In June 2022, MCHLG updated Part O of the Building Regulations setting standards for overheating in new residential buildings.</p> <p>The government is piloting local adaptation reporting with a group of local authorities.</p>	<p>NPPF focuses on flooding and coastal erosion but does not adequately address heat resilience.</p> <p>There is no policy to address overheating in existing homes and buildings.</p>
Department for Transport (DfT)	<p>Responsible for transport infrastructure</p>	<p>In 2024, DfT published its strategy on adapting the UK's transport system.</p> <p>The strategy will introduce a requirement for local government to report on climate adaptation.</p> <p>Transport Infrastructure Operators (TIOs) will also have additional requirements. These requirements relate to monitoring, the appointment of a senior responsible officer, and the integration of climate adaptation into organisational objectives.</p>	<p>It is unclear how responsibilities assigned to Transport Infrastructure Operators (TIO) and local authorities will be funded and resourced.</p>

Department	Role in managing health and heat intersection	Progress so far	Gaps in action
Department of Health and Social Care (DHSC)	Sponsors the UK Health Security Agency (UKHSA)	<p>The Centre for Climate and Health Security has been set up within the UKHSA to protect health in the context of a changing climate.</p> <p>Each NHS Trust in England has been asked to produce a Green Plan to align with the net zero target, and adaptation is mentioned in the guidance.</p>	<p>Adaptation could be more fully embedded in NHS Green Plans for trusts in England.</p> <p>DHSC should work with local authorities and MHCLG to monitor and address overheating risks in the social care sector.</p> <p>The Treasury and DHSC must make long term funding available to adapt hospitals, care homes and other NHS facilities.</p> <p>No policy exists to include heat resilience measures when refurbishing healthcare buildings.</p>
Department for Energy Security and Net Zero (DESNZ)	Responsible for power networks and energy generation infrastructure	<p>The new National Electricity Systems Operator (NESO) will provide season ahead readiness assessments, including the impacts of extreme heat and drought.</p> <p>DESNZ and Ofgem have committed to drive investment in infrastructure resilience through Ofgem’s price control framework.</p>	<p>DESNZ needs to mitigate overheating risks in programmes to install domestic energy efficiency measures.</p>

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Local government is responsible for the majority of policy delivery.”

Local government's role

Central government has a clear role in co-ordinating and leading the national programme on climate adaptation to protect people's health, driving the innovation required and setting standards and targets. But climate adaptation will not be a 'one size fits all' approach across the country and it is devolved to the national governments of the UK.

Local government has an important responsibility for the majority of adaptation policy delivery and emergency responses to extreme weather. However, many authorities lack adequate powers and resources to deliver adaptation at the pace and scale needed.

The previous government's Transport Adaptation Strategy proposed requiring local authorities to report on climate adaptation, and for them to appoint a senior responsible officer and integrate climate adaptation into their objectives.

The mayor of London has set an example for combined authorities with *The London Climate Resilience Review*, which assesses London's resilience to climate change and outlines recommendations to guide the capital's preparations for more frequent and intense climate impacts, such as producing a plan to support its response to heatwaves. Practical measures have been taken, such as rolling out a network of over a hundred water refill points. Other authorities should follow this lead with help from the government. As we highlight, climate adaptation can only be successful if delivered in co-ordination with local leaders who are given sufficient support and the power to act.

Cooling solutions and co-benefits

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Many of the solutions to prevent harm from extreme heat also have a host of co-benefits.”

As the new government embarks on the biggest housebuilding programme for 50 years, it is vital that solutions to prevent overheating are integrated into its plans. Many of these solutions also have a host of co-benefits.

Cost effective passive measures, like shutters, can be implemented instead of expensive, more energy intensive methods like air conditioning which produce heat waste, contributing the urban heat island affect (see overleaf). Although effective, the cost of air conditioning can be a barrier for some, increasing inequalities. However, air conditioning is an appropriate solution for public buildings, such as hospitals and prisons, and some forms of transport.

