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The London Climate Resilience Review

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Note to reader

The London Climate Resilience Review was scheduled to be published on June 4, 2024. The report was submitted to the Mayor of London in March 2024, ahead of the Mayoral election in May 2024. Publication was then delayed owing to the announcement of a general election on July 4, 2024. The findings and recommendations of the Review have not changed, but minor edits have been made to reflect contemporaneous events, up-to-date data, and relevant election manifesto commitments from the new national government.

Foreword

We are entering a new era. The world's warmest year on record was 2023. Europe is warming at around twice the global rate.[1, 2] This June to August, in 2024, is currently on course to be the world's hottest on record, even as El Niño fades. As late as January 2022, the UK Climate Change Committee was saying there was a "small chance" of temperatures reaching 40°C in England before 2040, and then London hit 40°C that July.

During that heatwave, the London Fire Brigade experienced its busiest day since World War Two; operations were cancelled at Guy's and St Thomas' hospitals because IT servers failed; the price of energy surged as power supply struggled to meet demand; the East Coast mainline was disconnected from King's Cross as trainlines buckled. Throughout 2022, there were 3,271 heat related deaths in England and 387 in London.

If no action is taken by 2050, England's public water supply will face a shortfall of 5 billion litres of water every day. Even though the winters are getting wetter, London is an area of serious water stress. Summer water shortages increase fire risk, reduce our ability to fight fires, and cause long-term damage to nature.

Higher temperatures often end with severe thunderstorms. In 2021, some parts of the London received more than twice the average July rainfall in two hours and over 2,000 properties flooded with stormwater and sewage. At the same time, the deadline for upgrading flood defences upstream of the Thames Barrier is 2050, and downstream it is 2040; a new Barrier is needed by 2070.

The new government's manifesto said: "For too long, Britain has been held back by governments that, because they lack a relentless focus on long-term ends, are buffeted about by events." In this report we have considered national and regional climate risks and set out six areas for urgent action to ensure that lives and livelihoods are not disrupted by increasingly frequent and severe shocks.

The manifesto said: "Preparing for the future not only means tackling the climate and nature emergencies, but also adapting to the changes they will bring to our environment... Labour will improve resilience and preparation across central government, local authorities, local communities, and emergency services." These commitments are long overdue and hugely welcome.

Our 50 recommendations are about more than avoiding the costs of being underprepared, they present opportunities to improve the living standards of working people and deliver robust infrastructure. This chimes with the manifesto commitment to "ensure we are building more high-quality, well-designed, and sustainable homes and creating places that increase climate resilience and promote nature recovery."

London

London is a modern city steeped in history, an international economic hub 21% of which is covered by trees, and it could be home to 10 million people by 2040. For 2,000 years, people have chosen to live and work here side by side. Resilience exists in the weave of the 32 boroughs and the City of London. That long-brokered network of connections between Londoners (95% of whom live within 400 metres of a bus stop) holds together like a web.

In May, the Mayor of London won a record third election victory after doubling down on health and climate policies. As Londoners increased the Mayor's share of the vote, the message for other leaders around the world is: stick with bold action on pollution and climate change. Days later, the Mayor said: "the climate crisis is intimately related to the dignity of human life. Whether in London or across the globe, it's the most vulnerable – those who've contributed the least to this catastrophe – who are forced to shoulder the heaviest burden of its consequences. Time is short. We need to get to work."

We need to stop looking at budgets for environmental initiatives as representative of the ambition needed; organisations' entire operating models must be rewired. Earlier this year, the Prime Minister hosted a summit of regional Mayors to look at "growth across every region" and to create a "gold standard" for boosting local economies. He praised the Mayor of London's Community Wealth Building programme, which has invested over £1.75 billion in small and medium sized businesses, as well as the new London Growth Plan. A "gold standard" regional economic plan must factor in climate resilience and give private companies the long-term certainty to invest in training and skills that will contribute to building a stronger economy.

Our research focused on people and places in London but that should not put off readers from other towns and cities. Our recommendations are relevant all over the world, indeed some are already underway in cities from Scotland to Colombia via Bangladesh and Australia. We have included specific sections on the economy, healthcare sector, and blue and green infrastructure because we have practical recommendations for people working in those sectors, but these are not intended to be read in isolation. We have already seen the Mayor and others act on some of our recommendations. I was pleased to attend London's extreme heat exercise 'Operation Helios' in June this year.

A recent paper in 'Nature' said: "Given how close 2023 was to the ominous 1.5°C warming threshold, it is imperative that we prepare for previously unthinkable and unseasonal heat extremes." This report is all about preparing for the consequences of a warmer climate, but we can't simply adapt without racing to reduce emissions. The competent strategy is to address both the symptoms and the cause.

And yet, with appropriate political ambition, optimism about the future is entirely reasonable. As the Mayor begins a record third term and a new national government takes power, there has never been a better time to make smarter, more resilient choices in the long-term interest. Adaptation is non-negotiable. The London Climate Resilience Review is a roadmap for delivery and, now that it is written, it's time for action.

Emma Howard Boyd
Chair of the London Climate Resilience Review

Executive summary

The London Climate Resilience Review (the Review) is an independent report, commissioned by the Mayor of London (the Mayor), to take stock of London's preparations for climate impacts and make recommendations.

The Mayor called for the Review following accelerating climate impacts in the UK and around the world. In London the flooding of July 2021 damaged homes and properties, costing local authorities tens of millions, with aggregate insured losses estimated to be over £100 million, displacing residents and disrupting critical services to vulnerable Londoners.[3, 4] In 2022, there were 3,271 heat related deaths in England and 387 in London.[5, 6] The 2022 heatwaves would not have happened without climate change, many of those deaths could have been preventable. The heatwaves caused widespread failure of green infrastructure including street trees, in Epping Forest alone a total of 76 fires were reported between 26 June and 16 August 2022. The extreme heat stretched water supplies, melted road surfaces, and caused damage to rail infrastructure. Health and social care, education, interdependent supply chains including those we rely on for food, and infrastructure, face major disruptions across London in events like these.

We have explored actions needed at the national, regional, and local levels to reduce climate impacts on people, infrastructure, nature, the environment, and economy in London. We ran a comprehensive research and engagement process to deliver an assessment of London's climate resilience and to inform recommendations to guide London's preparation for more frequent and intense climate hazards.

The complete findings of the Review are set out across four chapters: Enabling London to lead; People and communities; The built environment and infrastructure; A climate resilient economy. There are 50 recommendations for stakeholders across London, including the Mayor, local authorities, London's community and voluntary sector, public and private organisations and UK government. The recommendations from the Review's interim report, published in January of 2024, are included here.

We have included sections on the economy, healthcare sector, and blue and green infrastructure because we have practical recommendations for those specific sectors. These are not intended to be read in isolation. All the recommendations in this report will help people live healthier lives and will contribute to a stronger economy; many also support the creation of green and blue spaces rich in wildlife.

There are good examples of climate adaptation in London. London has a range of Mayoral delivery programmes to support immediate action as well as strategies to support long-term planning. These include the London Environment Strategy, the London Resilience Strategy and the London Plan. The Mayor convened the London Surface Water Strategic Group following the flash floods in 2021. The Mayor has also shown commitment to adaptation by commissioning this Review. Analysis from London Councils found that all London borough climate action plans contain

adaptation related actions, and most have clear senior sponsorship for adaptation work. Despite commitment and planning there are significant barriers to translating this into more targeted and strategic delivery plans. Lack of financial and human resources have been consistently identified as the primary challenge.

Resilience services support productivity by "avoiding the costs of downtime". Since 2008/2009 the UK's productivity growth has been "sluggish"[7] and additional pressures from climate impacts are highly undesirable. Lost output from heat related reductions in productivity are already significant in London. Losses in a typical year are valued at £577 million by research carried out by Vivid Economics for Arsht-Rock.[8] During the week of the July 2022 heatwave, TfL lost £8.4 million in revenue across their operations.[9] Climate change is likely to impact London's GDP by 2-3% every year by the 2050s, with those costs further increasing in the second half of the century. This estimate comes from the Review of the economic impacts of climate change on London by Paul Watkiss Associates for the London Climate Resilience Review (Annexe 2).

A strategic approach to adaptation can make London a fairer more equal city. Climate change will be the foremost public health challenge of the coming decades.[10] Action must prioritise those who face the greatest harm and those least able to cope with climate impacts. The Resolution Foundation has found that warmer summer temperatures in the UK will impact low income households and workers more than others, with the poorest in England more likely to live in homes liable to overheating and to work in occupations at risk of heat stress.[11] Research from the Race Equality Foundation and New Philanthropy Capital said: "People from ethnic minority communities in Britain are, on average, more affected by the environmental crises than White British people... The biggest risks for people from ethnic minority communities, particularly those in low-income households, concern air pollution, climate change, and damage to the natural environment."[12]

Climate resilience increases London's capacity to generate revenue. At a roundtable hosted for the Review by AtkinsRéalis one participant said: "Adaptation is powerful when people imagine the future they want rather than tweaking the edges of the system we have." The Thames Barrier, and its associated defences, has allowed significant development in London, including Canary Wharf and London Docklands; it continues to protect billions in revenue generation. In 2021 the gross value added per job in London was on average £81,400, 40% higher than the UK average.[13] This is vital to the Treasury. Transport for London (TfL) said: "A resilient transport system is key to responding to extreme weather events and keeping people safe and healthy (maintaining access to emergency and health services) and the city functioning to prevent cascading impacts."

London should become the world's go-to financial marketplace for climate resilience services. London has a world-leading insurance market, pioneering scientific institutions, a thriving technology sector, international banking and around 19% of the UK's private sector businesses.[14] The Oxford

University report, Mission Climate Ready calls for action to be taken to make the UK the leading net zero, resilient and nature positive finance hub. It finds that "Mobilising international adaptation finance can be a growth opportunity for the UK. ...To maintain the UK at the forefront of climate action for the next decade and to 2050 and beyond, government, regulators, industry, finance and the best science must come together. The UK financial sector has the appetite, expertise and capability to become the global hub for adaptation finance".[15]

The Mayor has invested around £30m in green projects since 2016.[16] Alongside reducing flood risk and providing shade, urban nature-based solutions such as street trees, sustainable drainage systems, green roofs and walls can deliver greater footfall for local businesses; better health due to increased physical activity, reduced air pollution, and reduced anxiety and mood disorders; decreased crime rates; and uplift property values.[17] However, the London Green Spaces Commission found that in the ten years to 2019, £4billion was cut by the previous government from core funding for local services in London.[18] Over the same period, spending on open spaces by local authorities fell by over 30% to £159m while London's population grew by around 900,000 people (11.2%).[19] The Royal Parks and Hackney Council both told us climate change impacts are increasing pressure on maintenance resources. London's trees, and other green and blue spaces, are under threat from severe climate impacts like heatwaves, wildfire and windstorms.[20] Maintenance is needed to ensure green infrastructure survives and continues to provide benefits.

Well-developed policy and regulation can drive water efficiency and reduce overheating in buildings. Unsuitable development locks in further climate risk. Enough data is available on vulnerabilities and risks in London to target and deliver adaptation retrofit programmes to keep Londoners safe. Efforts to upgrade building stock for energy efficiency are missing opportunities to incorporate adaptation to climate change, putting a huge amount of investment at risk. London's public realm, such as streets and squares should be adapted to climate risks to keep people safe and ensure the wellbeing of communities. Housing provider L&Q told us adaptation offers "reduced cost to the taxpayer and reduced cost of insurance premiums for businesses versus a do-nothing scenario, from avoiding damage to buildings and the public realm from extreme weather."

Shortly after we began work on the Review, the UK government published its five-year plan for climate adapting England. The Chair of this Review responded saying: "The Government's National Adaptation Programme [NAP] should be a wake-up call and yet it seems they are taking a NAP. It's nearly exactly a year to the day that England hit 40°C for the first time, when schools had to close, hospital operations were cancelled, and there were over 3,000 excess deaths. An official inquiry after an event can never turn back the clock but good preparation can provide return on investment, jobs, and healthier places to live and work. England needs to keep going whatever the weather. NAP3 won't convince anyone that we are ready and that is a dangerous, missed opportunity."[21] In March 2024, the UK Climate Change Committee said: "The

NAP does not go far enough to ensure that the UK is adequately prepared for climate change. This is true for the climate change already being experienced in the UK today, the climate changes expected over the programme's lifetime (out to the late 2020s), and the range of further changes possible over decades ahead."[22]

The House of Commons Committee of Public Accounts (PAC) report on Government Resilience: Extreme Weather has found that regulation, investment and action on resilience to extreme weather are not sufficient in the face of climate change and increasingly extreme weather, putting the UK at great risk. Their report clearly states that "Government is too focused on short-term reactive responses at the expense of developing the UK's medium- and long-term resilient to extreme weather events". The PAC recommends that "The Cabinet Office, working with HM Treasury and relevant departments, should ensure sufficient focus is given to building the UK's medium- and long-term resilience to extreme weather events....". The report sets out that Cabinet Office and Treasury do not know how much money is spent on resilience to extreme weather events, or other national risks, and that some regulators do not have a statutory climate resilience remit- which is holding back UK resilience.[23]

Decision paralysis due to uncertainty about the precise trajectory of climate change is locking in risk. A survey for The Guardian of 380 climate scientists all of whom have been lead authors, or review editors for reports by the Intergovernmental Panel on Climate Change (IPCC) showed almost 80% foresee at least 2.5°C of global heating, while almost half anticipate at least 3°C.[24] The UN says the world is on track for a 2.5-2.9°C temperature rise above pre-industrial levels this century, the GLA and others should use this trajectory to guide their work and planning while remaining flexible to any future changes.[25] Preparing for anything less would be an unacceptable gamble with people's lives and taxpayers' money. 2023 was the world's hottest year on record.[26] The International Panel on Climate Change's (IPCC) sixth report said: "the rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt."[27] The longer action is delayed, the fewer options will be available as climate impacts worsen. It will be easier to adapt to 2°C of global warming than to 3°C, or 4°C. In March 2024, the Climate Change Committee said the UK's current approach to adaptation is not working and that change is needed.[28]

To deliver large scale change at pace the Review calls for urgent attention and action in the following six areas:

1. A strategic, London-wide, action plan on heat risk is needed (Recommendation 9). Management of heat risk is a gap across all sectors and organisations. This risk urgently, needs leadership, strategy and collaboration. Warmer temperatures and extreme heat pose a threat to the systems London is dependent on, from transport infrastructure to water supply and health care services. Heat related deaths are set to increase in the UK and people will be exposed to unsafe temperatures. The Grantham Institute's Turning Up the Heat Report said England is ill-prepared for future extreme heat events and calls for a national heat risk strategy.[29] We urge the Mayor and the new national government to act.

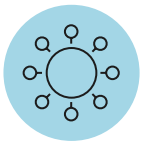
2. Despite greater coordination of stakeholders since the floods of 2021, London is not prepared for another major surface water flooding incident and lives and livelihoods are at risk (Recommendations 25, 31, 32, 33). Flooding poses a lethal risk to Londoners. In November 2023, the Chief Executive of the Environment Agency told the Public Accounts Committee: "What genuinely keeps me awake at night is surface water flooding. In July, we saw a tragic incident with two deaths in Liverpool. We saw multiple fatalities in the west of Germany last year. We saw 25 fatalities in South Korea last year. As a society, we have to take that much more seriously. It is difficult to forecast these very intense rain cells, and often we do not have the necessary warning systems."[30] Once again this is a nationwide problem with London-specific considerations. In July 2021, London was hit by two extreme rainstorms; some parts of the city received more than twice the average July rainfall in two hours causing major disruption and over 2,000 properties flooded with stormwater and sewage. The voluntary London Surface Water Strategic Group is good, but is not currently moving at the pace needed.

3. London must accelerate work to understand cascading risks and system interdependencies within and beyond London's boundaries (Recommendation 7). London has many interdependent parts: transport infrastructure is dependent on energy infrastructure which is dependent on water infrastructure and vice versa; disruption to one part of the system creates cascading risks. The heatwaves of 2022 stretched many interdependent systems beyond their limits. The IPCC has stated that concurrent, extreme events (like extreme heat followed by an extreme thunderstorm) are a 'virtual certainty'.[31] These interdependencies, and the potential for systemic failure, must be better understood nationally and regionally. Currently, where this knowledge exists at all, it sits with emergency response mechanisms, not wider policy teams or planners. That modus operandi is undermined by climate change, but

managing it better is an opportunity. Network Rail told us: "Our reliance on other sectors, e.g., power, suppliers and other transport organisations, means we will need to work more closely with them to adapt appropriately."

4. National, regional, and local governments must do more to enable investment in climate resilience (Recommendation 45). This means embedding climate resilience as a strategic priority across all sectors and investment decisions (Recommendation 3) and improving skills provision (Recommendation 48). Responding to events and repairing damage is more costly than investing in adaptation and climate resilience. Improved understanding about the costs of climate impacts, and how the costs and benefits of adaptation are distributed is needed (Recommendation 43 and 44). The Climate Change Committee emphasises the cost-effectiveness of early action, revealing a benefit-cost ratio for adaptation ranging between 2:1 and 10:1.[32]

5. Londoners should be engaged on climate impacts, the risks they pose and adaptation options (Recommendations 12, 13 and 15). Adaptation to climate change needs to work for all Londoners, from individuals and households through to community groups and large organisations. Building understanding of climate impacts and supporting Londoners to make climate ready choices is critical. This includes investing in social infrastructure, community groups and London's voluntary sector and other trusted voices who work at the community level.



6. All the above must be coordinated strategically. A shared regional vision and framework for adaptation is important (Recommendation 1 and 2). Stakeholders across London have asked for coordination and clarity to ensure that effective adaptation and climate resilience is delivered. Currently, governance is spread between many actors (including local authorities, the Mayor and government departments) and where roles and responsibilities are understood they are often siloed out to environment teams. This is a national problem, but the whole country would benefit if the Mayor took a lead. In January 2023, the Climate Change Committee report, "Investment for a well-adapted UK" said: "Currently there is no agreed and well-defined vision for what a well-adapted UK looks like set out by Government, and there are no associated targets or goals for desired resilience standards at a national, local or sectoral level. Without these inherently political judgements on the level of risk tolerance desired in key systems, the full scale of investment needed to deliver increased climate resilience is impossible to assess."[33]

Introduction

This is the final report of the London Climate Resilience Review (the Review). We published an interim report in January 2024.[34] The Mayor commissioned the independent Review in mid-2023 to take stock of London's preparations for climate change and make recommendations to help London adapt. Hazards, like flooding, storms, extreme heat, and drought, are increasing in severity, frequency, and duration.

As the climate changes we learn more about how we should prepare; this affects our long-term decision making. For example, London is currently well protected from tidal flooding by the Thames Barrier and other river defences. However, the current barrier is expected to last until 2070, and we must take action now to reduce the number of closures, prolong the barrier's lifespan and work to ensure an end of century option is in place. Today, effective monitoring of sea level rise means we know the deadline for raising flood defences upstream (west) of the Thames Barrier has been brought forward 15 years to 2050, and downstream (east) the deadline is 2040.[35]

We have looked at London's preparedness for physical climate impacts and suggested steps to enhance climate resilience. This is not a comprehensive audit or cost-benefit analysis of all climate impacts and adaptation action. London can be viewed as a system made up of many interdependent and interconnected parts. These interdependencies extend beyond London's boundaries, so in some cases we have considered solutions that reach beyond London. For example, research on integrated water management has shown how water supply in East London is dependent on nature-based solutions in Hertfordshire.

We focussed on seven key sectors across London. These were: People and Communities; Health Services; Emergency Services; Infrastructure; Built Environment; Natural Environment and Economy. We looked at current levels of climate adaptation, understanding about and preparation for projected climate impacts, and what is needed to accelerate action. We were provided with evidence from organisations and communities who play interconnecting roles in London's day-to-day activities and long-term planning. This includes London anchor institutions[36] such as the National Health Service (NHS), functional bodies like TfL, the London Fire Brigade (LFB), and the Metropolitan Police Service. Also, unions; the voluntary and community sector; local, regional and national government; businesses such as utilities companies, insurance firms, banks, private and public property owners, sports clubs and venues, cultural institutions, and environmental NGOs.

Santander Cycle users basking in the summer sun.
Creator: Transport for London

Findings are set out across four chapters:

1. **Enabling London to lead.** This chapter sets out our findings on the governance arrangements for climate adaptation across London and puts forward recommendations to unlock greater climate resilience action. It considers the role of UK government, the Mayor and the Greater London Authority (GLA), local authorities, the wider public sector and businesses, investors, and financial institutions. All levels of governance can play more of a role in enabling climate resilience action. The most urgent priorities are consistent investment, resourcing for local authorities, shared targets, and a framework to guide city wide action.
2. **People and communities.** This section focuses on the climate resilience of London's people and communities, as well as the services they rely on like healthcare. It considers the role of individuals, neighbourhoods and the community and voluntary sector. To achieve climate resilience people must be engaged and centred in the adaptation process to ensure it delivers changes which work for all. This also includes a section which makes a series of recommendations specifically to London's healthcare sector.
3. **The built environment and supporting systems.** This chapter focuses on London's built environment and infrastructure, the buildings, and manmade structures, features and facilities, and the systems like transport, water and power which keep London moving. It considers the role of all levels of government, infrastructure providers, landowners including the public sector and the planning system in delivering climate adaptation. Climate change is not sufficiently embedded in decision making, increasing risks to people and built environment assets. This also includes a section on London's blue and green infrastructure (BGI), although there are recommendations relating to BGI throughout the report.
4. **A climate resilient economy.** This chapter looks at how a well-adapted London is the foundation for a resilient economy. It puts forward recommendations to attract investment and finance for adaptation and climate resilience in London. Investors need confidence that they will benefit directly from the money they put into resilience services over the short and long-term. There is a need for more clearly defined policy ambitions and legislation to provide clarity and certainty in this growing market.

Throughout our work the following principles have evolved. We believe they should guide action on climate adaptation and the implementation of our recommendations:

- Adapting London to climate change must take a people-centred approach, be locally led, work to reduce vulnerability and to address socio-economic and racial inequality.
- Climate change adaptation must be embedded across decision making, and organisations should ensure adaptation is owned at the strategic level, with responsibility for adaptation clearly assigned.
- Climate change adaptation must be integrated with work to achieve net zero for coherent climate action.
- Adaptive pathways approaches should be used. Climate change is unpredictable, while we act on known risks and critical thresholds, it is important to be flexible.
- Nature-based solutions must always be considered and prioritised.

We have used the London Environment Strategy's definitions of adaptation and resilience. The London Environment Strategy defines adaptation as "the process (or outcome of a process) that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change. Adaptation policies can lead to greater resilience of communities and ecosystems to climate change." And resilience as "...the ability of a system to recover from the effect of an extreme load that may have caused harm. Adaptation policies can lead to greater resilience of communities and ecosystems to climate change."[37] However, future policy might be better communicated by updating these definitions. Good examples include the Union of Concerned Scientists: "Climate resilience is about successfully coping with and managing the impacts of climate change while preventing those impacts from growing worse. A climate resilient society would be low-carbon and equipped to deal with the realities of a warmer world."[38] Glasgow City Region says: "Climate change adaptation comprises all the actions and solutions that a country, a region, a city, or a community can develop and implement to build more resilient societies and economies, to respond to the impacts of climate change that are already happening or are expected."[39]

London's Climate Risks

Heat

As late as January 2022, the Climate Change Committee was saying there was a "small chance" of temperatures reaching 40°C in England before 2040.[40] In July 2022, London hit 40°C. During that heatwave, the LFB received 2,496 calls, including 740 relating to wildfires, and operations were cancelled at Guy's and St Thomas' hospitals as IT servers broke down in record heat.[41] The East Coast mainline was disconnected from King's Cross as trainlines buckled and overhead lines sagged. In 2022, there were 3,271 heat related deaths in England and 387 in London.[42, 43] The 2022 heatwaves would not have happened without climate change[44] but many of those deaths would have been preventable.

London's population density and many dark impermeable surfaces that absorb the sun's radiation mean the city can be several degrees warmer than surrounding rural areas. This is called the urban heat island effect.[45] The urban heat island effect increases the risks from higher temperatures in London, including those from hot homes and buildings, because people have fewer options to cool themselves in the city.[46] High temperatures also cause damage to trees which are critical to city resilience and provide cooling shade. Analysis carried out for Friends of the Earth, found that inner-city areas with fewer trees and green spaces were up to five degrees hotter in July 2022 than those with more tree cover and plant life.[47]

Heat exposure led to 470 billion potential labour hours lost globally in 2021. In the UK 6 million potential labour hours were lost, costing an estimated £94 million.[48, 49]

A growing body of international research suggests that rising temperature increases the risk of some violent crimes, such as intentional homicides, sex offences, and assaults.[50] The Review has been told by senior staff in the NHS that hot weather results in more people in mental health crisis. On one day in June 2023, the London Ambulance Service received 7,751 999 calls (the highest since the peak of the pandemic), as hot weather, thunderstorms, pollen count and pollution caused a spike in people experiencing breathing difficulties. The UK's population is ageing, thus increasingly vulnerable to heat, and this will add pressure on healthcare and individuals with caring responsibilities.[51, 52] In April 2024, the European Court of Human Rights ruled in favour of the more than 2,000 Swiss women, aged over 64, who argued their government's climate inaction put them at risk of dying during heatwaves.[53]Air quality is also affected by high temperatures, and the growing threat of wildfires adds to this risk. In the Mayor's report, **Climate Adaptation Plans for Schools**, London schools said that overheating had a significant impact on students' learning, productivity or behaviour.[54]

In 2021, the Climate Change Committee said: "Since CCRA2 [Climate Change Risk Assessment 2] was published [2017], over 570,000 new homes have been built in England alone that are not resilient to future high temperatures. These will require costly retrofit to make them safe, habitable and water efficient in the future. In the next five years, at least another 1.5 million homes are due to be built across the UK; these will also lock in increased climate vulnerability unless planning and building policy is changed now."[55] The new government's

election manifesto said: “We will take steps to ensure we are building more high-quality, well-designed, and sustainable homes and creating places that increase climate resilience and promote nature recovery.”

Drought

The Independent Assessment used to inform the third UK Climate Change Risk Assessment (CCRA3) for England said groundwater depletion combined with hotter and drier summers has the potential to significantly impact public water supply, especially in the south east of England.[56] In England, if no action is taken by 2050 the nation’s public water supply will face a shortfall of nearly 5 billion litres of water per day.[57] London is already an area of serious water stress.[58] Thames Water said that in July 2022, when London was under drought measures: “London saw temperatures exceed 40 degrees, a 50% increase in water consumption and our reservoirs were at their lowest for 30 years.” The National Audit Office said: “The economic costs of the 2012 drought in England were £165 million in revenues and £96 million in profits, based on a 2013 estimate.”[59] It has been estimated that not having enough water to go around would cost London's economy alone £500 million each day.[60] It would also kill wildlife and concentrate pollution in rivers.

Rising sea levels

London’s existing river defences currently protect homes, critical infrastructure, and businesses. The Global Commission on Adaptation said: “London’s Canary Wharf and other developments in East London would have been impossible without flood protection from the Thames Barrier.”[61]

Without action, there will be a 5 billion litre per day gap between the demand and supply of water in England by 2050.

When London saw temperatures exceed 40 degrees, there was a 50% increase in water consumption and reservoirs were at their lowest for 30 years.

It has been estimated that not having enough water to go around would cost London's economy alone £500 million each day.

Sea level in the Thames Estuary is now expected to rise by around 1.15 metres by the end of this century.[62] Of the total 330 kilometres of flood defences in the Thames Estuary there are 126 kilometres upstream (west) of the Barrier and just 9 kilometres of these (7%) are sufficiently high to last beyond 2050.

Of these: 17 kilometres need raising by between 40-50cm; 30 kilometres need raising by 30-40cm; 12 kilometres by 20-30cm; 12 kilometres by 10-20cm and 46 kilometres by up to 10cm. Proactive action to strengthen the Thames' defences presents an opportunity to invest in London's riverside. The deadline for upgrading defences downstream of the Barrier is 2040.[63]

The current Barrier is expected to last until 2070. The Environment Agency has said that by 2040, they will have selected an option to replace the current Thames Barrier, but they also say: "we ultimately expect to need a barrier with a second set of gates and locks by 2120, regardless of which option we select by 2040."[64] To prolong the Barrier's lifespan until a replacement is in place, the Environment Agency will have to stop using the Thames Barrier to protect west London communities from fluvial floods by 2035.

Surface water flooding

Flooding poses a lethal risk to Londoners. In July 2021, London was hit by two extreme rainstorms. Some parts of the city received more than twice the average July rainfall in two hours, causing major disruption and over 2,000 properties flooded with stormwater and sewage. More than 30 tube stations were affected; hospital wards were evacuated. Of all properties at risk of flooding (coastal, fluvial, groundwater and surface water) across England, 60% are at risk of surface water flooding.[65]

In November 2023, the Chief Executive of the Environment Agency told the Public Accounts Committee: "What genuinely keeps me awake at night is surface water flooding. In July, we saw a tragic incident with two deaths in Liverpool. We saw multiple fatalities in the west of Germany last year. We saw 25 fatalities in South Korea last year. As a society, we have to take that much more seriously. It is difficult to forecast these very intense rain cells, and often we do not have the necessary warning systems."[66]

At a roundtable hosted for the Review by the Better Buildings Partnership a major commercial real estate provider in London said 20% of their occupied commercial properties had to be vacated due to flooding from summer rainfall. Analysis from Zurich UK said flooding from torrential rain threatens 42% of the capital's 301,000 commercial buildings.[67] The average cost of flooding to a home is £30,000 and £82,000 to a business.[68] In its report on the impact of climate change on sports in the UK, the British Association for Sustainable Sport (BASIS) said: "For football and rugby union, the 25% overall increase in winter rainfall means experiencing wetter conditions more often." The Chair of the FA Debbie Hewitt has revealed that "...we have something like 120,000 games a season cancelled because the pitches are not playable."[69]

Wildfires

Wildfires are a growing threat at London's rural-urban interface, as shown by the fires at Wanstead Flats in 2018 and Wennington in July 2022. These events highlight the importance of informed land management where planning boundaries meet the natural environment. Wildfires are increasing in frequency and intensity around the world. For understandable reasons the public focus on this risk tends to be through the lens of emergency response (i.e. after ignition). More focus should be on prevention. Havering Borough Council told us: "The very infrastructure of Boroughs like Havering (and villages like Wennington) – with a significant level of rural-urban interface – presents a substantive challenge to preventing and managing the ever-increasing likelihood of wildfires." The UK Green Building Council's review of the National Adaptation Programme (NAP3) said that "there are no substantive proposals to comprehensively address wider climate risks to the built environment in key areas, such as wildfires and extreme wind" and said clear plans and policy initiatives are needed to address the impacts of these risks.[70] The Wildlife Trust also told us wildfires pose a significant risk to nature, and the preservation of biodiversity must be considered in any wildfire strategy. England does not yet have a national strategy or action plan for managing wildfires.[71]

The average cost of flooding to a home is £30,000 and £82,000 to a business.

Analysis from Zurich UK said flooding from torrential rain threatens 42% of the capital's 301,000 commercial buildings.

Wildfires are a growing threat at London's rural-urban interface.

Subsidence

Around 43% of properties are likely to be affected by subsidence in London by 2030.[72] London is especially vulnerable due to its clay rich soil, its density of infrastructure and buildings and high exposure to heat and drought. The British Geological Survey says this problem is exacerbated by climate change. Thames Water said: "The weather conditions during 2022/23 have challenged us operationally and we're not where we'd like to be on leakage. The hot and dry summer last year created an unprecedented 'soil moisture deficit'. As the ground dried out, our pipes and our customers' pipes moved and cracked, leading to an increase in leakage."[73] Local authorities told us London's ageing infrastructure is similarly disrupted by fluctuating winter temperatures – water pipes can be damaged in freeze-thaw events. The Third UK Climate Change Risk Assessment Technical Report said: "The formation of sinkholes under road and rail infrastructure can be caused by prolonged or extreme rainfall." And "Ground movement/subsidence, shrinkage and heave of high plasticity soils are expected to be exacerbated by projected increases in drought conditions and periods of prolonged heavy rainfall... This in turn would lead to shrink-swell effects permeating deeper into the soil."[74]

Cascading risks

London can be viewed as a system made up of many interdependent and interconnected parts. London's transport infrastructure is dependent on energy infrastructure which is dependent on water infrastructure and vice versa; disruption to one part of the system creates cascading risks. For example, in November 2023, schools closed, and thousands were left without water in Surrey when a storm caused a power outage at three of Thames Water's treatment plants.[75]

Many evidence submissions to the Review said more work needs to be done on interdependencies and cascading risks. Heathrow Airport Limited told the Review "There are many interdependencies and complexities with how transport sectors respond to climate change, and these are particularly dependent on the resilience of other utility bodies (for example water and energy)."

Heatwaves can drive concurrent risks such as area specific water shortages at the same time as fires. As water use surges in extreme heat, water companies manage this by reducing pressure in the water network, and this makes firefighting more difficult. The National Risk Register says: "Severe environmental damage due to drought conditions would occur, along with an increased fire risk due to dry conditions. This would be combined with a reduced ability to fight fires due to water scarcity."[76] This happened in July 2022, the Borough of Havering told us: "It should also be noted that the LFB's official investigation report into the fire made reference to the local water authority having reduced the water pressure on the day (which initially hindered the fire-fighting response). Although this action by the water authority was reported to only be for testing purposes that day, if regular water pressure reduction becomes a feature of future water supply management (given the increasing probability of droughts) then this may become a substantive fire risk in rural-urban interface boroughs such as Havering."

TfL's Climate Change Adaptation Plan said "Water and wastewater service provision to stations, depots and offices and surface water management in urban catchments" is one of their most important interdependencies.[77] Increased rainfall can disrupt electricity substations which has significant impacts for all systems dependent on reliable power supply, including transport, health, waste.

Wider climate risks

Even though these are not the focus of the Review it is important to note that London is vulnerable to climate shocks elsewhere in the world. For example, throughout history, poor harvests caused by floods and droughts have resulted in famine, civil unrest, migration, and conflict around the world. London's communities are globally connected, and we have been told how increasing global instability and devastating climate impacts around the world are impacting Londoners, particularly their mental health. The College of Policing cites global conflict, particularly where UK populations have connections to affected regions, as "a factor which may indicate or cause changes in community tension."[78]

Although it is not a core focus of this Review, we urge national and regional authorities to continue to prepare for disruption to domestic and transnational food and energy supply chains in the coming decades. Following the wettest 18 months in the UK since records began in 1836, a report in April 2024 from the Energy and Climate Intelligence Unit (ECIU) projected there will be a 17.5% reduction in overall production for winter wheat, winter barley, spring barley, oats and oilseed rape, compared to 2023.[79] Tom Lancaster, lead analyst at the ECIU, said: "This is likely to mean not only a financial hit for farmers, but higher imports as we look to plug the gap left by a shortfall in UK supply. There's also a real risk that the price of bread, beer and biscuits could increase as the poor harvest may lead to higher costs."[80]

National and regional governments should also consider "plausible low probability events with high impacts (wildcards), compounding hazards occurring at the same time or after each other, and risk cascades that stretch across national borders or sector boundaries."[81] For example, the failure of the Atlantic Meridional Overturning Circulation (AMOC) "a major tipping element in the climate system and a future collapse would have severe impacts on the climate in the North Atlantic region."[82] Some of our recommendations, for instance 6 and 7, would help with preparing for wildcards.

Several areas require further expert research and were beyond the scope of this Review. For instance, we have not tried to replicate the work on the rise of tropical diseases covered in 2023's "Health Effects of Climate Change" report.[83] We have also not looked at changes to humidity or salt-water intrusion. We have focussed on the main risks highlighted in evidence submitted to us.

Key Findings

Extreme weather events are increasingly frequent and disruptive to Londoners. Climate hazards like extreme heat, flash flooding, storms and subsidence are harming Londoners' health, disrupting critical services like education and transport and damaging infrastructure and water supply. They bring significant costs, to households, businesses and our wider economy. London must prioritise its climate resilience by adapting to remain safe in a changing climate and by going faster to reduce emissions.

The UN says the world is on track for a 2.5–2.9°C temperature rise above pre-industrial levels this century.[84] Europe is warming faster than anywhere else in the world.[85] Since the 1980s, warming on the continent has been about twice the global rate.[86] While we should redouble global efforts to reduce greenhouse gas emissions, London's climate adaptation strategy should be aligned with this overarching trajectory. Heathrow Airport Limited told us: "We recognise that historic GHG emissions have already committed the world to some degree of climate change. In the UK, future climate projections suggest increasing temperatures, increased rainfall patterns and flood risk and more extreme weather events." Preparing for anything less than 2.9°C would be an unacceptable gamble with people's lives and taxpayers' money. In 2023, the UN Environment Programme said: "Even if the rise in temperature eventually slows as a result of more ambitious collective climate change mitigation efforts, climate risks will accelerate with every fraction of a degree because of the compounding and cascading nature of climate-related impacts."[87]

2023 was the world's hottest year on record. The Copernicus Climate Change Service (C3S) said the 12 months from February 2023 to January 2024 were the warmest mean temperature on record, 1.52°C above pre-industrial average for the first time.[88] May 2024 was warmer than any previous May on record – the 12th month in a row that is the warmest on record for the respective month of the year.[89] The whole world is underprepared for extreme weather. The UN Environment Programme Adaptation Gap Report 2023 found that progress on climate adaptation is slowing when it should be accelerating to catch up with rising climate impacts.[90] The European Environment Agency said: "The record-hot summer of 2022 has been linked to between 60,000 and 70,000 premature deaths in Europe, despite considerable investments in heat-health action plans."[91] The World Meteorological Organization said heatwave deaths increased across almost all Europe in 2023.[92]

Shortly after we began work on the Review, the UK government published its five-year National Adaptation Programme (NAP3) for England. The Chair of this Review responded saying: "The Government's National Adaptation Programme should be a wake-up call and yet it seems they are taking a NAP. It's nearly exactly a year to the day that England hit 40°C for the first time, when schools had to close, hospital operations were cancelled, and there were over 3,000 excess deaths. An official inquiry after an event can never turn back the clock but good preparation can provide return on investment, jobs, and healthier places to live and work. England needs to keep going whatever the weather. NAP3 won't convince

anyone that we are ready and that is a dangerous, missed opportunity."[93] In March 2024, the Climate Change Committee said: "the NAP does not go far enough to ensure that the UK is adequately prepared for climate change. This is true for the climate change already being experienced in the UK today, the climate changes expected over the programme's lifetime (out to the late 2020s), and the range of further changes possible over decades ahead."[94] The new government's election manifesto said: "...poor risk management, and a disjointed approach across government and regulators have left Britain badly exposed."

London must retain its ability to go further than national minimum standards. The London Plan drives action with policies on areas such as overheating and cooling, urban greening, and flood risk management.[95] The Mayor brought ambition to London's institutional efforts to reaching net zero and must now do the same for adaptation. Including climate adaptation in the GLA's climate budgets is a step in the right direction.

Adaptation to climate change should be a part of all decision making at the GLA, including its functional bodies, and London Boroughs. The GLA has a legal duty to take account of climate change in undertaking its functions. The GLA does not have the powers or resources to directly deliver all of London's required climate adaptation solutions, but the GLA Group and Boroughs have a combined procurement spend of around £19 billion per year.[96] All of that money must be used in a way that builds resilience to climate shocks. Adaptation is non-negotiable.

Failure to prepare for climate impacts heightens risks and threatens efforts to reach net zero.[97] Without due regard to climate adaptation, risk is "baked-in" to the lifetime of assets, projects become less viable, and the benefits reduce over time. The cost of unmitigated climate impacts will derail net-zero investment as commercial and political interests seek to limit immediate damage. The International Panel on Climate Change's (IPCC) sixth report said: "the rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt."[98]

> The UN says the world is on track for a 2.5–2.9°C temperature rise above pre-industrial levels this century. Preparing for anything less than 2.9°C would be an unacceptable gamble with people's lives and taxpayers' money.

Emergency planning needs to stay one step ahead of climate impacts. Many climate impacts like floods or wildfires are not new, but as the frequency, intensity and scale of hazards grows there is a far greater weight of pressures on Category 1 responders like the LFB. Similarly, the Environment Agency's third adaptation report said: "The Environment Agency prioritises its Category 1 emergency response role by diverting resources from other activities according to demands. The cumulative effect of more frequent incidents will therefore reduce our capacity and focus on long term planning, engagement and strategy implementation."[99] The LFB told us that climate change is turning what might be considered extraordinary risks into normal risks, but legislation is not in lockstep with that. This means that governments invest in tools for consequence management reactively, after an event has occurred, when they should be proactively looking at the life cycle of a problem (Prevention, Protection, Preparedness, Response, Recovery, Engagement[100]) and making investment decisions accordingly. The LFB told us this is not only about capacity; clarity is also needed around statutory responsibilities, when multi-agency plans[101] are appropriate and, if so, who should take command in incidents, including floods.

Vulnerability to climate hazards is unequal in London. Research by CDP has found that across the UK's local authorities low income households, elderly people, marginalised and minority communities, children and youth and vulnerable health groups are consistently the most vulnerable to climate hazards.[102]The percentage of the population aged 65 and above is growing and "climate impacts pose a significant challenge to the health and wellbeing of older people, particularly those who live in vulnerable locations or lack the physical, mental, social, and financial resources needed to avoid or minimise the effects of extreme weather."[103] Disability Rights UK told us that people are disabled by barriers in society, not by their impairment or difference; adaptation can build in accessibility by actively engaging disabled Londoners. Around the world women's health and incomes are disproportionately vulnerable to climate impacts; the UK Health Security Agency (UKHSA) has said pregnant women are a key group at risk from hot weather and is currently considering the effects of hot weather on menopausal health.[104, 105]

The poorest and minority communities are among those who will be hit the hardest by climate impacts.[106] Poorer Londoners are more likely to live in housing that is not well adapted to high temperatures, meaning they are more vulnerable to heat, and more likely to live in areas vulnerable to flooding and less likely to have flood insurance. UK statistics show that people in Bangladeshi, Pakistani and Black ethnic groups are the most likely to be living in deprived neighbourhoods[107] The Office for Health Improvement and Disparities told us: "Climate change will exacerbate and widen existing inequalities. This is because people who experience health inequalities have poorer health and are more likely than the general population to have health conditions that are made worse by, for example, extreme heat and cold."

Ensuring the most vulnerable benefit from adaptation should be a guiding principle. Adaptation action will help all Londoners prepare for and to recover from climate events, such as flooding or extreme heat. The London Borough of Newham's Just Transition Plan is a new approach to adaptation and net zero that says "climate stress in Newham is an intersectional issue" and commits to "leveraging the Just Transition to improve the employment opportunities, living conditions, health and wellbeing of all Newham residents."[108] The GLA's Climate Risk Map helps the Mayor and other London-based organisations to target resources to support communities at highest risk of the impacts of climate change.[109]

Invest in people to protect nature. Recent research has shown that botanical gardens are the most effective green spaces for cooling during heatwaves.[110] That's a good reason to visit Kew Gardens, but to prepare for climate risks like extreme heat or flash flooding across the whole of London, you need to bring many thousands of small projects together, in the form of interventions like SuDS or street tree planting. London's trees and other green and blue spaces, are under threat from severe heatwaves.[111] The Mayor has invested around £30m in green projects since 2016,[112] however the London Green Spaces Commission said in the ten years to 2019, £4billion was cut from core funding for local services in London.[113] Over the same period, spending on open spaces by local authorities fell by over 30% to £159m while London's population grew by around 900,000 people (11.2%).[114] The Royal Parks and Hackney Council both told us climate change impacts are increasing pressure on maintenance resources.

London is underprepared, but not unprepared. Adaptation is taking place all over London, but now a step change is needed. We recommend an adaptive pathways approach, supporting decision makers to identify what actions can be taken now and in the future.[115] Adaptive pathways enable places and organisations to better plan for future climate hazards by being agile to the latest climate science, growth projections, investment opportunities and other changes to the local environment.[116] Francis Heil, Associate Director-Climate Change & Resilience at AtkinsRéalis explains an adaptive approach, as one where "sustainable investment is strengthened gradually over time, reinforced by continual monitoring and informed by up-to-date learnings that leads to a long line of low-regret decisions".[117]

Chapter 1

Enabling London to lead

This chapter sets out findings on London's governance arrangements and makes recommendations to unlock action. UK government, the Mayor and the GLA, local authorities, the wider public sector, and the private sector can all do more to prepare London for extreme weather. Resources for local authorities, shared targets, and a delivery plan to guide city-wide action are all important.

London is underprepared for climate impacts, in terms of severe weather experienced now and new extremes we could reasonably expect in the coming years. More frequent, overlapping, and severe weather events should be factored into the strategies and business continuity plans of London organisations. We should be preparing for extremes. We have previously recommended now that London has experienced 40°C it would be sensible to prepare for a longer period of 40°C and even higher temperatures.[118]

Regional and local authorities do not have the powers or resources to deliver adaptation at pace and scale, a clear plan and legislation are needed. Southwark Council told us: "Without a clear plan from central government responding to climate adaptation feels like a piecemeal approach with different organisations and bodies working on different projects, but with no major join up of adaptation themes or funding in place." The Royal Borough of Kingston Upon Thames said: "...we lack clear guidance, benchmarks, coordination and a regulatory framework from the national government that would facilitate collective action." London Councils said: "Resourcing and delivery priorities are necessarily driven by statutory obligations and associated funding from government."