It is possible to mainstream solutions through changes to the planning system and the forthcoming Future Homes Standard, such as introducing a legal maximum heat threshold on social and private rented properties, as is currently the case for the minimum temperatures, to ensure homes “provide a reasonable degree of comfort”. The government must deliver on its target to achieve EPC C or equivalent by 2030 in social and private rented properties.

While adaptation to climate change is urgent, the government, local authorities and the private sector must be careful to avoid measures inadvertently worsening conditions, as can happen with poor planning, known as maladaptation.

As well as specific adaptations, some of which we illustrate overleaf, the government should also consider a public communication campaign to raise awareness of the health impacts of overheating and what people can do to protect themselves. As part of this, the existing Heat Health Alert early warning system, should be publicised. Currently, only those who opt in receive the warnings, and most people are unaware it exists.

The urban heat island effect and adaptation measures

Shading devices

Shading devices, such as shutters on windows and awnings, reduce direct sunlight exposure. Installing shutters on England's 8.7 million more vulnerable homes would cost approximately £4.3 billion.

Increasing tree coverage

Increasing tree coverage by 30 per cent in cities can produce an average 0.4°C cooling effect. In some localised areas the effect can be far greater, reaching almost 6°C.

Natural ventilation

Natural ventilation reduces reliance on engineered cooling systems and improves indoor air quality, eg designing buildings to ensure funnelled air flow throughout the building and installing ceiling fans.

Cool roofs

Cool roofs are a relatively low tech solution to prevent homes and buildings from overheating. These can either be 'green roofs', planted with vegetation to capture rainwater and provide a pleasant space or simply painted white, which provides more cooling through reflection.



Improving urban infrastructure

Improving urban green and blue infrastructure, parks, wetlands, water features and street trees can provide heat sinks and better living environments, particularly in deprived neighbourhoods.

Installing water fountains

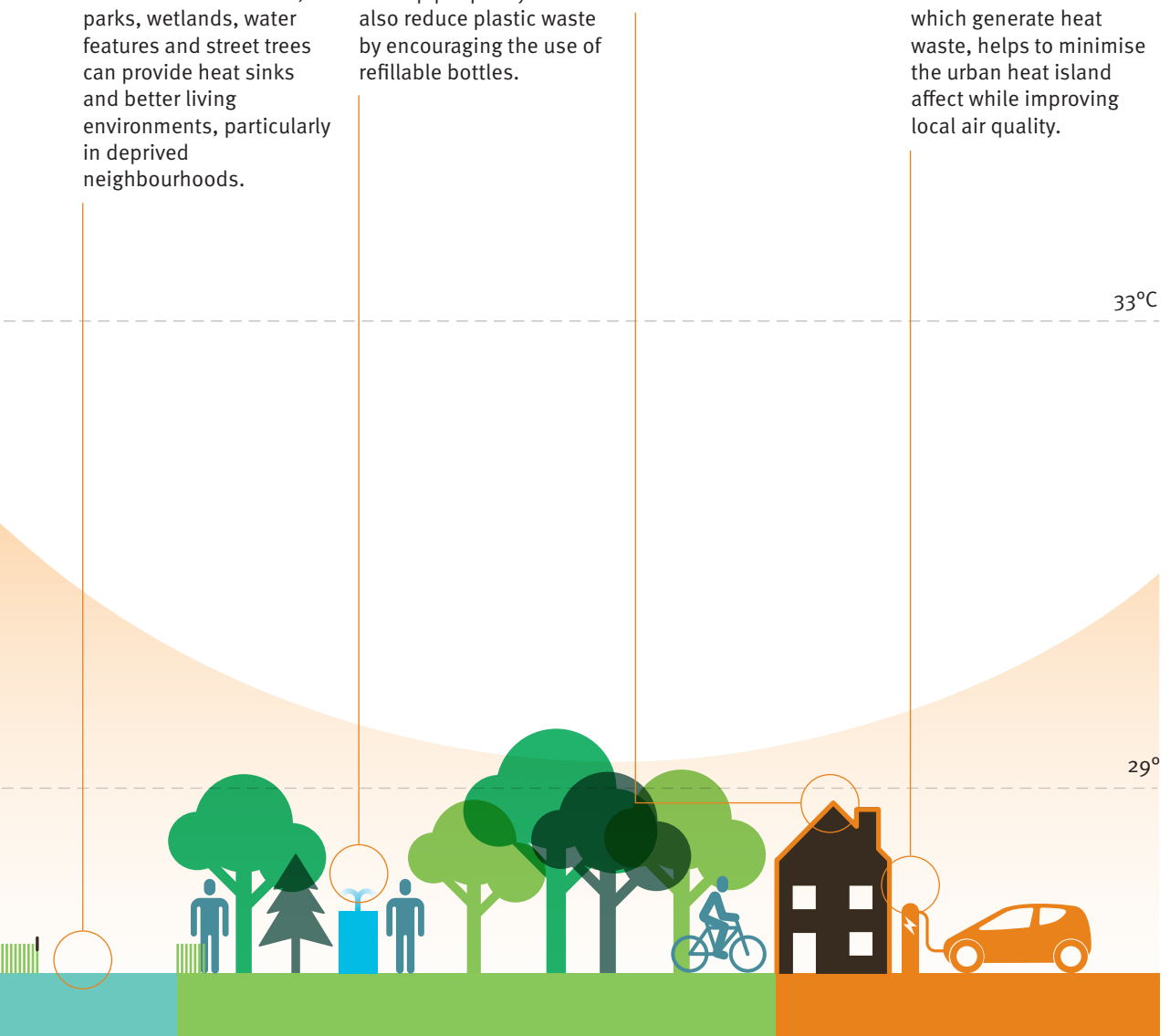
Installing water fountains to keep people hydrated also reduce plastic waste by encouraging the use of refillable bottles.