A lack of national strategy is holding back long-term investment for adaptation and resilience in London. The Oxford University report "Mission Climate Ready" said "Until now, the private sector has lacked a clear steer on the role they are expected to play on adaptation at the sector and local level and the policy certainty necessary to enable them to align their plans and investments."[119] London cannot wait until the Fourth National Adaptation Programme (NAP4) in 2028 for strategic direction. The Mayor should build on existing work and take a lead.

More frequent, overlapping, and severe weather events should be factored into the strategies and business continuity plans of London organisations. We should be preparing for extremes.

Sustainable Drainage Systems (SuDS) to help alleviate flooding. Rain gardens, Forest Road, near Blackhorse Road, Walthamstow.
Creator: Eleanor Bentall for Transport for London

There are good reasons for London to move ahead of national government on heat risk. London can be several degrees warmer than surrounding rural areas, this is called the urban heat island effect.[120] The Borough of Southwark said: “As an urban, central London borough, the impacts of a changing climate have mostly been felt by Southwark’s residents through excessive heat, particularly in the middle of the borough with less tree canopy and a lower level of access to green open spaces.” After the surface water floods in 2021, the Mayor convened the London Surface Water Strategic Group, bringing together public and private sector partners to decide how to address surface water flood risks strategically throughout London. No similar group yet exists for heat. The Mayor should immediately begin work to fill this national, regional and local strategic gap.

London has 33 Local Lead Flood Authorities compared, for example, to one in Essex, despite Essex having a land area two and a half times larger than London. The GLA is not a Lead Local Flood Authority; it has no legal responsibility for surface water flooding and cannot access funds from the Thames Regional Flood and Coastal Committee. Evidence from the London Environment Directors' Network (LEDNet) said: “London’s 33 local authorities deliver most of London’s public services in local communities on the ground. The layer of governance and local democracy that boroughs provide is therefore key – both to short-term resilience & recovery, and to long-term, strategic climate adaptation planning.”

Many organisations are not recording the scale of climate disruption or the costs. This means there is low understanding of the costs of severe weather and the benefits of preparedness. Following flash flooding of 1,500 properties in Hammersmith and Fulham in 2021, the cost of repairs and floodproofing are expected to have run into tens of millions of pounds, but this does not include the costs of disruption to businesses throughout the recovery, or the associated health costs. TfL said, by the end of 2026, it will "launch a pilot project to explore the feasibility of identifying weather (and consequently climate change) as a contributing factor in asset degradation" and "integrate data into asset-condition reporting where possible."[121] While we urge TfL to complete this exercise before the end of 2026, we know they are ahead of many others in that they have recognised this need and have committed to it.

We have seen good examples of climate adaptation in London. London has a range of Mayoral delivery programmes to support immediate action plus strategies to support long-term planning. These include the **London Environment Strategy**, the **London Resilience Strategy** and the **London Plan**. The Mayor convened the London Surface Water Strategic Group following the flash floods in 2021. The Mayor has shown commitment to adaptation by commissioning the London Climate Resilience Review. Analysis from London Councils found that all borough climate action plans (CAPs) contain adaptation related actions, and most have clear senior sponsorship for adaptation work. Despite commitment and planning

there are significant barriers to translating this into more targeted and strategic delivery plans. Financial and human resources have been consistently identified as the primary challenge.

Adaptation to climate change should be a part of all decision making at the GLA, including its functional bodies and London Boroughs. Exemplary urban climate resilience in London will help other decision makers to accelerate action. The GLA piloted adaptation in its climate budget process for 2024/25, this is a step in the right direction, as are references to adaptation in TfL's business plan and its adaptation plan itself.[122, 123]

The Mayor should use his convening power to drive climate resilience. The Mayor can bring together private, public and community organisations and make climate resilience a priority for collaborative work. This includes prioritising it in existing cross-sector forums, such as the London Partnership Board, London Anchor Institutions Network, Business Advisory Board and Infrastructure Coordination Service. The Mayor for Greater Manchester, Andy Burnham, said on the Leading podcast "You [mayors] clearly have huge power of influence over all public and private bodies within the city region. And you have something else which I would say is our superpower as Mayors, and it's a convening power... Get everybody around the table, get the conversation going and get a solution... that's our greatest power that's given to us to bring people together."[124]

The Climate Change Committee could be funded to consider the challenges of cities and urban areas more fully. The London Climate Ready Partnership (LCRP, formerly the London Climate Change Partnership, LCCP) asked Defra why cities weren't mentioned specifically in NAP3 and were told it is because the Climate Change Committee didn't consider them specifically in the climate change risk assessment (CCRA), but the Committee's budget comes from UK government. Some local authorities told us they used the CCRA as part of the evidence base to inform their climate adaptation and resilience activities. Ensuring the CCRA sets out specific risks to urban areas would support adaptation planning in London and other cities.

> "And you have something else which I would say is our superpower as Mayors, and it's a convening power... Get everybody around the table, get the conversation going and get a solution... that's our greatest power that's given to us to bring people together."
>
> Mayor of Greater Manchester, Andy Burnham on the Leading Podcast

Recommendations

1. **Recommendation for the Mayor: lead collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.**

The Mayor should lead collaborative work to set a vision for a London that is adapting well to climate change. This should guide the development of a strategic approach, or regional framework, to increase London's climate resilience to physical impacts. It should support policymakers and stakeholders in the development of coherent and effective policies and action. The UK's expert climate advisers have said much remains to be done to improve planning for a minimum rise in global temperature and the UN says the world is on track for a 2.5-2.9°C temperature rise above pre-industrial levels this century.[125, 126] Preparations should be guided by climate change projections, while continuing to deliver the highest net zero ambitions. Setting out which scenarios London organisations should plan for will help them set their own thresholds, and to take least-regrets action. As a part of this, the Mayor could support London to prepare for more frequent and extreme acute events as well as steady change.

The need for the Mayor to set this out is particularly important because in recent years the UK's national government has not articulated a clear strategic vision. The National Audit Office's report "Government resilience: extreme weather" praised the UK government's Resilience Framework but says "the framework does not set out a well-defined vision for what a resilient UK looks like, including targets and standards for the desired level of national, local or sectoral resilience. For three of the four extreme weather risks we examined (all except drought), government has not specified what outcome it is looking to achieve, such as target levels of preparedness or resilience, or the amount of risk that it is willing to accept in the pursuit of those outcomes (risk appetite). Without these, government cannot make informed decisions about trade-offs between long- and short-term priorities, investment or funding allocation of priority areas. It also makes it difficult for government or other stakeholders to track progress and evaluate how effectively and efficiently government is using public funds to improve national resilience."[127]

The UK government's Third National Adaptation Programme (NAP3), published in July 2023, does provide a vision in England: "The UK government's vision for adaptation is for a country that effectively plans for and is fully adapted to the changing climate, with resilience against each of the identified climate risks."[128] However, "fully adapted to the changing climate" lacks clarity and precision so this does not support alignment among all those who play a role in delivering the ambitions of NAP3.

While adaptation to climate change is a process, and not an easily defined target, it is possible to set out a clearer vision. In 2022, a public policy dialogue exercise led by Defra engaged individuals from both rural and urban areas to collaboratively envision an England that is adapting well to climate change. Participants' concluding vision for a well-adapted England "was

one of human safety and well-being where people have access to basic services and well-maintained infrastructure. They live in a prosperous economy that capitalises on green opportunities and provides green jobs, sustainable agriculture and increased urban green space. Economic impacts of adaptation have been distributed fairly with no exacerbation of existing inequalities. This England is adaptable and well-prepared; everyone is well-informed; net zero and adaptation measures are carried out in tandem and given equal importance."[129]

A clear national strategic vision is needed, but in its absence the Mayor can take a regional lead. The London Sustainable Development Commission has said: "London needs a shared vision of how to achieve a fair, net-zero city."[130] That should be a complementary piece of work.

2. **Recommendation for the Mayor: Work collaboratively to develop an adaptation delivery plan to support London's strategic vision and lead an exercise to map roles and responsibilities.**

There is no national or regional framework for adaptation and no shared understanding of responsibilities to prepare London for climate shocks at the pace and scale required. A shared framework would support local authorities and other London organisations to undertake climate risk assessments, set local targets, identify, and implement actions and monitor progress.

There are challenges in setting baselines for monitoring progress against adaptation targets, but more precise adaptation goals and indicators for London are possible and necessary. Work is needed to develop ways to compare and monitor progress at local, regional, and national levels. The GLA Group, local authorities, anchor institutions and businesses should work collaboratively to set regional climate resilience goals and share information on delivery. High level adaptation indicators should be developed to measure progress. The GLA Group, local authorities, anchor institutions and businesses can work towards these and share data on delivery.

A clear national strategic vision is needed, but in its absence the Mayor can take a regional lead.

A regional delivery plan for climate adaptation in London should set high level goals, or indicators where appropriate, which could be applied to local areas. Some examples include:

- Reduce the number of homes which overheat in London by a certain percentage by 2030. Prioritise those which overheat in today's climate, followed by those which overheat in a 1.5°C and then 2.5-2.9°C temperature rise above pre-industrial levels this century.
- Reduce the number of health, care and education settings which are unsafe in high temperatures by a certain percentage, by 2030.
- Increase the delivery of green infrastructure and nature-based solutions on all sites.
- Reduce the number of homes and buildings which face severe flood risk.
- Undertake analysis to identify 'hot spots' in important public realm settings- like high streets or major transport hubs
- Increase shading in the public realm, prioritising areas with known overheating risk, with low access to shade and green infrastructure.

A regional delivery plan should encourage organisations to collect and share climate adaptation data and work towards shared methods for setting baselines and monitoring progress, such as:

- Cataloguing adaptation actions delivered.
- Measuring the impact of adaptation actions (degrees cooled, litres of stormwater attenuated, m^2 new shaded space).

Several evidence submissions to the Review called for regional and local climate resilience targets, accompanied by tools and direct support.

A regional delivery plan for climate resilience in London must be created collaboratively. The Mayor can convene partners, provide guidance to enable action, ensure climate resilience supports other priorities for London and builds on ongoing work. The London Councils' Climate Programme for local authorities could be useful in the development of a regional delivery plan. London Councils and local authorities should support the plan for London and share data on progress.

The strategic vision and delivery plan should recognise and build upon work already undertaken on specific climate hazards. This includes the London Surface Water Strategic Group, and the **Thames Estuary 2100** plan for sea level rise. The Mayor has a key role in convening partners, providing guidance to enable action, ensuring climate resilience supports other priorities. No local authority needs to wait for this to build climate resilience into its procurement and operations, any delivery plan should recognise work which is already underway.

The London Climate Ready Partnership (LCRP) could play a role. This includes identifying who should feed into a climate resilience delivery plan ensuring collaboration, potential targets, and a collaborative exercise to understand roles and responsibilities in London, and transboundary risks. Barnet Council told us: "The review could consider clarity of policies on roles and responsibilities related to climate adaptation, both at the national and local level."

As part of a regional climate resilience delivery plan, work should be undertaken to develop a shared evidence base on climate risks. This should collect, share and utilise existing data and evidence, and work to increase available evidence. The GLA and local authorities should harness the London Office of Technology and Innovation (LOTI) to share data on climate risks and adaptation action. Several local authorities are developing localised climate risk maps. There is inconsistent data available on flooding and heat, and there are multiple plans to introduce local flood and heat sensors. LOTI should be utilised to ensure a London-wide approach to innovative climate adaptation solutions. One local authority told us: "Where is the sense in 32 local authorities [plus the City of London] allocating staff time to interpret local data which they then play back as their local interpretation of data, when there could be a consistent London wide approach and analysis which is meaningful for all boroughs."

3. **Recommendation for the Mayor: Build on work already underway to embed climate adaptation as a cross cutting organisational priority across the GLA's work and funding, where the GLA has discretion.**

Climate resilience is most effective when it is widely understood, not when it is treated as a standalone issue. To reduce the threat of increasingly severe weather to the GLA's programmes, policies, and investment, adaptation must become business-as-usual for all teams. Work to integrate climate considerations across the GLA's activities is underway. Climate budgeting, "climate in decision making" and climate literacy training workstreams should continue to be prioritised and developed to build organisational capacity on adaptation.

The Mayor should continue to embed climate adaptation as an organisational priority across the GLA group. Executive responsibility for adaptation should be assigned across the GLA's functional bodies who should undertake climate risk assessments. Severe weather events, including events with a long duration – such as intense heatwaves and prolonged rainfall, should be factored into business continuity plans. Our interim report recommended that "bodies in London also make severe weather a consideration for all business-as-usual resilience exercises."[131]

The GLA's adaptation team should be resourced to engage with and support other teams, and functional bodies, to incorporate adaptation into existing work. Existing partnership initiatives, including the London Partnership Board, should be asked to address physical climate impacts as a priority, alongside net zero. Work should be undertaken to encourage organisations that receive national, regional, and local funding to demonstrate minimum adaptation commitments. Such work must not limit access to funding for small and medium organisations or businesses who will require support, and time to adjust. Examples of commitments include a climate adaptation plan and/or risk assessment, evidence that the funded project has considered climate change and embedded adaptation where possible. This is to ensure that spending is resilient to London's changing weather, that adaptation is embedded where possible, and that organisations who receive funding can grow their adaptive capacity.

The Mayor can provide straightforward guidance to support organisations to meet this requirement. Such a commitment should be introduced within two years, but GLA funding could ask all funding recipients to demonstrate that they have considered climate resilience and embedded both net zero and adaptation where possible immediately. This is a low-cost action, requiring the GLA to set out the requirement, provide guidance and case studies to support funded organisations in the first instance. London's local authorities should consider how their funding can build capacity on climate resilience. This has the potential to make climate resilience business-as-usual across many London organisations.

4. **Recommendation for the Mayor: The GLA and London boroughs' finance processes should include a set of questions about climate risks to ensure spending is climate resilient, and the GLA Group's functional bodies should set adaptation plans and measurable targets.**

The GLA Group and boroughs have a combined procurement spend of around £19 billion per year.[132] The Mayor does not have complete discretion in how London's budget is spent due to restricted funding requirements but where the Mayor and boroughs have decision making power, spending should be climate resilient to, at least, minimum climate projections. A 'comply or explain'[133] model should be used for the GLA's investment to ensure that all investment by GLA functional bodies is able to withstand foreseeable climate events. Nature-based solutions should be prioritised.

Where the Mayor has decision making power over budgets, the GLA Group's departments and functional bodies should aim to lead on climate adaptation. This should include developing climate adaptation plans which consider minimum climate projections and set out targets as well as directives to embed nature-based solutions (where possible). This could be supported with the GLA's Climate & Equalities Tool which asks users questions about possible climate and equalities impacts of projects to help integrate the Mayor's statutory requirements on climate and equalities. The GLA's Environment and Energy Unit's adaptation team could lead on internal capacity building.

The GLA's leading climate budgets process should be used to monitor progress towards targets. The Mayor should also continue to support local authorities to explore climate budgets as a useful process for ensuring short-term actions (typically annual budgets) deliver long-term climate targets (in line with the city's climate action plan or net zero pathway).

5. Recommendation for London's local authorities: Develop climate adaptation action plans, informed by climate risk and vulnerability assessments.

Local authorities should integrate climate adaptation plans into their climate action plans. These could be informed by climate vulnerability and risk assessments to gain a better understanding of where staff, residents, health services, businesses and community groups are most at risk from climate impacts like floods or hot and cold weather. Many local authorities have also already undertaken work to map the distribution of climate impacts against other factors such as socioeconomics, access to green infrastructure, building stock and access to public transport. It would help target adaptation plans, resources, and action if this happened more consistently across London's 33 local authorities. Local authorities should consider an adaptation pathways approach where suitable.

This work should be informed by local authorities' key departments, service delivery partners and communities. This work should be locally led where possible, in partnership with London's voluntary and community sector, drawing upon residents' knowledge and lived experience to supplement an initial desk-based review of climate risks and vulnerabilities. Organisations may have different names or processes for identifying vulnerabilities. The 'who' of a locally led approach will also vary from service delivery organisations, those who work with communities, or individual vulnerable households, particular groups, or neighbourhoods.

Climate vulnerability and risk assessments could be a helpful model for local authorities, as well as other public and private sector organisations across London, to define realistic adaptation objectives and engage key service providers like local health services, community groups and residents' associations.[134] This would also protect investment for other priorities by ensuring they are not disrupted or damaged by London's changing weather.

There are existing resources and data which can help local authorities to assess climate risks and vulnerability at a high level and to target action. These include the GLA's climate risk maps,[135] the properties vulnerable to heat impacts in London report, [136] the Environment Agency's flood risk maps,[137] or the London 10-minute green space map.[138]

Local authorities should integrate climate adaptation plans into their climate action plans. These could be informed by climate vulnerability and risk assessments to gain a better understanding of where staff, residents, health services, businesses and community groups are most at risk from climate impacts.

6. **Recommendation for UK government: Delivers its commitment to a new process for assessing chronic risks by the end of 2025 and appoint a Cabinet Office Minister for Adaptation and Resilience with responsibility for the National Adaptation Programme.**

The Climate Change Committee has said: "Adaptation policy is currently coordinated across government by the Department for Environment, Food and Rural Affairs (Defra). However, many of the risks that need to be addressed sit with other government departments and local authorities. Despite the best efforts of officials, the machinery of government has been ill-suited to ensure that adaptation reaches the top of other departments' priority lists and is sufficiently well-understood and resourced in local government."[139]

The National Audit Office said: "Government cannot provide an estimate of how much it spends to manage the risks for droughts, high temperatures and heatwaves, surface water flooding and storms, because action is taken by a wide range of government departments and agencies, and no one collects this information."[140]

A Cabinet Office Minister of State for Climate Adaptation and Resilience with responsibility for the National Adaptation Programme would help ensure ownership of adaptation actions are assigned across departments alongside ownership of acute national risks. This would provide better value for money for the taxpayer as the pursuit of shared goals could be coordinated throughout government rather than duplicated in separate budgets. It would also improve join up between the UK's work on adaptation and resilience internationally and domestically.

The UK government's National Risk Register, published by the Cabinet Office, covers acute risks, worst-case scenarios and the responses citizens can expect. The 2023 edition of the National Risk Register is the first edition that does not feature a chapter on longer-term "chronic" risks like climate change which it said: "can make acute risks more likely and serious".[141] Examples could include: long term reduction in water availability; long term increase in humidity and rainfall; irreversible damage to nature, pests and diseases, and subsidence.

This is a significant gap and undermines the National Risk Register's analysis of acute climate risks, because they occur in the context of chronic vulnerabilities. The National Risk Register says: "As outlined in the Integrated Review Refresh the government is establishing a new process for identifying and assessing a wide range of chronic risks... As a first step, we will run a cross-government exercise to identify and understand the UK's current and future vulnerabilities, with recommendations for action."

That exercise must be prioritised within Government and given a timeline, we suggest by the end of 2025, because it is increasingly important to look at acute and chronic climate risks in the round, to ensure long-term climate readiness is informed by concurrent responses and vice versa.

Currently, adaptation is owned by Defra while the Cabinet Office assigns ownership

of acute national risks to lead government departments across risk identification and risk assessment; prevention, resilience, preparation and emergency response; and recovery.[142] The previous UK government told the Joint Committee on the National Security Strategy (JCNSS) that Ministers from both departments meet regularly.[143]

The JCNSS's report **Readiness for storms ahead? Critical national infrastructure in an age of climate change** recommended: "the government establishes a Minister of State for CNI Resilience and a team within the Cabinet Office to focus on this issue." Launching that report the Committee said: "It appears that no Minister is taking responsibility for this topic, and there are no cross-Cabinet Committees driving forward the Government's work on adaptation and CNI resilience. This may be why the previous Government has accepted the Climate Change Committee's finding that it is moving backwards on adaptation, and has failed to implement any of that Committee's latest adaptation recommendations in full. It is hard to imagine the Government taking such a lax approach to any other recognised national security risk."[144]

Since then, NAP3 committed to a new cross-government Climate Resilience Board of senior officials. The Climate Change Committee has said: "The challenge of adequate integration of adaptation into government activities has long been acknowledged, so this initiative to help tackle that challenge is welcome."[145] We agree this is welcome but don't believe a board of senior officials has enough heft to drive cross-sector action at the pace and scale needed.

The Institute for Government report **Adapting to climate change: how the UK can better manage a rapidly changing environment** also discussed this: "One of the advantages of having a cross-cutting minister is that it is a way of breaking out of the 'silo mentality' that characterises much of central government... [and] The government should seek to embed adaptation and resilience in core financial control mechanisms."[146] The new government's election manifesto said: "a disjointed approach across government and regulators have left Britain badly exposed. Labour will improve resilience and preparation across central government, local authorities, local communities, and emergency services."

7. **Recommendation for the Mayor: In the context of cascading failures due to increasing climate-related risks, consider how the new London Resilience Unit can further strengthen the GLA's approach to managing systemic interdependencies and risks.**

Following on from Recommendation 6 there is work in London that the GLA can build on and lead.

London is reliant on systems that reach beyond London's boundaries. For example, London's transport infrastructure is dependent on energy infrastructure which is dependent on water infrastructure and vice versa; damage to one part of the system has cascading effects. The way that London experiences and manages climate impacts, not to mention other non-climate-related disruption such as cyber-attacks, depends on the resilience of national and international systems (which are beyond the scope of this Review).

The London Resilience Forum and London Resilience Group consider systemic risk and cascading failures to London, using the Anytown model for resilience exercises; in turn, London Resilience Partnership organisations, including the GLA, use the findings of Anytown exercises to inform plans and practices.[147, 148] The Anytown project was developed in 2013; it exists to: "raise awareness of the consequences of infrastructure disruption with all emergency response organisations in London – it's a way of talking about disruption to London's infrastructure, which has developed over hundreds of years, into a simple model which could be applicable anywhere in the UK."[149] The GLA told us: "It also makes a good platform for engagement, which in itself helps to build capacity."

However, the GLA also told us: "It's true that systemic risk and cascading failures are still often not well understood and not always factored into decision making." UK Power Networks told the Review "...A clear understanding of the interdependencies between organisations is needed. As such, joint work would be required between all parties to ensure there is clarity and agreement on who is best placed to address and pay to tackle them."[150]

Following a recent review of London's resilience structures, commissioned by the GLA, the London Resilience Group, which provides the secretariat for the London Resilience Forum and coordinates partnership exercises, has recently moved from the LFB to the GLA and been merged with the existing City Operations Unit.[151] The move aims to create an integrated resilience function at the GLA that will work across prevention, preparedness, response and recovery. The Mayor should consider roles and responsibilities within this new London Resilience Unit, with a view to ensuring wider GLA decision making is informed by an awareness of cascading risks and the learning from exercises.

In March 2024, the National Preparedness Commission's report **Making it happen: encouraging government action on preparedness and resilience**, by Lord Toby Harris, said: "Decision makers, like everyone else, are also subject to confirmation bias – that universal tendency to pay attention to what supports our existing beliefs while downplaying information that contradicts them – and to group think – the inclination to follow the pack and too readily conform to the majority view. This often inhibits those with professional or specialist knowledge from contributing valuable insights that could improve decisions."[152]

Awareness about cascade risks is often lacking because utilities and other organisations don't share information due to commercial sensitivities, and because of a lack of clear ownership where risks can fall between organisations. The GLA is beginning to overcome some of these challenges with its Infrastructure Mapping Application, which could provide a model for future work, and regulation, in this area.[153]

The National Situation Centre (SitCen) was established to bring data, analysis and insight together to identify, monitor and manage risks. For example, during the period of extreme heat in July 2022, the SitCen worked with partners to identify vulnerable

groups and locations.[154] To support a better, shared understanding of climate, and other, risks SitCen could share more data with Local Resilience Forums to help local resilience planning.

The Mayor should also call on national government to better assess systems risks and set out action plans with stakeholders. Such work should be led by a Cabinet Office Minister for Adaptation and Resilience with responsibility for the National Adaptation Programme (Recommendation 6) to ensure that work is coordinated across departments.

The National Preparedness Commission said: "Much of the heavy lifting in responding to an emergency at local level will fall on the relevant local authorities and many mitigations are best organised locally. That means that input from those organisations who have operational responsibility locally, have the situational awareness at community level, and the practical experience of what works, needs to be fed in and to be an integral part of resilience and preparedness policymaking. Above all, it needs to be determined what accountabilities are local and what are national – and this should be predetermined rather than negotiated in the middle of a crisis."[155]

Control Centre Exercise
Creator: Transport for London

8. Recommendation for UK government: Introduce a statutory duty for local authorities, other public organisations, and major landowners to adapt to climate change, based on a clear framework of local roles and responsibilities. Funding should be provided in local authority and public sector settlements to meet the duty.

Local authorities deliver most of London's public services in communities on the ground but have limited statutory responsibility or powers to ensure these activities are climate resilient. Local authorities are lead local flood authorities and as local planning authorities, they are bound by a legal duty to ensure that plans contribute to climate change mitigation and adaptation. There are examples of good practice, but local adaptation action is inconsistent across local authorities and sometimes dependent on the presence of one or a few committed individual officers or leads.

Local authorities have told us that poorly defined powers and responsibilities around climate adaptation means short-term, reactive priorities are prioritised over longer-term imperatives. An overarching statutory responsibility would help local authorities to prioritise adaptation in all departments and services.

London Councils told us: "Resourcing and delivery priorities are necessarily driven by statutory obligations and associated funding from government. It is noticeable that action plans and officer resourcing are somewhat more established in flooding, where our members are LLFAs [lead local flood authorities]. While there are still challenges around adequate resourcing for these statutory duties (not all boroughs have funding for a designated flooding officer, for example), it is even more challenging on other risk areas (e.g. overheating) where national statutory frameworks are much weaker."

Lambeth Borough Council said: "We need legislation and powers to put councils in a stronger position." Hackney Borough Council said: "Without proper funding for climate adaptation as a statutory obligation, efforts related to climate adaptation, mitigation, and resilience may suffer with all services being affected."

The UK's Adaptation Reporting Power (ARP) provides an opportunity for organisations to report to government on how they are addressing current and future climate impacts. A key purpose of this is to ensure government understands the barriers to and opportunities for adaptation in local areas, so that the National Adaptation Programme can support improvements to local delivery. Defra is currently conducting an ARP Pilot which has the potential to increase available evidence on the costs of climate impacts and the benefits of adaptation action. The results of the ARP Pilot will inform any decision on extending the ARP to local authorities.

Adaptation Reporting should become mandatory for local authorities in time for the fifth Climate Change Risk Assessment in 2027. London Councils has told us that while many local authorities support this in principle, they are also clear that a new duty cannot be introduced without

funding to match. The ARP should also be extended to large businesses, especially major landowners (building on existing mechanisms such as the Task Force on Climate-Related Financial Disclosures)[156] and the Mayor should advocate for London's businesses to lead by example. Public organisations should also do this, some already volunteer like TfL and the Environment Agency.

This is consistent with our support for the Second National Infrastructure Assessment's recommendation 29 which says: "All sectors should publicly report adaptation costs in a compulsory fifth round of Adaptation Reporting Power reports in 2029."[157] Priority should be given to providing resources, support, guidance and funding for local authorities to undertake climate risk assessments, develop or update adaptation plans, implement actions and monitor their impact. If introduced, ARP requirements should remain flexible, so they do not undermine existing good work by organisations and so that resources can be found to fulfil an additional statutory reporting requirement. The economic effects of extreme weather will dwarf the staff costs of understanding where local authorities are exposed to physical risks and what action they might take. The question then becomes how resources should be made available.

Priority should be given to providing resources, support, guidance and funding for local authorities to undertake climate risk assessments, develop or update adaptation plans, implement actions and monitor their impact.

9. Recommendation for the Mayor: A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.

In July 2023, the world's hottest July on record,[158] United Nations Secretary-General António Guterres said: "The era of global warming has ended; the era of global boiling has arrived. Leaders must lead. No more hesitancy. No more excuses. No more waiting for others to move first. There is simply no more time for that."[159]

We are entering a new era. Management of the UK's increasing heat risk is a strategic gap across all sectors and organisations, it urgently needs leadership and collaboration, but the UK is culturally more familiar with preparing for cold winters than treating hot weather as a hazard. The UK Health Security Agency's Adverse Weather and Health Plan brings together guidance on weather and health. It concerns arrangements for planning and response in the health system to deliver the best outcomes possible during adverse weather, including heatwaves. The Plan is not for other sectors, like housing and buildings.

Many heat-related deaths are preventable, actions such as registers of vulnerable people; local heat plans; capacity building to help keep vulnerable groups safe, education, urban greening, and warning and informing can all increase resilience. There is no national strategy to adapt behaviours, communities, business, infrastructure, and nature to the higher temperatures and extreme heat we expect to see with climate change.

The Grantham Institute's Turning Up the Heat Report said England is ill-prepared for future extreme heat events and calls for a national heat risk strategy.[160] Cities around the world are particularly vulnerable to extreme heat because the density of their populations and many dark surfaces mean they can be several degrees warmer than surrounding rural areas.[161] Many global cities already have heat strategies and London could quickly learn from work underway elsewhere. Kate Gallego is the Mayor of Phoenix, the hottest city in the USA. Gallego has said: "We have probably 30 ideas about how to respond to heat. If New Orleans already knows 25 of them but they benefit from five new ones, that could be incredible. It's the same for mayors in Texas, who have lost too many lives already."[162] In March, the United States Agency for International Development and the International Federation of Red Cross and Red Crescent Societies held a Global Summit on Extreme Heat to bring together leaders from around the world who are working to lessen the impacts of extreme heat events and increase climate preparedness plans for saving lives and mitigating costs. One of the issues discussed is whether the naming of heatwaves, in the same way that hurricanes and typhoons are named, would help warning and informing.[163]

National strategic leadership on adapting to hotter temperatures is needed, but in the absence of national action the Mayor can take a regional lead. Key partners need to be convened, especially in public health and social care, the built environment and infrastructure, as well as academia, local, regional, and national government.

The strategic plan could be worked on at an expert level. The strategic plan would consider preventing and reducing overheating in infrastructure (for example, Hammersmith Bridge which became unsafe during 2020's heatwave[164]) and social infrastructure, such as care homes and hospitals. It would also look at reducing health impacts and provide strategic leadership for Borough level heat plans.

The strategic plan should support London's economy by ensuring London continues to see healthy footfall in hot weather, and support London's sporting and cultural institutions to manage higher temperatures. At a roundtable held for the Review by South Ken ZEN+, employees of a popular museum told us: "We are often a safe haven for members of the public wanting to escape heatwaves and find a cold place to sit or spend the day as some of our rooms are air conditioned. If heatwaves continue to be more frequent, this could impact on us as we cannot exceed maximum safe numbers of visitors at any one time."

Monument, Victoria, London
Creator: Transport for London

Case study
Heat Resilience Solutions for Boston

Released in 2022, the City of Boston's Heat Resilience Solutions for Boston (the Plan), is a citywide framework for the municipality and its partners to prepare Boston for rising temperatures and hotter summers, with an explicit focus on equity and environmental justice.

The Plan is part of the City's Climate Ready Boston initiative, which is the municipality's programme to prepare the city for the effects of climate change, including coastal flooding, sea level rise, heat, and extreme rainfall.

Boston experienced 10 days over 32°C (or 90°F) on average between 1986 and 2015. By the 2070s, the City projects that this could increase by a factor of six to seven. Boston has recognized that the impacts of heat are not equality felt across the city, with many neighborhoods facing higher temperatures due to their urban form and residents with higher vulnerabilities to extreme temperatures.

Reflecting the cross-cutting nature of heat, development of the Plan was guided by a Steering Committee consisting of 12 City entities, an external Community Advisory Board, and extensive community engagement. The Plan was created over 14 months and funded with City resources and State and philanthropic grants.

The Plan includes:

- 26 strategies, which are a mix of short and long-term actions divided into two main categories, first- **"provide relief during heat waves"** and second to create **"cooler communities"**.
- In addition to Boston wide actions, the plan sets out detailed analyses and actions for five historically-underserved neighborhoods: Chinatown, Dorchester, East Boston, Mattapan, and Roxbury.

Key citywide actions include:

- **Establishing an Extreme Temperatures Response Task Force**, which is charged with orchestrating a cohesive response across government departments to address the chronic conditions of high temperatures and to ensure the city is preemptively prepared for extreme heat events. This task force includes the Environment Department, the Office of Emergency Management, and the Boston Public Health Commission's Office of Public Health Preparedness.
- **Incorporate provisions for heat into the City's Climate Resiliency Checklist**, which provides standards and guidance to support green buildings and climate-resilient construction for public and private development.
- **Expanding Boston's Network of City Cooling Centers**, which include designated community centers, other public buildings, public outdoor spaces with shade and water features, and community cooling partners like churches, community organizations, and businesses.

Boston, USA – Boston Heat Resilience Plan

- **Supporting Pop-up Cooling** by distributing pop-up cooling kits to community organizations for public events during the summer. Kits contain items such as a hose, misters, and a tent to enable organizations to provide relief to attendees from high temperatures.
- **Launching a Cool Roofs Programme** to provide grants to complete cool roof installations on eligible properties (modeled after New York City's Cool Roofs program).
- **Adding Green Space in Street Improvement Projects**, including trees and pocket parks, and **Increase Shade on Municipal Sites.**
- **Launching a Community Design Challenge for a "Cool Bus Stop"**. This competition will solicit designs for a heat-resilient bus shelter and is part of a broader effort to "Cool Commutes".

Boston experienced 10 days over 32°C (or 90°F) on average between 1986 and 2015. By the 2070s, the City projects that this could increase by a factor of six to seven.

10. **Recommendation to the London Resilience Partnership: Conduct an exercise to test London's preparedness for a severe heat episode and identify potential cascading and concurrent risks.**

The Joint Committee on the National Security Strategy's report "Readiness for storms ahead? Critical national infrastructure in an age of climate change" said: "We recommend that the Government oversees a programme of 'exercises' to plan for major regional extreme weather events with multiple cascading effects. It should involve local and regional actors in these exercises, including key CNI [critical national infrastructure] operators, and use them to clarify and communicate roles and responsibilities at a national, regional and local level."

In October 2023, Paris ran an exercise that simulated a 10-day 50°C heatwave event in 2 districts of the city. Our interim report said: "We believe a similar heat exercise could be a useful stress test for London. It would help clarify roles, responsibilities, and primacy of command in the event of multiple failures of infrastructure, for instance in transport, power, and water. We know extreme events will occur more frequently in the future and often overlap, 2022's heatwave occurred at the same time as drought and wildfires, sometimes heatwaves are followed by flash flooding. We have previously suggested that now London has already experienced 40°C it would be sensible to prepare for 45°C among other possible events.[165] We recommend bodies in London also make severe weather a consideration for all business-as-usual resilience exercises."

On 27 June 2024, the Greater London Authority's London Resilience Unit brought together key London agencies to stage an extreme heat exercise. Operation Helios, named after the Greek god of the sun, explored a scenario of five days of extreme heat. More than 80 participants joined the exercise from sectors including emergency responder organisations, local government, public health, environment agencies, transport services, utilities and business, voluntary and faith groups. Helios will also help support longer-term approaches to managing the risk of extreme heat, including the development of a regional plan for adapting to higher temperatures.

Writing in the Evening Standard, Professor Bob Ward said the exercise "should help London's authorities to identify challenges and weaknesses that could prove critical when the city inevitably suffers several successive days of unprecedentedly high temperatures."[166] Following the Operation Helios, we have heard that Resilience First is preparing a similar exercise for businesses in the autumn and London's sports and cultural organisations are also preparing a similar exercise.

11. **Recommendation for UK government: Develop funding programmes and increase fiscal devolution for regional and local organisations to accelerate climate adaptation.**

Public money in the UK is stretched and plans need resources, or at least a clear route to secure resources. Analysis by London Councils found that all boroughs' Climate Action Plans contain adaptation related actions, and most have clear

senior sponsorship in place for adaptation.[167] However, the Local Government Association said: “It is understood how stretched local authorities are on officer resource and budget, and that a key priority at the moment is just survival. As such, if there is no funding or finance provided for non-statutory activity it is likely to be overlooked by finance directors.”[168]

Whereas climate mitigation is a global priority, adaptation is place-based work and local communities are often best placed to understand their priorities. Local authorities who want to invest in projects that offer long-term strategic value are competing against neighbouring councils for increasingly small pots of money and outsourcing work to fulfil their statutory responsibilities. Greater fiscal devolution and flexibility would allow local authorities more freedom to put in place frameworks and policies to incentivise investment in locally led action. For example, tax incentives & rebates, risk sharing for investments, and programmes that cover upfront investment costs which can be paid off over time.

If aspects of climate adaptation become statutory requirements for local authorities, this should be matched with long term, non-competitive funding allowing use of funds strategically for ‘crowding-in’ resources and capacity building. Funding could be distributed using climate risk and vulnerability assessments (whereby local authorities that face the greatest climate risk receive the most support) but also based on applications for innovative, revenue generating projects. The London Sustainable Development Commission has said: “National government should devolve the further funding and powers needed to accelerate local action tailored to residents’ needs.”[169]

The new government’s election manifesto said: “Labour will transfer power out of Westminster, and into our communities, with landmark devolution legislation to take back control... Local areas will be able to gain new powers over transport, adult education and skills, housing and planning, and employment support.”

On June 27th 2024, the GLA’s London Resilience Unit ran Operation Helios, an exercise that simulated 5 days of extreme heat in London to help inform the development of a new pan-London Extreme Heat Plan.

Chapter 2

People and communities

This chapter focuses on the climate resilience of London's people and communities, as well as the services they rely on. One of the most damaging ways climate change will impact on Londoners is through their health as set out in The UK Health and Security Agency (UKHSA)'s 'Health Effects of Climate Change' report,[170] so we have included a set of specific findings and recommendations about the healthcare sector in London.

Severe weather, including heat, flooding, storms, drought, and wildfires, is disrupting everyday life in London. When essential services like education, childcare, health and social care are interrupted, lives are put on hold. The failure to recover quickly from climate events prolongs impacts to people and communities. At worst, extreme weather impacts are life-threatening.

Many people in the UK do not consider themselves at risk from climate impacts. Research from the Red Cross shows that despite significant heat events and the impact of heat on human health, most people in the UK do not consider themselves to be at risk, those from high-risk groups are less likely to take action in a heatwave, and only one in four UK adults said they had a good understanding of flood risk to their homes and areas.[171, 172] If people are not aware of their own risk, they are less likely to take precautions. Friends, families, neighbours and communities have an important role to play. Further, while we have heard overwhelming evidence from organisations, communities and individuals about the disruption caused by increasingly severe weather in London, it is important to note that a small number of individual responses expressed scepticism. One correspondent told us: "When it's hot it's hot, when it isn't it isn't. Normal weather patterns shouldn't concern government."

In May 2024, the government launched a new "Prepare" **website**. The website is designed to help people prepare for emergencies, be more informed about hazards, and get involved in activities to support communities before, during and after an emergency. We welcome this initiative and look forward to seeing it develop. It will be important to measure its impact beyond click-through rates in terms of behavioural change.

Climate change will not impact Londoners equally. Research by CDP has found that across the UK's local authorities low income households, elderly people, marginalised and minority communities, children and youth and vulnerable health groups are consistently the most at risk from climate change.[173] The Royal College of Paediatrics and Child Health said: "Very young children are especially vulnerable to heat-related deaths, including dehydration, as they cannot regulate their temperature and control their environment."[174]

The percentage of the population aged 65 and above is growing and "climate impacts pose a significant challenge to the health and wellbeing of older people, particularly those who live in vulnerable locations or lack the physical, mental, social, and financial resources needed to avoid or

Brixton Market, London
Credit: peeterv Stock photo ID:472831624
Upload date: May 08, 2015 iStock (istockphoto.com)

minimise the effects of extreme weather."[175] Disability Rights UK told us that people are disabled by barriers in society, not by their impairment or difference; adaptation can build in accessibility by actively engaging disabled Londoners. Around the world women's health and incomes are disproportionately at risk from climate change; UKHSA has said pregnant women are a key group at risk from hot weather and is currently considering the effects of hot weather on menopausal health. [176]

Social isolation or unemployment can decrease an individual's adaptive capacity.[177] Adaptive capacity is the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities.[178] This can be about access to information and ability to use it, financial and human resources, physical mobility, and local knowledge. Good accessibility to flood insurance can increase a household's adaptive capacity. An individual's adaptive capacity can be improved with good coverage of air-conditioned environments outside the home, access to them, such as through facilitated travel, as well as information about where they are and how to get there.

People experiencing homelessness are at an "elevated risk of hospitalization associated with even moderately high temperatures."[179] We spoke to Professor Shakoor Hajat of the London School of Hygiene & Tropical Medicine who told us: "In general, we always find heat-related health impacts in London to be greater than in other Government Regions, which may partly be due to the Urban Heat Island effect increasing temperatures in London by a few degrees."

Ensuring the most at risk from climate impacts benefit from adaptation should be a guiding principle. Adaptation action will help all Londoners prepare for and to recover from climate events, such as flooding or extreme heat. The London Borough of Newham's Just Transition Plan is a new approach to adaptation and net zero that says "climate stress in Newham is an intersectional issue" and commits to "leveraging the Just Transition to improve the employment opportunities, living conditions, health and wellbeing of all Newham residents."[180] The GLA's Climate Risk Map helps the Mayor and other London-based organisations to target resources to support communities at highest risk of the impacts of climate change.[181]

Londoners most affected by climate impacts should be able to influence decision making and shape action. Two-way engagement processes that empower and involve people can help to achieve change that is wanted by communities. London should invest in engaging with people, communities, and organisations that work directly with communities so that Londoners' lived experiences help shape the design of places and policies. This will require sustained engagement and capacity building. We have seen examples of work across London, from the Mayor, local authorities, the community and voluntary sector, and businesses, but more needs to be done. Equalities groups and the community and voluntary sector should be included in this work.

Higher temperatures and extreme heat are a significant occupational risk. Employers and sector representative bodies must make sure workers are safe in heat. The Health and Safety Executive said overheating is a bigger risk for workers in physical occupations, those who work outside or in environments where heat is created.[182] The Resolution Foundation said a fifth of workers in England face overheating risk and poorer office workers are less likely to have access to air conditioning.[183] We heard from workers in one NHS trust that in the July 2022 heatwaves, indoor temperatures were over 30 degrees throughout the night, putting patients and staff under tremendous strain. The UK has no legal maximum temperatures for work. Unions have been calling for maximum working temperatures since 2008. The Trades Union Congress (TUC) has called for 30 degrees as a maximum indoor temperature to indicate when work should stop, or 27 degrees for those in strenuous jobs.[184] This summer, unions organised an online rally called #heatstrike to draw attention to the cost of climate change to working people.

The theme for 2024's Workers' Memorial Day is Climate Change and workers' health- the impacts of climate change are an occupational hazard and a health and safety issue, climate justice is front and centre. The impacts go beyond heat alone. The International Labour Organization estimates that 1.6 billion workers worldwide are exposed to UV radiation, with more than 18,960 work-related deaths annually from nonmelanoma skin cancer. It also says there are likely to be 1.6 billion people exposed to workplace air pollution, resulting in up to 860,000 work-related deaths among outdoor workers annually.[185]

A strategic aim for climate adaptation should be that people are healthy enough to stay out of the healthcare system. William Roberts, Chief Executive of the Royal Society for the Protection of Public Health, told us: "There is no version of the evidence where you can argue the public are healthier now than they were 10 years ago." Activities Londoners rely on for health and wellbeing, like recreational sport, professional sport, cultural activities, and settings including theatres, venues and museums should be able to access support to adapt. It has been estimated that Londoners avoid £950m per year in health costs due to public parks. This figure is made up of reduced disease risk due to higher levels of physical activity and improved mental health due to access to parks.[186] The Mayor's Health Inequalities Strategy says: "The Mayor will support local areas to create built environments that reduce harm to health and enable all Londoners to fully participate in community life."[187]

The International Labour Organization estimates that 1.6 billion workers worldwide are exposed to UV radiation, with more than 18,960 work-related deaths annually from nonmelanoma skin cancer.

Community resilience is needed to reduce mental health impacts. The Environmental Audit Committee (EAC) report on **Heat resilience and sustainable cooling** said: "The "silent killer" of heatwaves could claim up to 10,000 lives annually in the UK without concerted action, with the most vulnerable at greatest risk. Physical and mental health can be severely impacted: the Committee heard that suicide risk is twice as high in the UK when the temperature was 32°C rather than 22°C."[188] The Environment Agency has said "data shows that people experience higher rates of anxiety, depression and post-traumatic stress disorder (PTSD) after a flood. The costs associated with these illnesses include: treatment; loss of employment; co-morbidity (suffering from more than one condition at the same time); the proportion of people seeking treatment; the assumption that mental health effects will last on average for two years after each flood."[189] The **Health Effects of Climate Change in the UK** report says: "The importance of community resilience in mitigating negative mental health outcomes is increasingly recognised. Emotional and social support from friends and family may be a protective factor for adverse mental health outcomes and increase resilience. However, resilience can be affected by a lack of support and service provision, community and family separation and solastalgia."[190]

"The "silent killer" of heatwaves could claim up to 10,000 lives annually in the UK without concerted action, with the most vulnerable at greatest risk. Physical and mental health can be severely impacted: the Committee heard that suicide risk is twice as high in the UK when the temperature was 32°C rather than 22°C."