Insulation

Insulating homes to keep them cool in summer as well as warm in winter.

Reducing fossil fuel vehicles

Reducing fossil fuel vehicles on urban roads which generate heat waste, helps to minimise the urban heat island affect while improving local air quality.



A mission-led approach to heat resilience and adaptation

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Introducing statutory or quantifiable targets for heat resilience or climate change adaptation would drive progress.”

Despite the benefits of measures that help to prevent extreme heat having serious impacts on health, especially in urban areas and for the most vulnerable, the UK is still not doing enough to implement them. The consequence of this inaction will be more health crises as heatwaves are projected to become more frequent and intense. Labour was elected on a manifesto setting out five missions for national renewal, including action to grow the economy, tackle climate change and create an NHS fit for the future. Ensuring our towns, cities and strategic infrastructure are resilient to rising temperatures and more extreme weather should be a national priority if the government is to achieve its missions.

We propose that rapid steps are taken to revisit the UK's National Adaptation Programme and revitalise the UK's approach to heat resilience and adaptation. The existing NAP₃ is inadequate. Waiting four years until NAP₄ for plans to be strengthened will only entrench problems the UK's population and infrastructure are already experiencing.

Introducing statutory or quantifiable targets for heat resilience or climate change adaptation would drive progress. The UK's net zero target and the government's clean energy mission to decarbonise the power sector by 2030 are both specific, measurable, actionable and timebound, we propose a similar approach should be taken to adaptation.

Labour's manifesto committed to build 1.5 million homes should be built with the changing climate in mind. The Future Homes Standard being developed by the government should include measures to ensure passive cooling and ventilation in homes, preventing costly retrofits later as the need grows. However, the government must also focus on retrofitting existing homes, buildings and infrastructure.