The Environmental Audit Committee (EAC)

Recommendations

12. **Recommendation for the Mayor, local authorities, community groups and London anchor institutions: Increase action to engage Londoners on climate risks and build their capacity to adapt. Initiatives should be informed by behavioural science, insights based and targeted to ensure that interventions result in behaviour change.**

[This recommendation has evolved from Recommendation 20 in our interim report: "The Mayor identifies appropriate partners to develop public engagement work, informed by behavioral science, to help Londoners make climate ready choices."[191]]

We have been told by members of London's voluntary and community sector, and charities, that there is little funding available for programmes that help people to respond and adapt to the impacts of climate change. The GLA, through the London Resilience Unit, is undertaking work to upskill London's community and voluntary sector on climate resilience through climate risk workshops and directly supporting community organisations to build understanding about options for action. We recommend long-term work is undertaken to engage individuals and households and build their adaptative capacity. This is important to increasing understanding about climate adaptation and to enable more Londoners to engage at the local level. Work with communities should enable them to be empowered and involved, and encourage two-way communication to drive adaptation action, encourage community ownership, and ultimately drive local action.

Work to communicate directly to households about the risk of surface water flooding has accelerated in London since the floods of July 2021. In June 2023, the Mayor sent leaflets to 48,000 basement properties to raise awareness about what to do in a flood.[192] The Mayor worked with local authorities, LFB, Environment Agency, and London Councils to develop this. Advice for coping with hot weather is available on London.gov.uk, and this directs people to expert services.[193] A more consistent approach to community engagement would support adaptation to hotter summers. Work should go beyond providing information to deliberation and engagement and co-design. The London Strategic Surface Water Group should embed community engagement in its work on an emerging London surface water strategy.

In a 2021 survey undertaken by the Grantham Institute, the three weather related extremes of most concern to organisations were "a heavy downpour causing localised flooding" (66%), "severe flooding at the nearest coastline" (50%), and "an intense heatwave lasting a week" (47%).[194] These extremes consistently draw more concern and provide a potential focus for both engagement, behaviour change initiatives, and for greater adaptation preparedness and action.

Londoners have a key role to play in preparing themselves and their neighbours for climate impacts. The **Health Effects of Climate Change in the UK** report said: "Given the lead time needed for shifts in population behaviour, as well as policies, practices, and infrastructure, early planning will be necessary, and may be ineffective

if delayed."[195]The Mayor can support Londoners to prepare for climate impacts by leading work to engage local communities and incentivise people to reduce risk. To be effective this requires local engagement, enabling and trusting local leaders to innovate, learn, and build relationships, prioritising the needs of communities and places. The Review has identified three areas which could be fast tracked. These are: keeping safe in the heat, water efficiency, and de-paving front gardens, public and community spaces for water attenuation and to support wildlife. For these, much of the relevant information already exists but needs to be targeted at the best audiences.

Action to build adaptive capacity must engage Londoners who are most at risk from climate impacts. Disability Rights UK and the Disability Resilience Network said that disabled people may find it difficult to access or interpret timely and relevant information about what to do in extreme conditions. Adaptation of the built environment is an opportunity to make the public realm more accessible to all Londoners but can also risk maladaptation if it is not done in collaboration with disabled people's organisations. Representatives from Disability Rights UK spoke about the social model of disability, which sets out that disability is created by physical, organisational, and attitudinal barriers and explains how to plan in a way that includes rather than excludes disabled people.[196]

The most at risk should be provided with information and support to understand their potential exposure and put in place plans with their support networks to prepare. Adaptation communications should be made available in formats which can be accessed by Londoners with different needs. For example, in community languages, for the vision and hearing impaired, and in formats for those with intellectual disability. The needs of those with low levels of IT access must also be considered.

In **The Second Scottish Climate Change Adaptation Programme** preparation to ensure that carers and cared-for people have plans in place in case of extreme weather is an explicit action. [197] The London Borough of Barnet said "Some of the challenges we have been working on is educating staff, partners, residents, businesses, and community groups on the inherent dangers of extreme weather and what precautions can be taken." We know extreme weather in London is set to increase, and targeted work to support the most vulnerable in extreme weather should be undertaken.

Lambeth Borough Council said retrofit and energy efficiency communications are available across London, but "...very little focus on how homes and community should be adapting to prepare for climate risks, e.g. minimising solar gains, reducing heat risk, cross-ventilation, implications for home works, etc." Southwark Borough Council said there is a need to "make a compelling case for individuals to understand and take ownership of climate adaptation action." To ensure engagement programmes achieve their aims, national, regional and local authorities must work directly with Londoners.

Case study
Be a Buddy in New York

New York's 'Be a Buddy' is a community led programme created to build community resilience specifically for extreme heat.[198] Be a Buddy pairs people who are at high risk from extreme heat events with trained volunteers. Heat vulnerable residents include those aged over 65 with multiple comorbidities and who are socially isolated. Volunteers are provided with training, and conduct wellness checks, provide support to their buddy and connect them to services during heat events or other emergencies. Over the course of a two-year pilot project, the city invested $930,000 and served 1,300 residents. People reported feeling more supported and appreciated by their community.

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13. **Recommendation for UK government, the Mayor, local authorities, equalities groups, funders and the voluntary and community sector: Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.**

Community groups, faith groups, and equalities organisations are critical to London's resilience but are at risk due to a lack of investment and short term funding. These groups are embedded in communities and can play a vital role in adaptation and resilience planning and delivery. We have been told: "There are currently opportunities for communities across London to develop local resilience plans, and this work is supported by small, short-term grants. Communities' engagement in these issues needs to be supported by sustainable investment which strengthens resilience in the longer term." An example of such funding is the Mayor's Community Resilience Fund, which is supporting 22 organisations across 22 local authorities to drive a specific focus on climate resilience. More funding must be made available for London's community and voluntary sector, to prepare for the impacts of climate change. UK government should make more strategic funding available for community climate resilience and fund local initiatives. The new government's election manifesto said: "Labour will transfer power out of Westminster, and into our communities, with landmark devolution legislation to take back control... Local areas will be able to gain new powers over transport, adult education and skills, housing and planning, and employment support."

Funders and grant making organisations across London should explore how they could invest more in community led climate resilience. Major developers should also consider how they can fund and support community climate resilience, both directly and through their philanthropic foundations.

Capital Growth, is London's largest food growing network, launched in partnership with the Mayor in 2008. They told us that "...during the pandemic many gardens stepped up their production, targeting it at those most in need, and having the skills and spaces ready to adapt to this need is a critical infrastructure for a city dependent on other places for its food supply... Capital Growth's Community Harvest initiative was born in response to the sudden onset of the pandemic to support this further by providing community food gardens the tools, materials and advice to grow more food for and with their local communities." This is an example of a programme responding to community needs, embedding resilience with adaptation benefits. The response to the Covid-19 crisis made clear how vital community organising and action are to resilience. We should ensure community groups are harnessed for community resilience and climate adaptation. To build on community action there is a need for funding which is long-term rather than crisis driven. Ashden told us there is a need for "...resourcing of sustained community engagement over multiple years beyond project end dates and link to green skills and job opportunities."

Designing and delivering adaptation and resilience projects can provide a wide-range of benefits. The Review team visited the Firs Farm Wetland Scheme in the London Borough of Enfield which has created a community green space by de-culverting a lost river and allowing it to run through wetland basins. Before the scheme was delivered, Firs Farm was an underutilised open space. By incorporating footpaths and seating areas alongside the wetlands, the park is now full of dog walkers, children, families, and is supported by an active group of community volunteers.[199] Southwark Borough Council said "...our Tiny Forest projects in Peckham Rye empower communities to get involved in climate adaptation, encourage collaboration and local ownership." Hackney's Parks and Green Spaces strategy was developed with over 50 community meetings.[200] Communities should be involved in Climate Vulnerability and Risk Assessment process, to help develop effective adaptation plans, and to deliver the actions in those plans.

Case study

Vancouver, Canada: Resilient Neighbourhoods Programme

In June of 2021, extreme heat (the "heat dome") plunged British Colombia, Canada, into one week of temperatures up to 20°C above normal and "there was a 100% increase in deaths among adults aged 50 or older during the heat dome. Many of the people who died had chronic health conditions, especially schizophrenia, depression, substance use disorders, diabetes, heart disease, and respiratory disease."[201]

The City of Vancouver had already developed an extreme heat action plan

consisting of city-led initiatives, but 2021 showed this was not enough. In 2022, Vancouver launched the Resilient Neighborhoods Programme.[202] The city conducted interviews with the most heat-vulnerable populations, including elderly, disabled, and lower income residents, to assess their needs and recommendations for extreme heat adaptation.[203] Using this information, the city partnered directly with community organisations through twelve service agreements and nine grants to deliver services directly to people in need. These services included: distributing cool kits, providing cooling centers across the city, transporting people to these centres, conducting wellness checks, establishing Heat Buddy Systems, and spreading public resources on heat. At the end of each summer, Vancouver conducts a review of the community-led initiatives, summarizes the lessons learned, and applies these findings to the next summer's community partnerships.

14. **Recommendation to the Mayor, local authorities, the voluntary and community sector, and faith and belief partners: Continue to grow London's spaces for resilience initiatives and drive a coherent approach.**

London's local authorities, voluntary and community sector and faith and belief partners should consider how they can support the use of their spaces for community resilience. They should engage directly with the Mayor's emerging resilience hub initiatives, Cool Spaces programme and Warm and Welcoming spaces programmes. The Review encourages partners to build a strong engagement around these initiatives in order to increase community resilience and improve provision of climate ready spaces, including by registering suitable spaces to grow existing networks.

The GLA's cool spaces map helps the public find places of refuge during hot weather and summer heatwaves.[204] There were 485 indoor and outdoor cool spaces, including those provided by mature tree canopy cover, available in summer of 2023 during the extreme heat episodes. During the Level 4 heat alert in July 2022, page views on the environment section of the GLA's website reached 36k on 19 July (from a daily average of 2.2k). The GLA is currently supporting work with Aviva, Groundwork and the British Red Cross on Resilience Hubs. This is being trialled with Havering Volunteer Centre and Havering Council.[205] The Mayor could build on the strong foundation of the Cool Spaces and Warm and Welcoming Spaces programmes to promote a consistent approach across London, using community spaces to build local climate resilience.

15. **Recommendation for London's cultural organisations, like the Exhibition Road Cultural Group, and sector representative bodies, like London Sport, businesses, and grassroots organisations: Convene key partners to share best practice on adaptation within specific sectors and create adaptation plans and actions.**

Organisations in the same sectors, like sports or culture, face similar challenges and would benefit from learning alongside

similar organisations. For example, in July, the Olympics will be held in Paris, where the authorities are working with Météo-France and Santé publique France to plan for the possibility of a catastrophic heatwave coinciding with the Games. They are using historical data to understand what this could mean for each venue.[206] Last year, a Taylor Swift fan died of heat exposure at a concert in Rio de Janeiro.[207] Brazil's justice minister said the death was unacceptable, and his ministry issued a regulation obliging organisers of big events during heat waves to guarantee water for attendees. When Coldplay played Wembley during a heatwave in 2022, the official advice provided by the venue stated "Don't arrive too early for the show – doors will not open until 5pm and we don't advise sitting outside in the heat."[208]

London's culture sector, including theatres, museums and galleries are already being impacted by higher temperatures, poorly adapted buildings, and disrupted public transport which can reduce visitor numbers and income which the sector relies on. Keeping staff, visitors and performers safe in higher temperatures during hotter summers was a key concern raised in roundtables held for the Review. During the 2022 heatwave some theatres adapted by scheduling more frequent breaks to ensure performers and staff could stay safe in extreme heat.

At a roundtable held for the Review by the V&A it was clear that at least one museum has better knowledge about the precise climate needed for the preservation of artefacts, than for visitors or staff. The Exhibition Road Cultural Group in South Kensington told us that heritage protections could limit innovation in making the area climate ready, and this had direct implications for London's tourism and cultural offer.

Several attendees said clear thresholds and guidance on interior temperatures and conditions would be welcome, as would shared best practice on strategies to mitigate against extreme heat. For example, potentially shifting to later opening or performance times in summer months could help avoid extreme heat. This would require co-operation between many different stakeholders, cultural organisations to ensure coordinated later schedules, food and drink venues, local authorities, and TfL to ensure Londoners and visitors could travel later on hot nights. This is about to have a new precedent: the band Massive Attack have worked with TrainHugger and GWR to arrange five post show trains at 11:30 at night, in order to reduce audience transport carbon emissions from their Bristol gig on 25 August 2024.[209]

Some organisations also wanted advice on how to ensure adaptation would not compromise work on net-zero, for instance by reducing the need for active cooling, like air-conditioning.

Recreational and professional sport both face significant climate impacts. Sports will become more difficult and, in some cases, dangerous in extreme heat. Parks and other grounds will more frequently be saturated by heavy rainfall (these impacts and more are discussed in the report **Game Changer II**, from the British Association for Sustainable Sport).[210] Londoners' access to sport will be compromised by climate impacts, with consequences for health and wellbeing.

It is increasingly important to ensure sports grounds are shaded and adapted to deal with heavy rainfall; that people take more breaks in extreme heat and take on water to stay hydrated.

At a roundtable for the Review, representatives from across participatory and professional sports said they would like adaptation actions to be based on consensus. This sentiment was echoed by representatives of London's cultural institutions. Both groups have strong social, convening, and cultural power, and noted that adapting to a changing climate will enable them to continue to perform their important role in London. Both groups said they are dependent on individuals' own awareness of climate risks and behaving in climate smart ways, notably understanding how to protect themselves in extreme heat. Community and charity leaders who work directly with communities must be included in climate adaptation working groups to ensure adaptation does not drive inequities.

Londoners' access to sport will be compromised by climate impacts, with consequences for health and wellbeing.

UEFA Women's EURO 2022. Second day of fan party at Trafalgar Square. CWSA (Collaborative Women's Sports Association). July 24, 2022. Creator: Eleanor Bentall for Transport for London

Case study

Climate Safe Rooms in Australia

Climate Safe Rooms is a community led project in Geelong, Australia, that ran a pilot programme offering "free home energy upgrades for low-income households where at least one resident received home care support services for an existing chronic health condition that puts them at risk from heatwaves and extreme cold."[211]

The project made one room in a house energy efficient, fully insulated, and draft proof, with high efficiency air conditioning and small solar systems to offset running costs. The project retrofitted 16 households and aims to scale up to work with over 1,000 in future. People reported feeling happier and healthier, they visited doctors less often, and electricity bills were reduced by up to 45% in summer.

Cultural bodies, such as the Exhibition Road Cultural Group could drive this work forward by convening a climate working party for London's culture sector. London's grassroots and professional sports organisations, including London Sport could convene a climate working party for the sport and physical activity sector in London. This would deliver actions such as setting temperature thresholds and guidance for sports activities, including actions to take in extreme heat; collaboration on a communications campaign for safe sport in a changing climate; learning from international counterparts already dealing with extreme heat, and driving investment in adapting fields and venues with:

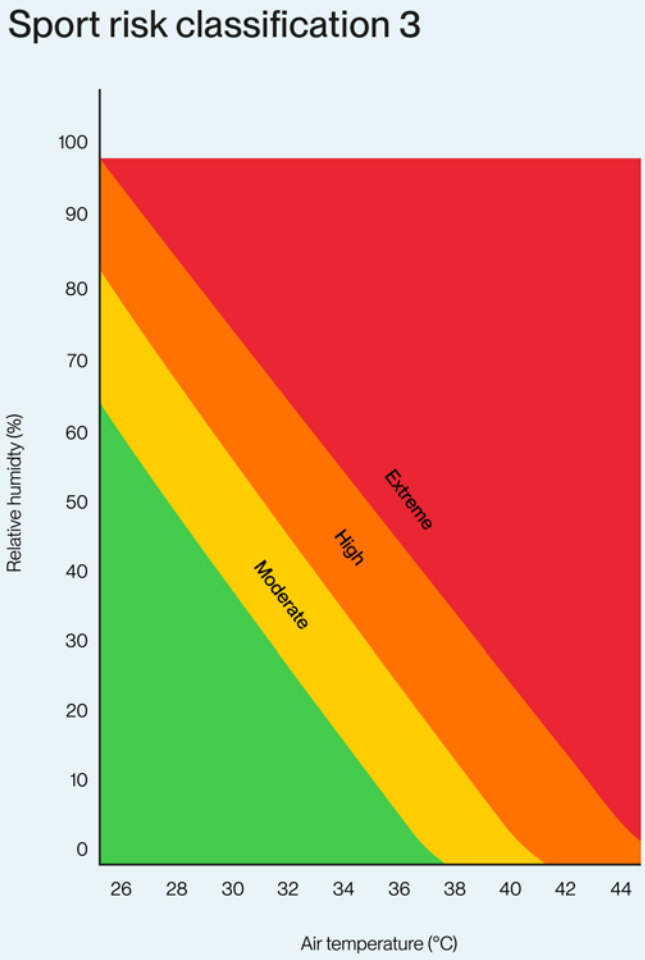
- shade sails,
- water refill stations,
- sunscreen and,
- sustainable drainage.

Community and charity leaders who work directly with communities must be included in climate adaptation working groups to ensure adaptation does not drive inequities.

Case study

Touch Football Australia's "Extreme Heat Guidelines"

Sector specific guidance for people to manage the effects of hotter temperatures and extreme weather can be effective. Touch Football Australia's Extreme Heat Guidelines[212] help people identify their heat risk given the temperature and humidity where sports are taking place. By matching risk ratings with clear information and options to reduce heat stress risks it supports individuals and groups to make informed choices about how to play on, and when to stop.



London's healthcare sector

We have included this section, which is specifically about London's healthcare sector itself, because we received a lot of evidence from people who work in the sector. These submissions talked about the threat that climate shocks pose to people's health, the performance and operations of healthcare systems, and the climate resilience of NHS estates. However, this should not be read in isolation: every chapter of this report is relevant to people's health. The goal should be keeping people fit, healthy and out of the healthcare system as much as possible in the first place.

In September 2023, the GLA's Public Health Unit hosted a workshop bringing together leads from across the healthcare system in London to inform the Review. There was widespread appreciation that climate change is increasingly having an impact on the sector but attempts to forward plan were often side-lined by immediate pressures on acute care, the elective surgery backlog, industrial action, and significant resource constraints as well as lack of awareness and strategic oversight about how local authorities and the NHS should be working together. The Health Effects of ClimateChange report said: "The total costs of heat-related mortalities from climate change and related socio-economic change in England have been estimated at approximately £6.8 billion per year in the 2020s, rising to £14.7 billion per year in the 2050s."[213]

Responsibility for preventing harm to people's health in London is spread across many organisations and communities. The policy levers for adapting the health system exist in many places including the Department of Health and Social Care: NHS England; local authorities; the UKHSA, and the Care Quality Commission (CQC). However, the impacts of climate change are not routinely monitored in health and social care settings, and there is a lack of clear accountability for the management of risks to health. At present the health and social care system, like many other parts of the public sector, is not adequately equipped or resourced to successfully manage more frequent and severe climate shocks as these become business-as-usual. A senior person in the NHS told us: "We had to evacuate over a hundred inpatients who were in beds because of a flood in East London two years ago. And if you've ever thought about moving one patient from one ward to another, that's two porters and a nurse moving a hundred beds. That causes huge system disruption. We don't have a hundred spare beds anywhere."

Emergency response is different to climate adaptation. The UK Adverse Weather and Health Plan shows that the health sector is thinking about the health effects of climate change, but primarily in the response phase. The Civil Contingencies Act requires NHS organisations, and providers of NHS-funded services, to show that they can deal with incidents, including extreme weather events, while maintaining services. This work is referred to in the health community as emergency preparedness, resilience and response (EPRR).[214] However, there needs to be a decoupling of adaptation and EPRR to ensure organisations can prioritise and address both. It would be expected that EPRR teams would have expertise that can contribute to the development and delivery of adaptation planning, but chronic

risks cannot sit with that service as they require strategic policy action across the broader system. UK government and the Mayor should work to reduce reliance on emergency response mechanisms to adapt to climate impacts, by reducing exposure and vulnerability to them.

Lack of clear guidance for adaptation and resilience in London's healthcare system is compounding risks. An NHS staff member told the London Climate Resilience Review "We have been very clear to hospitals: you need to go and make sure the servers are not in the basement because of the flood risk. Guy's and St Thomas' did that and their servers melted in the heatwave." This failure might have been averted with better adaptation planning.

Action is needed at the individual, community, and system levels. The South West London Integrated Care Board said: "Our sites can also be impacted by storms and wetter weather which increase wear and tear to our roofing structures, leading to water ingress. Localised flooding due to heavy rainfall has caused instances of disruption to local health services and supply chains, and the ability of patients to attend medical appointments due to public transport disruption and road closures." This is a system problem, so the system needs to be brought together. The London Health Board aims "to drive improvements in London's health, care and health inequalities where political engagement at this level can uniquely make a difference."[215] As Chair of the London Health Board, the Mayor can convene key actors with the powers and knowledge to drive change in the healthcare sector, this includes senior figures in the NHS, local authorities, communities and technical experts working in the built environment.

The UK's ageing population, and particularly older people over 65 residing in care homes, are at the highest risk of heat-related mortality. Deaths occur across hospitals, domestic housing and care homes, and there is a need for wider understanding of vulnerabilities in all settings.[216]The world's population is ageing. A paper in Nature Communications said: "The age 60+ population is projected to more than double by mid-21st-century - from 1.1 billion in 2021 to nearly 2.1 billion by 2050. By 2050, a projected 21% of the global population will be age 60+..." [And] "Despite extensive research confirming the individual-level effects of extreme heat on older adults' health and mortality risk, older adults' population-level heat exposure has received less attention."

> "Localised flooding due to heavy rainfall has caused instances of disruption to local health services and supply chains, and the ability of patients to attend medical appointments due to public transport disruption and road closures. This is a system problem, so the system needs to be brought together."
>
> The South West London Integrated Care Board

Recommendations

16. **Recommendation for NHS England in London: Provide strategic leadership and coordination to systems in London to allow them to develop and implement adaptation plans and risk assessments. Support identification of "once for London" opportunities.**

17. **Recommendation for Integrated Care Boards: Work with their organisations to collaboratively agree an approach to adaptation risk assessment and planning. Coordinate support required for providers and work with partners to set system level adaptation plans.**

18. **Recommendation for Providers of NHS services: Ensure they have completed a climate change adaptation risk assessment to support development of an adaptation plan.**

19. **Recommendation for the Mayor: Work with the London Health Board to mainstream adaptation action by ensuring that climate mitigation and adaptation are included in any future London Health and Care Vision or strategy, and by considering adaptation in its meetings in 2024/2025 (and beyond). The Mayor could act as a convenor to improve mutual understanding of what London's priorities are for managing the health effects of climate change and preparing the health sector for acute and chronic impacts.**

People who work in the NHS manage risk daily but also have many competing priorities and require guidance to clarify standards and accountability. Without a step-change in the quality of guidance, and resources, provided, adaptation action will continue to be led semi-voluntarily by passionate individuals with different targets, processes, and resources.

The London Health Board is a non-statutory group chaired by the Mayor that brings together elected leaders and professional health leads to drive improvements in London's health, care, and health inequalities. It meets four times a year.

The London Health Board could play an important leadership role by ensuring that both climate mitigation and adaptation are a key part of any future London Health and Care Vision[217] or strategy. The Board could also play a convening role to ensure that risks assessments and adaptation planning undertaken by system partner organisations are brought together to provide a full picture of London's climate resilience for health, and to support the development of a coherent system-wide plan for action. This should include a consideration of:

- The nature and scale of the problem.
- Clarity around roles and responsibilities.
- Identification of opportunities and levers for action across the system.
- Effectiveness of interventions at different scales of implementation.

This would involve multiple stakeholders and we appreciate the GLA's Public Health Unit would require significant resources to support this. However, through the London Health Board, the Mayor can convene actors in London's healthcare sector and connect them with experts from other sectors. The NHS has people who are estates managers,

there are some people in the NHS who think about adaptive measures like cool roofs or green spaces, but not many at the capacity or level of expertise required. This would be the best place to demonstrate and mobilise system leadership for action.

Currently, the London Health and Care Vision, which underpins the Health and Care Partnership and London Health Board's work does not mention climate change, heat, or flooding. By including a specific priority for reducing the health effects of climate impacts on Londoners in the London Health and Care Vision, the Mayor and partners can improve join-up. This would also support the UK's commitment at COP26 to "creating climate resilient, low carbon, sustainable health systems."[218]

There is guidance on producing NHS green plans as well as support and policy for many of the suggested focus areas. However, there is a lack of support, resource, and guidance for adaptation specifically. The Third National Adaptation Programme (NAP3), says the government will "support NHS Trusts and Integrated Care Boards in incorporating climate change adaptation within their Green Plans by 2027."[219]

We have been told the NHS estate in London is "not fit for purpose" and there is a huge gap in investment. The NHS Confederation says "There is currently a maintenance backlog of over £11 billion across the NHS."[220] One member of the NHS told us: "It's really hard to spend any NHS money on that because someone will say that's 15 nurses or that's 12 NICU [Neonatal Intensive Care Unit] cots... there are bits of our estate which would really benefit from some significant investment and I don't think that's something we can easily say... because it is a difficult message for the NHS to say we're spending a billion pounds on this because someone will say, well, why has my aunt not had her hip replaced?"

Adapting London's health care settings to climate change in an efficient manner is an NHS-wide problem and requires specific, ring-fenced, funding from the UK government. There is a lack of capacity and skills to respond to increasingly severe impacts through building design, maintenance, retrofit and green infrastructure. During the health roundtable arranged for the Review, attendees said it would be helpful if the GLA could do more to support the NHS in London. The Review recommends the GLA commission expert technical advice on climate adaptation of health care settings, create case studies, and share best practice. This aligns with Recommendation 28 for the creation of an adaptation accelerator. The Mayor's convening power should be used to ensure that this work benefits all of London's health sector.

> "There is currently a maintenance backlog of over £11 billion across the NHS."
>
> The NHS Confederation

Case study
Health National Adaptation Plan in Bangladesh

Bangladesh is one of the countries which faces the highest climate risk globally and has put in place plans to ensure its health sector is adapting to climate change. It faces extreme hazards and is particularly vulnerable due to its population density and high rates of poverty. In 2018, Bangladesh developed a Health National Adaptation Plan (HNAP), led by the Ministry of Health and Family and the Climate Change and Health Promotion Unit (CCHPU), with support from the World Health Organization (WHO).[221] The goals of this HNAP are to build capacity within the healthcare system to adapt and respond to climate change risks and create partnerships between the health and climate sectors.

The HNAP team conducted two vulnerability and adaptation assessments, which clarified the four largest climate-sensitive threats to health: vector-borne diseases, water-borne diseases, impacts from extreme weather events (primarily food insecurity and mental health), and effects on water, sanitation, and hygiene. The HNAP largely relies on incorporating climate change into existing health systems, rather than building new structures. A five-year action plan is outlined for short and medium-term action health adaptation activities, which requires an estimated budget of $1m USD.

20. Recommendation for the UK Health Security Agency (UKHSA): Ensure responsibility for regional aspects of climate change are clearly defined.

The population density of London means the health effects of climate events present a significant challenge to the capacity of the healthcare system. For instance, in a heatwave, UKHSA has said: “Everyone is at risk from the health consequences of hot weather as high heat directly compromise the body’s ability to regulate its internal temperature. There are certain factors that increase an individual’s risk during a heatwave, for instance concurrent risk factors for cardiovascular disease and greater difficulty cooling down. As such, key groups at risk from hot weather include: older people (65+ years), children, pregnant women, people with long-term conditions, people with disabilities, people with low income or in deprivation, people who are sleeping rough, people with drug and/or alcohol dependence, people with language, culture or context limitations, and in specific settings such as prisons and social care settings.”[222] In a city of nearly nine million people, that means a lot of people needing healthcare support at the same time.

We approached UKHSA for input but were advised that there is no specific resource dedicated to support climate and health action in London. Given the escalating nature of climate risks in London, the importance of place-based interventions, and the high level of risk faced by similarly urbanised populations across the country, we recommend that UKHSA clarify their role in relation to supporting public health action at the regional, city and local level.

In October 2022, UKHSA announced a new Centre for Climate and Health Security which would "offer scientific advice and support to ensure that the impacts of climate change are considered and embedded in the design and delivery of climate change policies across local and national government and with international partners."[223] The new Centre for Climate and Health is the focal point for public health leadership on climate and health issues, and could support a regional approach.

The population density of London means the health effects of climate events present a significant challenge to the capacity of the healthcare system.

Case study
Green social prescribing in Surrey

In 2023, the Surrey Health and Wellbeing Board reported on a two year "test and learn" study to assess the benefits of Green Social Prescribing (where healthcare professionals recommend nature-based interventions to improve the mental health and emotional well-being of their patients).[224]

The report found that:

- Nature and green space play a key role in health creation and the prevention of ill-health
- Lack of equity of access to nature and green space is a health inequality
- Ongoing barriers to accessing nature and green space for health and wellbeing exist
- Nature connectedness is uniquely placed to treat and prevent mental ill-health
- A resilient and accessible nature and health sector requires sustainable funding
- Stronger connections are needed between community-based nature health providers and the healthcare system
- Nature-based workplace wellbeing support for health and care professionals can support a cultural shift towards valuing nature in health
- The management of Surrey's land and water should support human health and wellbeing
- Cross-sector partnerships and empowered communities are key to delivering sustainable green health and wellbeing provision."

Chapter 3

The built environment and infrastructure

The built environment and infrastructure shapes how Londoners experience climate impacts like heatwaves or intense rainfall. In this chapter we consider how London's built environment, such as homes, workplaces, public and commercial buildings, schools, museums, theatres, squares, streets, playgrounds and paths can help us better cope with climate impacts. We also look at infrastructure for vital systems like transport, water, and power, and specific structures for managing climate change like the Thames Barrier and hundreds of kilometres of river defences.

A lot of what needs to be done is known but isn't happening at scale. Roofs can be painted white, made reflective to reduce urban heat island effect, or mounted with solar panels, which provide cooling benefits and generate electricity. At a regional scale, with 10% of roofs greened, a 2.7% overall reduction in stormwater run-off can be achieved, with a 54% average reduction in runoff per individual building.[225] Trees positioned next to buildings can lower internal summer temperature by 4°C, and raise winter temperatures by 6°C, compared to having no trees.[226] In turn, this can lower energy consumption for cooling and heating. The trees in Hyde Park divert up to 3,600 cubic meters of storm water run-off from local sewer systems, and remove 2.7 tonnes of pollutants each year.[227]

Homes and buildings can be more comfortable in extreme heat and reduce pressure on people, health, and emergency services. External shading can reduce temperatures in buildings. Outdoor awnings provide shade and respite on hot days. The Good Homes Alliance and the British Blinds and Shutters Association have said "from any time from the end of the 19th century until the 1950s, most British shopping streets had a layer of awnings floating above the shopfronts."[228] Edwin Heathcote wrote in the Financial Times "As we head into this summer, and the naked London streets bake in the sun, you can't help but feel the city is bereft."[229]

Care homes can be made resilient to heat. The University College London Institute for Environmental Design told us: "It is important to act now to protect vulnerable care home residents from extreme heat. Both structural and simple behavioural interventions, such as window opening, can benefit London care home residents. Overall, a combination of passive interventions, including nighttime ventilation, is required for the maximum possible reduction of overheating, both now and in the future. This is expected to allow London care homes to remain comfortable and safer for longer and delay the need to install air conditioning. Where the implementation of passive measures alone is not sufficient, their combination with air conditioning will enable care homes to maintain a comfortable indoor environment and rely less on energy – and carbon – intensive cooling methods.

Liverpool Street Station, London England
iStock (istockphoto.com)

Making London's built environment and infrastructure more climate resilient can help reduce health and economic risks to people. The Climate Change Committee said: "there is still little preventative action being taken to address health risks from overheating in buildings."[230] In the UK, 90% of hospital wards are estimated to be at risk of overheating.[231] Lambeth and Hammersmith & Fulham borough councils told us there is an increased reliance on air conditioning to cool building stock that is not adapted to higher temperatures. It doesn't have to be this way.

> Trees positioned next to buildings can lower internal summer temperature by 4°C, and raise winter temperatures by 6°C, compared to having no trees.

Maintenance is as important as innovation. The Royal Parks told us climate impacts are increasing pressure on existing resources for maintenance. Climate risks are often discussed in terms of acute, extreme, or catastrophic events, and new capital projects that attract attention. Westminster City Council said: "Westminster typically has capital funding available for the introduction of greening assets and infrastructure but does not have the required revenue funding to support the maintenance of these assets in the long-term."

Everyone has a role to play. Adapting existing buildings will require action from private and social landlords, commercial developers, facilities managers, managers of public buildings and people who live in their own homes. Local actors bring clarity on how to adapt in specific places. Climate Vulnerability and Risk Assessments (CVRAs) can support delivery plans and drive action in neighbourhoods.

Skills are needed to adapt new infrastructure and retrofit existing buildings. London's building stock is underprepared for climate impacts. Under current climate conditions, half of UK homes suffer from overheating risk, with a particularly high risk in London.[232] Across the UK, 80% of buildings which will be occupied in 2050 already exist.[233] This requires a workforce that understands how to manage London's current weather extremes and what climate projections mean for the retrofit, design and development of buildings, homes, infrastructure, and green spaces. Enfield Borough Council said: "We need more ambitious, stronger planning policies for new developments and in relation to retrofitting homes.

More focus is needed on adapting to extreme heat." The South West London NHS Integrated Care Board told us: "The majority of trust estates air conditioning systems are over 10 years old and designed to cope with temperatures up to 30°C, in accordance with Chartered Institution of Building Services Engineers (CIBSE) design guides. Therefore, should the DHSC's Health Technical Memoranda (HTM) be adapted to, for example, stipulate units for healthcare be designed to cope with higher temperatures? (temperatures in SWL exceeded 37°C in 2022)."

Climate change is not fully accounted for in the design of buildings and places, or financial decision making on development and infrastructure. This results in decisions being made which lock in climate risk. Dr Nicola Ranger, Director of the Resilient Planet Finance Lab at Oxford University, said: "Physical climate risks are not fully accounted for in financial decision making which means investment flows into critical sectors like infrastructure, buildings and agriculture may be unknowingly pushing the UK in the wrong direction, as well as leaving the UK financial sector itself exposed to systemic financial risks. These gaps require action by financial institutions but also regulators and government."[234]

At a roundtable hosted by the Better Buildings Partnership commercial real estate owners in London asked for clear priorities to be set in local plans. Attendees agreed that one of the most significant barriers to climate resilience and long-term planning is a perceived contradiction between achieving net zero and climate resilience. They identified the opportunity

In the UK, 90% of hospital wards are estimated to be at risk of overheating.

Areas with higher levels of climate risk also have high levels of deprivation and less access to green space.

to do more if net zero and adaptation were considered together so that cost calculations could be made with a more long-term view. Directives to passively cool buildings and using waste heat to warm residential buildings were said to be under-incentivised.

The Town and Country Planning Association has said the loss of in-house skills in local government undermines the effectiveness of the planning system.[235] Many local authorities identified a lack of staff resources as a barrier to harnessing the planning process to drive climate adaptation outcomes. A skilled, and functioning planning system would support innovation and delivery. Introducing a statutory requirement and investment to support local authorities would create new roles in adaptation.

The GLA's climate risk maps show areas with higher levels of climate risk also have high levels of deprivation and less access to green space.[236] London has more than 8 million trees, covering around 21% of the capital's land area, but this is not evenly distributed.[237] Ashden told us: "The cooling effect of trees in urban settings also addresses heat-related health inequalities. Typically, those on lowest incomes have least access to mechanical cooling, amplifying the importance of green infrastructure." Research by Friends of the Earth found that people of colour make up 65% of the population in neighbourhoods with the least cooling.[238] The Mayor has committed to increasing tree canopy cover 10% by 2050.[239] Action to create more blue and green infrastructure must target areas and communities who are underserved now.

The London Tree Officers Association said limited local authority resources to plan for extreme weather events leads to excess tree loss. Hammersmith and Fulham told us: "...trees and other green infrastructure were significantly compromised during the heatwave in 2022. Many newly planted trees failed because an increased and adaptive watering schedule was not in place". Climate change is increasing the natural environment's vulnerability to pests and diseases in London.[240]

Short term, competitive grants for adaptation projects drain staff time in applications and limit the impact of funding. For example, the National Audit Office's report Resilience to flooding said: "...until June 2023, the amount of work required to include projects in the capital programme was not related to the size of the project. For example, the amount of analysis needed to support business cases was the same for small and large projects and was therefore disproportionately burdensome for smaller projects. This is despite the increased importance of smaller projects to the capital programme. It is only now, almost halfway through the second six-year programme, that Defra and EA [Environment Agency] are considering changes to ensure a more proportionate approach for smaller projects."[241]

Recommendations

21. **Recommendation for UK government: Invest in local planning to address under-resourcing and skills gaps which hinder delivery of climate resilience through the planning system.**

Despite increasing awareness of climate impacts, new developments are being built which do not sufficiently consider London's current or future climate. This puts people, livelihoods, nature and investment at risk. Overheating is not prioritised strongly enough, new developments can contribute to the intensification of the urban heat island effect effect, flood risk and the biodiversity crisis.

There are shortcomings at all levels of the planning system: regulation, planning, enforcement and development. Research by the Centre for Sustainable Energy and the Town and Country Planning Association (TCPA) found that "the planning system has the potential to be a key tool for net zero and climate resilience at the local level but is not delivering on this."[242] There are several reasons that planning in practice is not delivering on the ambitions of local and regional plans to make places climate resilient. Local authorities identify under resourcing and a skills gap as major challenges, demands on local authority planning functions currently outstrip human resources, funding and skills.[243]

Development management control processes, such as planning decisions, must drive sensible outcomes for climate resilience. Climate change must be a material consideration in planning decisions, as well as in plans themselves; this applies to local authorities and decisions referrable to the Mayor. A recent report shows that in England only 36% of local authorities always acknowledge the need to adapt to climate change as a key factor in individual planning decisions. Similarly, only 28% of local authorities fully recognise greenhouse gas emissions as a material consideration in planning decisions.[244]

New weather extremes should be given more weight in the consideration of planning decisions. A statutory duty exists for local and regional planning authorities to consider climate in local plans but this is not driving sufficient consideration of climate in practice. Many local plans in England are out of date, and updates can take years to be finalised.[245]

There is no statutory duty to consider climate change in every planning decision. The Association for Public Service Excellence and TCPA have said that mitigating and adapting to climate change need to be embedded in the priorities of the Planning Inspectorate in England and that the importance of climate change needs to be reinforced through all appeal decisions in order to give local authorities the confidence to place weight on the issue as well.

The previous government planned to simplify planning processes and decision making through the Levelling up and Regeneration Act. In their manifesto, the new government said "We will immediately update the National Policy Planning Framework... We will take tough action to ensure that planning authorities have up-to-date Local Plans and reform and strengthen the presumption in favour of sustainable development". The new government should clarify that climate change is a priority in National Development Management Policies (NDMP) and in the

National Planning Policy Framework. The Mayor and local authorities should respond to consultations on draft NDMPs to advocate for these to be worded in such a way as to allow planning authorities to formulate climate policies going beyond the climate policies included in the NDMPs.

UK government has a critical role to play in ensuring England's planning system is fit for 21st century risks. UK government must invest in local planning, to address under-resourcing and skills gaps across planning and enforcement. Local planning authorities must be sufficiently resourced to fulfil their planning functions. In their manifesto, the new government said: "Labour will support local authorities by funding additional planning officers, through increasing the rate of the stamp duty surcharge paid by non-UK residents". In a speech on 8 July 2024, the Chancellor said: "we will also support local authorities with 300 additional planning officers across the country."[246] Local plans are led by London's local authorities and are "the key documents through which local planning authorities can set out a vision and framework for the development of the area, engaging with their communities in doing so."[247] The Spatial planning for climate resilience and Net Zero report identified 10 adaptation themes through a review of existing evidence relating to local planning.[A] [248] Out of these measures, the research found that only flood risk appears to be considered comprehensively. Respondents to a survey undertaken as part of that work felt the planning system was least effective at dealing with high temperatures and overheating. The adaptation measure least likely to be addressed by local plans is urban heat island effect. The analysis in the report found that the lack of a coherent legal and policy framework for planning and climate adaptation as well as national policy and guidance on climate risk is hindering climate adaptation being addressed as a priority.

Hackney Borough Council told us: "Inclusion of adaptive measures and guidance in supplementary planning guidance should be given the same priority as energy efficiency and net zero." Lambeth Borough Council said there is a need for: "Planning frameworks that have robust minimum standards for climate resilience, adaptation and natural capital, but also allow stronger local standards where required." Overall, evidence submitted to the Review said spatial plans should set demanding adaptation requirements.

UK government has a critical role to play in ensuring England's planning system is fit for 21st century risks. UK government must invest in local planning, to address under-resourcing and skills gaps across planning and enforcement.

A Flooding from surface water; Flooding from rivers and the sea; Sea level rise / coastal erosion; Impacts on habitats, landscapes, and land management; High temperatures and overheating; Urban heat island effect, Water scarcity and drought; Reduced water quality; Health impacts of climate change; Soil degradation.

Southwark Street, London, Creator: Transport for London

The Heritage Challenge

Adapting the built environment and preserving heritage go hand in hand. The planning system must manage change, balancing climate adaptation with other priorities. A significant proportion of building stock in London is protected through heritage classification and conservation areas. Westminster City Council has over 11,000 listed buildings and 78% of its land is within a conservation area.[249] The conservation of historic buildings can result in lower greenhouse gas emissions than demolition and rebuilding, while maintaining local character. Historic buildings need to be resilient to climate impacts to remain in use. Managing the adaptation of historic buildings has been raised as a specific challenge by developers, local authorities, and local area coalitions. Adapting historic building stock is complex, heritage assets can require greater technical demands and more cost,[250] and a lack of capacity and expertise in local planning authority teams can lead to difficulty in identifying suitable solutions.

A lack of capacity and expertise about how to balance heritage and climate resilience in local planning authority teams means that simple solutions (like putting up awnings) are sometimes discarded. It is vital to London's economy that people can enjoy the city's history without putting their health at risk in places that weren't designed for temperatures above 30°C. Many historic buildings are still used as places of work, homes, and other settings. Work should be undertaken to address this barrier, such as identifying shading solutions which protect historic character, case studies, knowledge sharing and the development of clear heritage guidance on adaptation by Historic England.

Case study
H.ID.RA.N.T in Athens, Greece

Athens, in Greece, faces significant climate risks including heatwaves, wildfires and water scarcity. The H.ID.RA.N.T project engaged residents to reimagine a subterranean roman aqueduct to create community green space, increase local access to nature and walking routes.[251] The municipality worked directly with local residents to successfully repurpose this aqueduct, which created 5km of water networks, 10,000 m^3 per year of potable water and 8,500 m^2 of green public spaces near the aqueduct. By co-governing this project with the local community, H.ID.RA.N.T inspired people who are now willing to continue to develop local climate adaptation projects.

The London Plan is the spatial planning strategy for London. It has sound adaptive policies, but we have been told these aren't always delivered on the ground and it would benefit from stronger enforcement powers.

22. Recommendation for the Mayor: Build on the London Plan's leading adaptive policies and ensure that climate change, both adaptation and mitigation, are given greater weight in planning decisions.

The London Plan is the spatial planning strategy for London. It has sound adaptive policies, but we have been told these aren't always delivered on the ground and it would benefit from stronger enforcement powers. Investment in local authorities planning functions by UK government, to enable them to fulfil those planning functions, deliver London Plan policies and drive climate resilience is critical. This requires active consideration of climate resilience at the application stage, as well as ensuring local authorities are resourced to enforce compliance.

The London Plan requires new development to take measures to manage heat risk, flood resilience and water efficiency. This includes promoting and prioritising green sustainable drainage systems (SuDS) wherever possible. The Mayor's cooling hierarchy requires applicants to mitigate overheating risks using passive measures. External shading is strongly encouraged, as is solar control glazing to reduce heat gain. The London Plan's Policy S.I 4 on managing heat risk seeks to reduce the impact of intensification of urban heat island effect. The policy encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and to reduce the intensification of urban heat island effect on an area wide basis.

The Mayor should make climate resilience central to the next London Plan. This is critical to achieving other goals, such as housing delivery and economic growth. London Plan policies should establish that climate change be given greater weight in decisions referrable to the Mayor, in local plans and in planning decisions. This principle will inform local plan preparation and development management. To support this objective the GLA's London Plan team, should be provided with dedicated climate adaptation capacity.

23. **Recommendation for UK government: In line with the Environmental Audit Committee's recommendation,[252] expand Part O of the Building Regulations to refurbishments.**

Housing should maintain safe and healthy temperatures in hot weather. Developers and existing housing providers should consider up to date climate projections, so that people's homes are fit for today's weather and for the coming decades. The new government's election manifesto said: "We will take steps to ensure we are building more high-quality, well-designed, and sustainable homes and creating places that increase climate resilience and promote nature recovery." This should involve updating Part O of the building recommendations. We heard from one housing provider who asked to remain anonymous that homes built in 2023 were overheating even in 2023's comparatively mild summer.[253]

Approved Document O (Part O) of the building regulations came into effect on 15 June 2022. It is the first (and welcome) piece of legislation of its kind in England that covers the overheating mitigation requirements for new residential buildings. Part O only applies to new residential buildings.[254] It aims to include all aspects of passive overheating design, including limiting unwanted solar gains in summer, and to remove excess indoor heat. Part O is a good starting point, now it should be applied to existing as well as new buildings.