**“
The government
should review and
update the third
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priority.”**

We recommend the following actions:

1. Review and update the National Adaptation Programme

The government should review and update the third National Adaptation Programme (2023-28) as a priority, as it will run for the majority of this parliament. The updated NAP should set out a clear action plan to increase the heat resilience of homes, public buildings, transport and other key infrastructure. Effort should focus on the communities and infrastructure that most need to be adapted. This should include a comprehensive review of emergency procedures to avoid repeating the high number of deaths the UK experienced in 2022. Public health communications should be designed to raise awareness of the health impacts of extreme heat and what people can do to protect themselves.

2. Set clear targets to improve the heat resilience of infrastructure

The absence of clear and quantifiable climate change adaptation targets is a barrier to action. The government should ask the CCC to advise on targets to ensure buildings, transport and NHS infrastructure are resilient to extreme heat. These should be as specific, measurable, actionable and timebound as the government’s clean power mission.

3. Improve governmental co-ordination and accountability

The new cross governmental Climate Resilience Board, pledged under NAP3, should be rapidly established to facilitate cross departmental co-ordination, and drive faster action to increase heat resilience across the economy. As part of the review of NAP3 the government should consider how ministerial accountability on adaptation and resilience could be improved.

**“
The design of
buildings and
infrastructure
should embed a
passive ‘cooling
first’ approach.”**

4. Empower local authorities to do more

Local authorities need more resources to produce locally specific adaptation plans and develop more urban green and blue infrastructure, particularly in deprived neighbourhoods, eg parks, wetlands, water features, bodies of water, street trees and vegetation, which all serve as ‘heat sinks’.

5. Ensure housebuilding and new developments are heat resilient

Changes to the National Planning Policy Framework and Future Homes Standard should reflect the need for all new developments and homes to be built with cooling measures as standard. The design of buildings and infrastructure should embed a passive ‘cooling first’ approach. A hierarchy of adaptation methods should be outlined to ensure passive cooling techniques, such as shading and green roofs, are used before solutions like air conditioning, requiring greater energy use which is costly and contributes to the urban heat island effect. The lessons from developing more resilient new homes should be applied to existing housing stock.

Endnotes

- 1 *New Civil Engineer* 21 July 2022, 'How did UK infrastructure cope with record temperatures?'
- 2 UK Health Security Agency (UKHSA), 2024, *Heat mortality monitoring report: 2022*
- 3 Climate Change Committee (CCC), 2022, *Risks to health, wellbeing and productivity from overheating in buildings*
- 4 World Bank Open Data, 2021, 'Urban population (% of total population), United Kingdom'
- 5 P Watkiss, 2022, 'The costs of adaptation, and the economic costs and benefits of adaptation in the UK'
- 6 Office for Budget Responsibility, 2024, *Fiscal risks and sustainability report*
- 7 IPCC, 2023, *Climate change 2023: synthesis report summary for policymakers*
- 8 UNEP, 2024, *Emissions gap report 2023*
- 9 Climate Copernicus, 2024, 'Surface air temperature for May 2024'
- 10 *The Independent*, 6 June 2024, 'Hottest May makes 12 straight months of record global temperatures'
- 11 UKHSA, 2023, *Health effects of climate change 2023 report*, 'Chapter 2: Temperature effects on mortality in a changing climate'. Heat related deaths, with no additional adaptation and limited global decarbonisation, could increase nearly six fold from a 2007 to 2018 baseline average estimate of 1,602 deaths per year, to 10,889 in the 2050s.
- 12 *PreventionWeb*, 1 October 2020, 'Guest post: How 'urban heat islands' will intensify heatwaves in UK cities'
- 13 UKHSA, 2024, *Heat mortality monitoring report: 2022*
- 14 BBC, 10 July 2023, 'London wildfire response hit by crew shortages - report'
- 15 Resolution Foundation, 2023, *It's getting hot in here: how ever-warmer UK summer temperatures will have an outsized impact on low-income households and low-paid workers*
- 16 Red Crescent Climate Centre, 2023, *Understanding the compound risk of heat, humidity and air pollution on human health: a scoping review*
- 17 Centre on the Developing Child: Harvard University, 2024, *Extreme heat affects early childhood development and health*
- 18 Unicef, 2023, *Protecting children from heat stress, a technical note*
- 19 UKHSA, 2024, op cit
- 20 CCC, 2022, *Risk to health, wellbeing and productivity from overheating in buildings*
- 21 F Chersich et al, 2020, 'Associations between high temperatures in pregnancy and risk of preterm birth, low birth weight, and stillbirths: systematic review and meta-analysis', *National Library of Medicine*
- 22 C Part et al, 2022, 'Ambient temperature during pregnancy and risk of maternal hypertensive disorders: a time-to-event study in Johannesburg, South Africa', *Environmental Research*
- 23 Bluebird Care, 'Keeping cool during a heatwave'
- 24 R Thompson et al, 2023, 'Ambient temperature and mental health: a systematic review and meta-analysis', *The Lancet*