The Environmental Audit Committee's (EAC) report **Heat resilience and sustainable cooling report** said "We support the extension of Part O of the Building Regulations not only to cover material changes of use to residential, but also for refurbishments of existing properties."[255] The EAC's full recommendation reads: "We recommend that the Government clarify whether it is intended that Part O of the Building Regulations be expanded to refurbishments. If that is indeed the case, we recommend that Ministers, in their response to this report, set out when, and by what mechanism, this is to be achieved. If it is not the case, we recommend that Ministers explain how the UK is to achieve Commitment M5 of the Global Cooling Pledge."[256] The learning from implementing this recommendation could help preserve London's heritage for residents and visitors. Warmer days have the potential to unlock certain parts of the economy, such as tourism, retail, construction, and hospitality,[257] and some historic buildings already offer cool temperatures in heat, like churches. But the benefits of sunnier weather also come with a cost. UK Government have responded to the recommendation, outlining that they are running further calls for evidence on Part O as part of the Future Homes and Buildings Standards consultation.

The Valuation of Risks and Opportunities in the UK's 3rd Climate Change Risk assessment has found that the monetary values associated with flooding (river, surface and coastal) and of extreme heat and cooling demand in the UK have estimated costs of £ billions per year- Monetary Valuation of Risks and Opportunities in CCRA3.

A 2.5–2.9°C global temperature rise above pre-industrial levels this century will increase disruption to services from severe weather in London so people should be informed about the levels of service they can expect in the future.

24. **Recommendation for UK government: The Decent Homes Standard and Future Homes Standard should set out specific measures for climate resilience with explicit requirements for managing excess heat (cooling), ventilation, water efficiency, flood resilience and biodiversity. The updated Decent Homes Standard must be accompanied by investment from UK government to bring existing homes to this standard.**

The Monetary Valuation of Risks and Opportunities in CCRA3 report said the impact of extreme heat, notably in terms of health and wellbeing (including fatalities) and overheating in the built environment (residential and business), impacting either in terms of discomfort / reduced productivity, or increasing cooling demand for households and business could run into the billions per year.[258] The average cost of flooding to a home is £30,000.[259]

The new government's election manifesto said: "Labour will also work with the private sector, including banks and building societies, to provide further private finance to accelerate home upgrades and low carbon heating." The updated Decent Homes Standard (DHS) and Future Homes Standard (FHS) should ensure homes are fit for the UK's changing climate. They should consider up to date climate projections and require that housing can maintain safe and healthy temperatures in extreme heat. This should involve updating Part O of the building regulations. The standards should also have a presumption in favour of passive design, nature-based solutions, and adherence to the 'cooling hierarchy' wherever possible, to ensure mechanical ventilation is prioritised over air conditioning.

Standards should specify flood resilience measures for homes in areas of high flood risk. UK government must provide clear guidance and incentives for landlords to support them to meet standards, and to local authorities to support them to enforce the DHS and FHS. The UK government must regulate to drive investment in existing homes, and funding should be available to social landlords and housing associations to meet these standards.

25. **Recommendation for UK government: In line with the Second National Infrastructure Assessment (Recommendations 28 to 31) by 2025, government should work with relevant sectors and update resilience and technical standards above and beyond the minimum projected rise in global temperatures.**

A 2.5–2.9°C global temperature rise above pre-industrial levels this century will increase disruption to services from severe weather in London so people should be informed about the levels of service they can expect in the future. Recommendation 1 shows how the Mayor can help prepare people and infrastructure in London, but national government has a vital role in setting resilience standards and targets for key climate risks such as flooding and heat.

For example, in July 2022's heatwave the East Coast mainline was temporarily disconnected from King's Cross; this was not an acceptable level of service but given more regular and severe hot weather in the south east, it may be that rail operators are permitted to run a slower, reduced service in the future. TfL has said to the Review that they would like more clarity about minimum levels of service UK passengers should expect under different extreme event conditions in the future as this would help all transport providers to align their plans. The London Borough of Havering suggested to the Review that the Mayor "share technical experience on infrastructure resilience given the predicted increases in temperatures which may require new materials and techniques to build in resilience in the future."

The Institution of Mechanical Engineers has said: "although it is relatively easy to agree at an early stage of project procurement that the design needs to be 'resilient' to hazards, the reality is that heat impacts, vulnerability and risks cannot be addressed using many current standards and design codes, due to their reliance upon data for the past climate."[260] The Institution for Civil Engineers, the Climate Change Committee, and the Fabian Society with the Association of British Insurers (ABI) have all called for resilience standards.[261]

The Second National Infrastructure Assessment makes practical recommendations (Recommendations 28 to 31) for how resilience standards and technical standards should be updated.[262] Deciding appropriate timelines for action is a sector specific activity. Decisions should depend on the lifetime of assets. Government and regulators should be working with experts to set basic expectations and legal requirements, but it is currently losing time. The Second National Infrastructure Assessment said: "The government has committed to publishing resilience standards by 2030, but this will miss the next round of regulatory cycles…"

so "If government does not set out clear service standards until 2030, around £400 billion of future investment in infrastructure may not be optimised fully for resilience."[263, 264, 265]

The new government's election manifesto said they will develop "a ten-year infrastructure strategy, aligned with our industrial strategy and regional development priorities... [And] We will work closely with business to map and address the delivery challenges we face. We will create a new National Infrastructure and Service Transformation Authority, bringing together existing bodies, to set strategic infrastructure priorities and oversee the design, scope, and delivery of projects." This work must include updating resilience and technical standards above and beyond the minimum projected rise in global temperatures.

26. **Recommendation for UK government: Enact Schedule 3 to The Flood and Water Management Act to ensure that Sustainable Drainage Systems (SuDS) are considered and used to manage surface water, ensuring resilient drainage systems for new developments in both urban and rural areas.**

This was originally Recommendation 12 in our interim report. Since then, there have been developments, so we update it here.

In the Jenkins Review of the arrangements for determining responsibility for surface water and drainage assets, David Jenkins wrote: "I have found that it is not possible to go far into a conversation about surface water flooding before someone brings up the issue of Schedule 3 to the Flood and Water Management Act 2010."[266]

Schedule 3 "provides a framework for the approval and adoption of drainage systems, an approving body (SAB), and national standards on the design, construction, operation, and maintenance of SuDS. Also, it makes the right to connect surface water runoff to public sewers conditional upon the drainage system being approved before any construction work can start."[267]

In the foreword to the previous government's **Review for implementation of Schedule 3 to The Flood and Water Management Act 2010**, the then Defra Secretary of State wrote: "The Government will now consider how Schedule 3 will be implemented, subject to final decisions on scope, threshold and process. A public consultation later this year will help to shape the new approach, with implementation expected during 2024."[268] In our interim report we said: "London needs to see this expectation realised."

In 2022, the National Infrastructure Commission said that "by the end of 2023, government should implement Schedule 3 of the Flood and Water Management Act 2010 and update its technical standards for sustainable drainage systems."[269]

In March 2024, the previous government said that it "partially accepts this recommendation... [and] We expect to consult on these matters by spring 2024 and aim to have finalised the implementation pathway by the end of 2024."

The new government's election manifesto said: "Without action, flooding and coastal erosion will pose greater risks to lives, livelihoods and people's wellbeing. The Conservatives' poor risk management,

and a disjointed approach across government and regulators have left Britain badly exposed. Labour will improve resilience and preparation across central government, local authorities, local communities, and emergency services." We urge the Environment Secretary to sign-off all relevant action at pace.

The need for pace is urgent. Speaking to the Public Accounts Committee in November 2023, the Chief Executive of the Environment Agency said: "we have been saying for a while that rainfall levels and intensity are going up. We had the highest ever rainfall recorded in England earlier this year, in Devon. We had the highest ever rainfall recorded in the UK earlier this year, in eastern Scotland. In Storm Babet, we had maybe 15 cm of rain in South Yorkshire on that one day, which is the most in 139 years of record-keeping... [and] When you have rainfall that can be 15 cm in one day, almost anywhere could be at risk."[270]

Thames Water's evidence to the Review said: "A SuDS first approach should be adopted and preference for nature-based infrastructure should be installed across the capital, ranging from water butts in people's homes, to rain gardens in the streets, and the creation of new wetlands. The DWMP [Thames Water's Drainage and Wastewater Management Plan] aims to deliver SuDS to over 7,000 hectares of land in London over the next 25 years, the equivalent of more than 10,000 football pitches, to help combat the loss of 'spongy' green surfaces." However, Thames Water's plan shows that they also plan to carry out most of this after 2040 and they are open about the fact that much of this work will need to be delivered by others.[271]

Given the acceleration in surface water risk in London, action needs to be taken at a strategic London level to deliver this scale of integrated water management much sooner than 2040. The National Infrastructure Commission has said: "It will also be vital that Ofwat enables water and sewerage companies – who own and operate underground drainage on which we will rely – to invest in solutions to address surface water flooding, including nature-based drainage systems. This will require them to work closely with local authorities to protect the people in the areas they serve."[272]

> "We had the highest ever rainfall recorded in England earlier this year, in Devon. We had the highest ever rainfall recorded in the UK earlier this year, in eastern Scotland. In Storm Babet, we had maybe 15 cm of rain in South Yorkshire on that one day, which is the most in 139 years of record-keeping..."
>
> Philip Duffy, Chief Executive of the Environment Agency

The Thames Tideway Tunnel and flash flooding

To manage flood risk in London you need many small interventions not large-scale capital projects. Some organisations' evidence expressed hope that the Thames Tideway Tunnel, the 25-kilometre tunnel being built to intercept, store and ultimately transfer sewage waste away from the River Thames will help manage surface water flooding.

Tideway told us: "The Tideway Tunnel by itself should have no impact on surface water flooding as it intercepts combined sewer overflow discharges just before they enter the river. Surface water flooding occurs when the volume of rainfall exceeds the capacity of the drainage system and/or is unable to soak into the land. As such, the water that cannot enter the sewage and drainage system cannot be intercepted, stored and taken away for treatment by the tunnel... The tunnel could perhaps assist with mitigating surface water flooding but there would have to be significant investment upstream to direct stormwater to the drainage system and the combined sewer overflows intercepted by the tunnel."

27. **Recommendation for the Mayor, TfL, Mayoral Development Corporations, local authorities, social housing providers, UK government, businesses, National Highways, Business Improvement Districts, landowners and managers: Prioritise action to adapt existing buildings and create climate ready streets and roads.**

Climate impacts are widely experienced across London's built environment, and there is strong understanding that these impacts will become more severe and frequent. Despite this, delivery of adaptation interventions at pace and scale are lagging. The reasons for this gap include the cross-cutting nature of adaptation; a lack of funding and finance; competing priorities and staff capacity, particularly in the public sector; overly theoretical adaptation information which does not support practical action, and a lack of clarity on which actions are most urgent.

Recommendations 1 and 2 aim to address these issues through creating a shared adaptation framework for the region, including setting out roles and responsibilities. Urgent delivery action is needed in parallel. Existing data and partnerships should be harnessed to deliver robust and effective climate adaptation and build on work already underway. Across London there is enough data and information available on climate hazards, exposure, vulnerability, and possible responses to step up delivery action.

Priority should be given to the adaptation of existing buildings and to ensuring streets are climate ready and contribute to London's

climate adaptation. This will require action and investment at all levels, and particularly from building owners and estate managers. National Highways, local authorities and TfL should ensure upgrades made to London's roads and streets consider climate projections and drive adaptation outcomes- rather than investing in "like for like" replacement.

Cross sector collaboration should be prioritised. Neighbourhoods are places where Londoners interact with buildings, transport and green spaces. The Borough of Southwark said there should be "... the introduction of holistic or spatial neighbourhood-level or area-based climate adaptation 'master plans' (similar to Local Area Energy Plans (LAEPs)) that brings together multi-sector action in neighbourhoods with the highest climate risk, particularly from overheating and in need of retrofitting. This could include approaches to delivery, prioritisation and co-design of projects."

At a series of roundtables hosted by the Review, attendees agreed that action must be undertaken to enable stakeholders to co-deliver neighbourhood scale adaptation projects that aim to build collective capacity.[273] London's private sector, including major landowners and developers, should engage with local authorities and other local partners, like Business Improvement Districts (BIDS) to co-deliver adaptation projects and work towards climate resilient neighbourhoods.

Built environment adaptation delivery interventions should commence as quickly as possible and organisations across London should embed adaptation into projects already planned or underway. These interventions should be designed to deliver training and employment opportunities to Londoners. There are several opportunities where existing work and research can be built upon to fast-track adaptation delivery. London's major landowners and managers, including Mayoral Development Corporations, private land managers and developers, must deliver adaptation on their sites, through new developments and improvements on existing developments.

Climate Ready Buildings

Adaptation of existing buildings should be a priority for delivery. The Mayor has led work that provides a strong foundation of evidence to help London organisations make the case for investment and action. This includes:

- Roofs Designed to Cool
- Properties Vulnerable to Heat Risk
- Care Home Over Heating Audit Pilot
- Climate Resilient Schools

Evidence submitted to the Review highlighted the need to prepare London's buildings for climate change. The London Borough of Haringey said it was important that "Addressing inequalities and targeting support for the most vulnerable / less able to adapt and in areas of highest heat risk (Retrofitting areas of higher risk i.e., care homes, schools, nurseries, specific housing stock) – speed up any evidence research that will help to identify building stock most at risk and help to prioritise)." Westminster City Council said "...the age profile of social

housing stock means they are not designed to deal with extreme heat, which creates challenges for effectively cooling homes to help minimise risk to resident health. For example, there is often very limited external shutters and insufficient ventilation, which can be exacerbated by south facing flats with large window areas." Lambeth Council said there is "... very little focus on how homes and community should be adapting to prepare for climate risks, e.g. minimising solar gains, reducing heat risk, cross ventilation and implications for home works."

Retrofit delivery programmes should be developed for those most at risk from climate impacts. We recommend social homes, health settings, social care settings and education settings be prioritised.

Climate Ready Streets

Harnessing London's street space to drive climate resilience is also a priority for delivery. All actors who influence street space have a role to play. London's major landowners and developers, BIDS, National Highways, TfL and local authorities can drive action.

The Mayor should build on the Green and Healthy Streets fund and work with TfL, local authorities and other partners to develop delivery programmes to ensure London's streets, roads and wider public realm are contributing to increased climate resilience. TfL should lead on roads and streets within its control to ensure they are designed to cool, using nature-based solutions, permeable materials and strategically placed reflective surfaces.[274]

Lambeth Council told us roads and streets are underutilised for climate adaptation: "Street space in particular, is currently governed by outdated legislation, Highways Act 1980 and Traffic Management Act 2004. These have very little consideration to the role streets need to play in ensuring climate resilience in dense urban environments. A Healthy Streets Act, or something similar, that ensured highway authorities nationally had a duty to make necessary adaptations would be of great benefit."

Case study

Better Buildings Partnership (BBP) Climate Resilience Guide

In 2022, the BBP launched the BBP Climate Resilience Guide. The guide combines industry guidance, case studies and a framework for defining, measuring, and reporting on climate resilience in real estate portfolios. Central to the guide is the integration of climate mitigation, adaptation, and disclosure commitments. It emphasizes the significance of producing and publishing a climate adaptation plan and outlines eight key themes for plans. These include identifying physical and transitional climate impacts, quantifying climate value at risk, integrating adaptation into the investment life cycle and considering the interaction between adaptation and nature and social outcomes.

Case study

Paris, 2-in-1 Drinking and Misting Fountains

In 2023, Eau de Paris, the public water service company for Paris, announced a plan to deploy 120 2-in-1 fountains that will provide drinking water and misting services which lower body temperatures during extreme heat events.[275] Some 50 of these fountains will involve renovation of the historic and cultural Wallace fountains to add a misting capability,[276] while the remaining 70 will add new locations or replace damaged fountains with a new Mât-Source fountain. By integrating these fountains into historical public spaces, this project ensures that these fountains will be used and appreciated by Parisians and visitors.

Case study

Tokyo, Japan, Cool Pavements

As pavements were undergoing reconstruction in preparation for the 2020 Olympic Games in Tokyo, Japan, the Metropolitan Government used innovative technologies to reduce the surface temperature on their roads.[277] This project used two methods: thermal-barrier coating on top of pavement that reflects solar radiation, and water-retentive pavement that enhances water evaporation. This created 84km of cool pavement, with 64km of thermal-barrier coating and 19km of water-retentive pavements. Thermal barrier coating and water-retentive pavement are shown to reduce the surface temperature by up to 8°C and 10°C, respectively.

28. Recommendation to the Mayor: Create an "adaptation accelerator" programme which supports organisations to develop climate action plans, as well as the development and delivery of projects.

Adaptation action is underway across London but it is inconsistent and there are barriers. Organisations need support to understand current and future climate risks, to identify, assess and select actions to take at a local level, and support to develop and implement projects. The Mayor should develop an 'accelerator programme' which provides direct support. The accelerator programme should build adaptive capacity in organisations, require locally led action and community engagement where possible. It should be informed by climate risk assessments.

The accelerator should prioritise organisations facing high climate risk, and could be identified using leading work by the Mayor including the GLA's Climate Risk Maps,[278] 'Properties Vulnerable to Heat Impacts in London',[279] and the Mayor's Care Homes Overheating Audits.[280]

Supported projects should share findings on the costs and benefits of adaptation action in London to build data, support decision makers, and catalyse wider action. The accelerator programme could build on existing good work such as the Climate Resilient Schools Programme which provides a model for taking a place-based approach to adaptation.[281] The programme could roll this model of support out to other settings, such as social housing or care facilities. An adaptation accelerator should support locally led adaptation plans and build community engagement: the Future Neighbourhoods 2030 programme funded delivery of community co-designed plans and strategies in twelve climate vulnerable communities, including Somers Town and Notting Dale, to shape greener, healthier, more resilient neighbourhoods.[282] An adaptation accelerator could support development of such neighbourhood strategies, as well as implementing adaptation actions in strategies.

Battersea Power Station, London
Creator: Transport for London

Case study

Seville, Spain, Canvas Awning Project

Seville in southern Spain can be exceptionally hot in summer and climate change is making this problem worse. In 2022, Seville City Council announced a project to expand canvas awnings over the streets of its historic district.[283] The awnings help locals and tourists stay cool during extreme heat, and will be provided and maintained by a private company that will receive €810,000 over three years.

29. **Recommendation for UK government, the Mayor, and local authorities: Ensure both net zero and adapting to climate change are considered in all building upgrade policies and programmes and national funding is made available to support delivery.**

London's built environment needs to be upgraded to cope with extreme weather. This should be a priority in all strategies to upgrade building stock; reflected in policies and programmes including, but not limited to, work to decarbonise buildings.

Many of London's homes, workplaces, public buildings, recreational and leisure settings will need some climate adaptation to remain healthy and safe places where people want to live and are being targeted by other building upgrade schemes. Adaptation action must be delivered at scale and pace. Failure to integrate adaptation into building upgrade policies and programmes, such as energy efficiency retrofits risk duplication of effort and increases exposure to climate hazards.

Efforts to upgrade building stock are missing opportunities to incorporate climate adaptation measures. Westminster City Council told us that "As properties in Westminster need to be retrofitted to improve their energy efficiency, flood resilience and be adapted to overheating, this provides a new and complex challenge for the Council to deliver." This challenge must be dealt with at all levels by UK government, the Mayor, and local authorities. The London Borough of Southwark told us the financial cost of retrofitting existing public sector housing, buildings and places in the borough so that they will be ready for climate impacts (and are reducing greenhouse gas emissions) will be challenging.

Existing funding programmes should expand their objectives to include climate adaptation alongside other aims, making them safer, healthier, more affordable to run. London Borough of Brent's housing service use "the Social Housing De-carbonisation fund to invest in some of our worst performing blocks and through improved energy efficiency seek to stabilize the temperature in residents' homes."

Where funding is awarded for the upgrade of large estates there should be a requirement to assess and install adaptation measures. For smaller interventions, guidance should be developed for applicants on how domestic, and public sector building upgrades to address energy efficiency can incorporate adaptation actions.
In the absence of national leadership the Mayor should explore how 'top up funding'

schemes could support recipients of other building upgrade funds to incorporate adaptation action at the same time.

30. **Recommendation for the Mayor, GLA Group, local authorities: Public bodies in London should incorporate subsidence risk into their plans and take a risk-based approach.**

Subsidence is a considerable climate risk in London. The British Geological Survey (BGS) has said: "Most susceptible are properties in the highly-populated London areas, particularly in northern and central London boroughs, and Kent in the South East. Projections suggest that the number of properties in London likely to be affected by climate will rise from 20 per cent in 1990, to 43 per cent by 2030, and almost 3 times 1990 values (57 per cent) by 2070."[284]

Aviva's **Building Future Communities Report 2021** said: "Between 2016 and 2021, the data also shows a sharp increase in claims for subsidence: when the ground beneath a property sinks, pulling the foundations down with it. A major reason for this could be hotter and drier summers causing soil shrinkage."[285]

Thames Water said: "The weather conditions during 2022/23 have challenged us operationally and we're not where we'd like to be on leakage. The hot and dry summer last year created an unprecedented 'soil moisture deficit'. As the ground dried out, our pipes and our customers' pipes moved and cracked, leading to an increase in leakage."[286]

Despite climate and subsidence risk in London being reported in the media on a semi-regular basis, many organisations beyond the insurance industry do not appear to be considering the risk. We recommend organisations, including local authorities, incorporate subsidence risk into their climate plans. There are subsidence maps available, such as BGS's Property Subsidence Assessment dataset, which could be used for risk awareness.[287]

We recommend local authorities and others first take a risk-based approach, but an appropriate geotechnical survey to review the underlying geology, moisture contents and local root demand when considering potential development will be necessary in some places.

31. **Recommendation for UK government, Ofwat and water companies. Plans must be developed to secure the investment and deliver the action required to meet 1 in 500-year resilience standards to droughts.**

London's water supply must be resilient to hotter, drier summers, and periods of extreme heat. Increasing London's water security will require action to reduce leaks across water infrastructure, new supply options and significant water efficiency increases through smart metering, behaviour change and regulation for appliances. Thames Water forecasts a shortfall of over 1 billion litres of water by 2050, equivalent to the water needed by around 3.5 million people. Thames Water say 24% of their water supply is lost to leakage across infrastructure, customer pipes and unmeasured consumption.[288]

Using water more effectively accounts for their plans to address 80% of the forecast shortfall, through fixing leaks, installing smart

meters and working to enable behaviour change. We are concerned that while these challenges are understood, current action does not reflect the scale of the problem.