- 25 TN Dang et al, 'Main and added effects of heatwaves on hospitalizations for mental and behavioral disorders in a tropical megacity of Vietnam', *Environmental science and pollution research*
- 26 BBC, 13 August 2022, 'Some antidepressants may make heatwave challenging'
- 27 *Bloomberg*, 1 March 2024, 'How a hurricane might rip through your medicine cabinet'
- 28 UK Climate Risk, 2021, Business and industry. *The third UK climate change risk assessment: technical report*
- 29 Department for Levelling UP, Housing and Communities 2019, *Research into overheating in new homes - phase 1 report*
- 30 Lancet Countdown, 2023, 'United Kingdom: Lancet Countdown on Health and Climate Change, data sheet 2023'
- 31 J Park, 2018, *Hot temperature and high stakes exams: evidence from New York City public schools*
- 32 Ofqual, 2021, 'Infographics for GCSEs'
- 33 P Watkiss et al, 2021, *Monetary valuation of risks and opportunities in CCRA3. Supplementary report for UK Climate Change Risk Assessment 3*, prepared for the Climate Change Committee
- 34 M Marmot et al, 2010, *Fair society, healthy lives* (the Marmot Review)
- 35 C Turholske et al, 2021, 'Global urban population exposure to extreme heat', *Proceedings of the National Academy of Sciences of the United States of America*
- 36 Department for Levelling Up, Housing and Communities, 2023, 'English housing survey 2021 to 2022: social rented sector'
- 37 Office for National Statistics, 2020, 'One in eight British households has no garden'
- 38 CCC, 2022, op cit
- 39 *The Observer*, 5 August 2023, 'Three-quarter of prisons in England and Wales in appalling conditions as overcrowding fears grow'
- 40 Gov.UK, 2023, press release: 'Updated list of education settings with RACC'
- 41 London School of Economics and Political Science, 2024, *Turning up the heat: learning from the summer 2022 heatwaves in England to inform UK policy on extreme heat*
- 42 *Carbon Brief*, 16 August 2024, 'Revealed: three-quarters of prisons in England and Wales face 'high risk' of overheating'
- 43 D Cloud et al, 2023, 'Extreme heat and suicide watch incidents among incarcerated men', *JAMA Network Open*
- 44 Resolution Foundation, 2023, op cit
- 45 Friends of the Earth, 17 July 2024, 'Legal challenge over government's climate adaptation plan begins'
- 46 CCC, 2023, *Progress report to parliament 2023*; Gov.UK, 2023, 'National Adaptation Programme 3'
- 47 *Road CC*, 20 February 2019, 'Summer heatwaves saw record numbers of cyclists in London – but casualties rose too'
- 48 CCC, 2023, *Progress in adapting to climate change – progress report to parliament*
- 49 Bank of England, 2015, *Breaking the tragedy of the horizon – climate change and financial stability*
- 50 CCC, 2024, *Independent assessment of the third National Adaptation Programme*
- 51 Friends of the Earth, 17 July 2024, 'Legal challenge over government's climate adaptation plan begins'
- 52 Gov.UK, 2023, 'National Adaptation Programme 3'

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