This risk is increasing due to climate change. Recent heatwaves have demonstrated that demand shocks pose a significant risk in England. Thames Water said in July 2022 "London saw temperatures exceed 40 degrees, [and there was] a 50% increase in water consumption and our reservoirs were at their lowest for 30 years." This incident highlights the need to invest in London's water supply and storage infrastructure, as well as parallel action to reduce leakage and consumer demand for water.

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Behaviour change and reducing demand

The UK government's National Framework for Water Resources has set the target to reduce average personal water consumption to 110 litres per person per day by 2050.[289]
The average water used per person per day is 142 litres in England, this compares with 105 litres per person per day in Denmark.[290, 291]

Low awareness about drought in London compounds risk because people won't know what to do when it is vital to change their habits at speed. Asking the public to be more water efficient at a time when leakage is so high, water bills are going up, and winters are getting wetter is going to be politically challenging, but it would be deeply irresponsible to avoid action. The Chartered Institute of Water Managers (CIWEM) has said: "CIWEM believes that people throughout the UK are insufficiently aware both of the possible impact of drought and measures that they can take to help to reduce its effect. Understandably, water suppliers are reluctant to alarm their customers but it is important to understand that there can be a risk of restrictions to water supply."[292]

Public engagement informed by behavioural science is needed to reduce demand. Ofwat is currently consulting on its proposed Water Efficiency Fund, a "fund of up to £100 million to help stimulate a transformative, sustained and measurable reduction in water demand nationally, using a range of water efficiency approaches."[293] The Mayor, all water companies that serve Greater London and the South East, local authorities and not for profits should engage with this consultation.

London is an ideal region to pilot a targeted programme of behaviour change, due to its population density, high water consumption and the higher likelihood of drought and water shortage. Smart metering is a critical component of addressing consumer demand for water. It can help households and businesses to take control and to identify leaks. Efforts to install smart meters should be accelerated across London. It is also important to further explore methods of water recycling such as Direct Potable Reuse and grey water systems.

As we push for more water efficiency, we want to stress that this is not all aimed at homeowners. The market-operator MOSL has said: "the top 1% – 13,800 NHH [non household] users – use 1.37 billion litres of water per day. That's half of the total consumption of the market and the equivalent of the average consumption of 9.1 million household customers."[294]

Non household users – use 1.37 billion litres of water per day. That's half of the total consumption of the market.

Further, those higher water using businesses pay less than everyone else for that additional water use. Ofwat says "If you use more than a specified amount of water, you may be able to opt for a large or intermediate tariff, instead of paying the standard charges."[295] While Ofwat have put in place measures so that businesses are disincentivised from using more water to qualify for this tariff, the more water consumed the cheaper it gets and the incentive to reduce water usage is less.

Investment in existing water infrastructure

The water sector in England is complicated, with responsibilities fragmented between many different agencies. This limits London's ability to take a truly transformative approach to managing water resources. While the issue of water scarcity is well understood by the professional water sector, the current regulatory model does not enable sufficient action to address it. The Second National Infrastructure Assessment finds that "Without action, there will also be an over 4,000 mega litre per day gap between the demand and supply of water by 2050. Government should follow a twin track approach to drought resilience, by managing demand and increasing supply. Both reducing demand, including leakage, and providing new water infrastructure will require additional investment in the upcoming sector Price Review 2024 and beyond."[296]

Ofwat must lead on action to set out a plan to drive the investment needed to meet 1 in 500-year drought resilience standards. Proactive resilience action is a sound investment, analysis for the National Infrastructure Commission suggested that

proactively preparing for a drought with a 0.2% annual probability may cost half of the amount that emergency measures would cost. There is a 6% chance of such a drought in the next 30 years.[297]

At the same time, London's water companies must accelerate efforts to identify and address leakage across water networks. Thames Water told us they would like to be allowed to move to an "ongoing programme of mains renewal" and said: "We know that more than 2,000km of distribution mains need replacing as a priority, and this number grows by around 120km per year."

The whole of the south east of England needs a new reservoir

In England, if no action is taken by 2050 the nation's public water supply will face a shortfall of nearly 5 billion litres of water per day.[298] Water Resources South East said: "the South East could account for around 50% of the UK's future water demand. Our estimates show we could need an extra 1 billion litres of water per day over the next 15 years."[299]

Transfers to the south east from other UK regions have been suggested but require significant investment in new pipelines and other infrastructure and have implications for the water resilience of other places. The new government's election manifesto said: "We need to forge ahead with new roads, railways, reservoirs, and other nationally significant infrastructure." The South East Strategic Reservoir Option (SESRO) is a planned new reservoir in Oxfordshire with a capacity of 150 million cubic meters. The scheme is currently undergoing detailed engineering, design and environmental studies to develop the scheme prior to a formal planning application. If approved, it is currently forecasted to be complete by 2040.

SESRO is critical to the south east's water security and should be taken forward under Specified Infrastructure Project Regulations (SIPR), as opposed to direct procurement for customers (DPC) which "involves a water or wastewater company competitively tendering for services in relation to the delivery of certain large infrastructure projects."[300]

For an infrastructure project to be delivered with SIPR, "the Secretary of State or Ofwat must be of the view the project is of a size or complexity that threatens the incumbent water company's ability to provide services for its customers; and specifying the infrastructure project is likely to result in better value for money than would be the case if the infrastructure project were not specified."[301] Lessons could be learnt from the Thames Tideway Tunnel, another significant infrastructure project for London delivered with SIPR.[302]

SESRO is deliverable by 2040, but time is tight. The Mayor should continue to advocate for government, and Ofwat, to ensure this is not delayed. In the meantime, Thames Water told us that in order to "increase the resilience of our customers' supplies to drought events we will need a water recycling scheme in London from the early 2030s onwards."

32. Recommendation for the Mayor: Continue work on the development of sub-regional integrated water management strategies and convene partners to deliver the East London pilot strategy.

The previous UK government's Plan for Water says: "The best way to manage supply and pollution pressures is by taking an integrated approach across a whole catchment."[303] London's pilot Subregional Integrated Water Management Strategy (SIWMS) for the Lower Lea is a leading example of integrated water management.[304] It has been developed in partnership between the GLA, Environment Agency, Thames Water, Natural England, Enfield, Waltham Forest, Hackney, Haringey, Tower Hamlets, Newham and the City of London. The strategy is a non-statutory, dynamic planning level framework that sets out actions and is responsive to changing conditions. The GLA could undertake research into how the methodology for the East London pilot could help develop further integrated water management strategies for London and at what scale (for example, the Thames Basin, sub-regional or catchment scales).

The Mayor could convene partners to deliver the East London IWMS. This could be through a place-based integrated water management forum, with executive level support from partners and enabling officers to confidently dedicate their time to implementation. Stakeholders could explore options for investment.

33. Recommendation for UK government: Based on the work of the London Surface Water Strategic Group, UK government creates a Strategic Surface Water Authority for London, led by an independent and non-political Chair, to promote, enforce, and allocate funds in-line with a strategic London-wide approach to flooding.

No single entity has responsibility for surface water flooding across London. Defra's Surface Water Management Action Plan says: "Defra will review the funding sources which are available for surface water risk management, considering how spending by water and sewerage companies, local and central government and others can best be directed to reduce surface water flood risk and whether the mechanisms are appropriate for these types of projects."[305]

The Review team believe the UK government should review mechanisms for funding surface water projects, taking into consideration the most appropriate mechanisms for cities. London is an appropriate place to pioneer a new approach for urban areas: it is the smallest region in the UK by land area but with the highest population density and 33 separate Lead Local Flood Authorities all operating within the Thames catchment. Of these, 6 currently don't have a flood officer and outsource the work.

The strategic, physical and governance problems are recognised by key actors in managing London's surface water flood risk. The London Surface Water Strategic Group is funded by organisations including TfL, the GLA, Thames Water, local authorities

via local levy and the Thames Regional Flood and Coastal Committee.

This voluntary group shows that organisations can agree and be productive on some aspects of managing surface water flooding, but the voluntary concord of the group is likely to be severely tested as the public increasingly demand accountability for loss, damages, and fatalities. To accelerate delivery a strategic approach to action and the distribution of resources should be embedded in law. We are aware that not all members of the group support this recommendation.

A Strategic Surface Water Authority would help ensure a joined-up approach was locked-in to London's governance and could direct partnership funding to the most impactful projects across the 33 local authorities.

London is an appropriate place to pioneer a new approach for urban areas: it is the smallest region in the UK by land area but with the highest population density and 33 separate Lead Local Flood Authorities all operating within the Thames catchment.

Case study

RiverSmart, Washington DC, USA

Launched in 2008 by Washington DC's Department of Energy & Environment, RiverSmart provides technical assistance and financial incentives to property owners to install green infrastructure to reduce stormwater runoff. Eligible practices include rain barrels, green roofs, rain gardens, permeable paving and trees for shade. These practices keep rainwater on site enabling it to soak into the ground, diverting rainwater from the sewer system and waterways and allowing soils to remove pollutants. RiverSmart has programmes specifically aimed at homeowners, schools and communities.

Participating homes receive a sign that is placed on their property to raise awareness about the programme. RiverSmart Homes has installed over 20,000 green features on residential properties since 2008, managing an estimated 12 million litres of stormwater. Homeowners who pay the upfront the cost to install green infrastructure can apply for partial reimbursement from DDOE, up to $9,300. Participating property owners receive a rebate on DC's stormwater fee of $15 per sq ft for voluntary installations of green roofs.

Selected schools receive schoolyard greenspaces worth $3,500-$170,000; $500/year for five years for site maintenance; $100 stipend for teachers

that attend green infrastructure training and participate in at least one community action day; technical assistance; and a boat trip for students on the Anacostia and Potomac River.

Non-profit organizations and houses of worship can receive grants to install green infrastructure systems and educate the public about stormwater issues.

RiverSmart programmes are awarded annually on a first-come, first serve basis via an open application process with clear eligibility standards. Participants who install green stormwater infrastructure are also able to receive a discount of up to 55% off DC's stormwater fee and up to 20% off the impervious area charge. As of 2022, these programmes have retrofitted more than 4,000 properties.

The permeable fraction of the total urban area [in England] has decreased from 63% in 2001 to 54% in 2022.

34. **Recommendation for UK government: As part of the UK government's review into managing the surface water impacts of increases in impermeable surfaces in public and private spaces, consider introducing stormwater charges for people who pave over gardens and incentives to remove paving.**

In its "Research to update indicators which monitor progress in adaptation in England" for the Climate Change Committee, ADAS found that: "The total permeable area (natural and multiple (permeable)) has decreased by 70,000 ha, from 821,000 ha in 2001 to 751,000 ha in 2022. The permeable fraction of the total urban area [in England] has decreased from 63% in 2001 to 54% in 2022."[306] There is currently an undersupply of housing in the UK and while the London Plan says development plans should "identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks" the risk of surface water flooding continues to increase.[307, 308]

In November 2022, the National Infrastructure Commission's report "Reducing the risk of surface water flooding" said: "Government should undertake a comprehensive review of the effectiveness of all available options to manage unplanned increases in impermeable (or hard) surfaces, and their costs and benefits. By the end of 2024, government should decide whether policy changes are required to reduce the impacts on surface water flooding or adjust investment levels for flood risk reduction accordingly."[309]

In March 2024, the previous government accepted this recommendation.[310] It said: "We agree the impact of increases in impermeable surfaces on surface water management needs further investigation, including options to mitigate where these occur. Government will scope and establish a review into the impacts and opportunities to manage these in public and private spaces including for surface water management, mitigating flood risk and water quality, with a view to concluding the review by the end of 2024. Government will then review the findings and make any policy changes it considers necessary, feeding into the future cycle of local flood plans and investment."

The new government's manifesto said: "Without action, flooding and coastal erosion will pose greater risks to lives, livelihoods and people's wellbeing." We have spoken to many organisations and individuals with a specific ask on this issue, for a change in the law to stop people paving over their gardens. UK government "Guidance on the permeable surfacing of front gardens" says: "The drains in most urban areas were built many years ago and were not designed to cope with increased rainfall. Paving front gardens further adds to the problem. Although paving over one or two gardens may not seem to make a difference, the combined effect of lots of people in a street or area doing this can increase the risk of flooding. The harm caused by paving gardens is not limited to just flooding. Hard surfaces such as concrete and asphalt collect pollution (oil, petrol, brake dust etc) that is washed off into the drains. Many drains carry rainwater directly to streams or rivers where the pollution damages wildlife and the wider environment."[311]

In 2008, the UK government introduced changes to the law making the hard surfacing of more than 5 square metres of domestic front gardens permitted development only where the surface in question is rendered permeable.[312] However, the GLA's evidence to the Review said: "no guidance provided on standards of permeability and insufficient capacity and expertise to check compliance, leads to inconsistency with regards to solutions and doesn't solve the problem it was designed to."

Rendering surfaces permeable is sometimes provided by a grille or gap between the garden and the pavement or using permeable paving. However, grilles and permeable paving both require maintenance and often fill up with moss, weeds, dust and other matter. This means they do not capture run-off, particularly during the heavy downpours, and cumulative effect of all these residential modifications is that the water is overwhelming drains and blocking roads.[313]

The drains in most urban areas were built many years ago and were not designed to cope with increased rainfall. Paving front gardens further adds to the problem.

As more people are angered by their neighbours adding to local flood risk, one solution could be charging people based on the surface area of the land they own that is impermeable. This would not only raise much needed revenue to mitigate risks, but also disincentivise paving over gardens and other green spaces.

Melbourne Water in Australia charges all customers a waterways and drainage charge that funds services to manage its drainage networks and protect waterways and creeks. The charge is not related to water or sewerage services, but is for services such as flood risk management and community access.[314] Melbourne Water further offers a stormwater offset where stormwater cannot be managed onsite, "a financial contribution paid by residential developers to us for stormwater management works to be undertaken in another location."[315] Stormwater charges are found in many cities in the USA and are based on the concept of an Equivalent Residential Unit (or ERU), which is based on the average amount (1,000 square feet) of impervious surface on residential properties. In Washington DC, the District Government "uses these funds to keep trash and other pollutants out of the rivers, install green infrastructure throughout the District, ensure that new construction and redevelopment projects incorporate green infrastructure, and provide incentives for voluntary retrofits."[316]

Case study

12,000 Raingardens Puget Sound Region, USA

Washington State University and Stewardship Partners are leading a groundbreaking campaign to install 12,000 rain gardens in the Seattle/Puget Sound Region, which "would soak up 160 million gallons of polluted runoff to protect our waterways, significantly helping stop the stormwater crisis that is threatening our waterways."[317] The campaign links communities with resources and incentives to install rain gardens. This includes events, videos, and written guidance covering how to build a raingarden or hire contractors; a directory of incentive programmes, including local government or charitable grants to offset the cost of building raingardens, and links volunteers with opportunities to build gardens.

35. **Recommendation for UK government: Produce a National Wildfire Strategy and Action Plan by 2025. This should define effective wildfire risk reduction measures, including at the rural/urban interface, and be informed by a real-time and dynamic England Wildfire Risk Map by 2028.**

Wildfires are increasing in frequency and intensity around the world. In August 2023, Greece experienced Europe's largest recorded wildfire. In the same month, over 100 people died in wildfires in the town of Lahaina in Hawaii.[318, 319] Wildfires in Chile in early 2024 have also killed over 100 people.[320]

Wildfires are a growing threat at London's rural/urban interface, as shown at Wanstead Flats in 2018 and Wennington in July 2022. UK government must work to ensure that communities on rural/urban interface are better protected from wildfire risk, without destroying the natural world in and around UK towns and cities.

Based on the commitment in the third National Adaptation Programme (NAP3) to "scoping out the Wildfire Strategy and Action Plan by mid-2024",[321] UK government should develop a national wildfire strategy and action plan by 2025.

A national strategy and action plan, with short, medium, and long-term targets, would seek to reduce the danger to people, property, and nature. The plan must reflect the complexities of land ownership in England. A strategy would help clarify roles and responsibilities and unlock investment by giving businesses, local authorities and national government clear parameters and targets. It could also mean firefighting and land management resources are better directed nationally, which would help individual fire and rescue services and land managers get mutual aid. We are not suggesting that firefighting should be directed centrally (local areas have specific needs), but the ability to better direct national resources at the point of need would support local actors and the work of National Resilience Fire Control.[322]

The National Risk Register says: "The future risk of droughts due to climate change is increasing, and there is a trend towards hotter summers with associated high water demand. [This brings] an increased fire risk due to dry conditions. This would be combined with a reduced ability to fight fires due to water scarcity."[323] The LFB told us: "Drought, and the resulting reduction in water pressure, can impact on firefighting operations as well as the Brigade's ability to undertake training due to the requirement to prioritise the use of water. Water companies can reduce water pressure as a control measure during a drought, but this process needs careful coordination with partners to ensure the required controls are implemented. For instance, a reduction of available water in an area which contains a risk that requires a large volume of water for firefighting may result in LFB moving resources to mitigate that risk." The national strategy and action plan must reflect the increased risk of reduced water supply due to drought and therefore consider non-water-based fire suppression.

The UK government should also develop an England Wildfire Risk Map by 2028, as NAP3 commits to.[324] This should be able to be used by planners and developers to

consider wildfire mitigation measures and adaptation measures for new and existing properties as well as appropriate performance standards for wildfire risk to properties and infrastructure. It could also be used in risk prevention and preparedness for critical national infrastructure. And it could help to engage with the public and provide appropriate warnings. It could be used by the health departments to work out where they're likely to experience increased demand from physical health impacts. The **Health Effects of Climate Change** report says: "Wildfires can lead to a range of health impacts, including injuries, respiratory and cardiovascular effects from smoke exposure, harmful mental health effects and can negatively impact health services."[325] In June 2023, wildfires in Canada created air quality problems as far south as New York City.[326]

A real time and dynamic wildfire risk map should be informed by a fire danger rating system. The UK Fire Danger Rating System is a project run by a coalition of UK universities to develop the science that might underpin a system that looks at fuel and weather.[327] The next step is to make this into a national resilience product to be used by the emergency services and land managers.

36. **Recommendation for the Mayor and TfL: Support the Transport Adaptation Steering Group to connect with transport providers in other cities nationally and internationally to develop best practice adaptation for city transport.**

TfL's Climate Change Adaptation Plan 2023 said: "We recognise that we cannot operate a resilient transport network by ourselves. Managing our interconnected systems in the face of climate change will require engagement, support and collaboration with a wide range of organisations."[328] Heathrow Airport Limited told us: "...disruption of the transport system to and from the airport is a significant concern with climate change, and there is a need for an integrated transport resilience plan considering more adverse weather."

TfL's officers share knowledge and best practice with industry stakeholders, such as Network Rail and Highways England, through the quarterly Transport Adaptation Steering Group.[329] Cities have considerable powers and resources to invest in public transport, the Mayor should use his convening power to bring together Mayors from other UK cities with major transport infrastructure including roads, rail, trams and busses, and connect the Transport Adaptation Steering Group with transport providers and experts to share expertise and best-practice. London would have a lot of expertise to share and could learn from other cities and regions.

Boroughs on the rural-urban interface. If this delivery group proves successful, it should be considered as a model for other groups

looking at similar challenges such as retrofit. International expertise could also be sought via C40 cities.[330]

37. **Recommendation for UK government: As part of the Defra review of the statutory powers and responsibilities to map, monitor, inspect and maintain all assets across all flood risks and coastal erosion, (including watercourses and riparian landowners' role and responsibilities), due in March 2024, Defra should reconsider the Thames Estuary 2100 10-Year Review Advisory Group's recommendations.**

Effective monitoring in the Thames Estuary means we now know flood defences must be adapted upstream (west) of the Barrier by 2050, which has been brought forward 15 years from 2065 in the original plan.[331]

Those who own land bordering the Thames are responsible for providing and maintaining tidal flood defences. At a roundtable hosted for the Review by the Better Buildings Partnership, major London landowners said they didn't see the rising tide as a pressing risk to property along the Thames because their understanding was that the Thames Barrier would be effective until 2070. But the Barrier is only one part of a much bigger system of river defences.

Of the total 330 kilometres of flood defences in the Thames Estuary there are 126 kilometres upstream (west) of the Barrier and just 9 kilometres of these (7%) are sufficiently high to last beyond 2050.

Just as concerning is downstream of the Barrier (east) where the deadline for completing the first stage of downstream defence upgrades is 2040. The required height for some downstream defences will be around 30 to 60 centimetres (cm) higher than it is now, depending on location.

Many different individuals and organisations own or manage land and infrastructure along the river. Flood defences often form part of buildings, roads, or other structures and it is not always clear who is responsible for these and where. Even along the north bank of the Thames within the City of London, (which we visited with the City of London Corporation and the Environment Agency), who exactly owns what isn't completely understood.

Of the total 330 kilometres of flood defences in the Thames Estuary there are 126 kilometres upstream (west) of the Barrier and just 9 kilometres of these (7%) are sufficiently high to last beyond 2050.

The Environment Agency owns only 12% of the defences in the Thames Estuary. Third parties are responsible for maintaining 88% of the flood risk assets and 77% of the Estuary's 'Below Required Condition' assets. The Environment Agency currently pursues landowners to act but there is often an assumption that if part of the Thames riverbank is at risk of failure, the authorities will step in [as the "insurer of last resort", see chapter 4 on a climate resilient economy]. This needs to be addressed in law because sea level rise poses a risk to all development along the Thames. Developers should understand the TE2100 plan, its implications for them, and invest in its effective delivery.

The TE2100 Group's recommendations are: The Thames Estuary 2100 Plan should be placed on a statutory footing in spatial planning; A long term funding solution is essential to ensure the sustainable implementation of the plan; A Government review of how best to maintain and fund third party flood defences in the estuary to ensure a consistent and comprehensive approach which keeps pace with rising sea levels; local authorities and the Environment Agency need ongoing resources and support for the science and evidence gathering, innovation and research, engagement and collaboration that is essential to an adaptive planning approach.

38. **Recommendation for the GLA, local authorities and London Anchor Institutions: The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.**

As the Environment Agency pursues all landowners to act on sea-level rise in London, the GLA must demonstrate best practice. This will help communicate the need to act to other public and private landowners. The GLA told the Review: "As a property owner the Mayor will work with the EA [Environment Agency] to understand what's needed to ensure embankments, barriers and other equipment is maintained, and site owners understand their responsibilities to maintain." This would be helped if all local authorities with frontages on the Thames were to produce a Riverside Strategy by 2025. At present only the City of London Corporation has done so. We recognise that some boroughs are working together to deliver some of these outcomes by 2027 through the Thames Estuary Partnership's Joint Thames Strategies. We welcome this work but urge all relevant landowners to work with greater urgency.

Following the publication of our interim report, the South Bank and Waterloo Partnership told us: "We support the flood risk management recommendations for the river Thames and the development of

a Riverside Strategy by Local Authorities in partnership with other stakeholders. This approach will be vital for protecting the South Bank's cultural venues, integral to London's cultural landscape. The Review notes that financing options should be considered. Many of the South Bank's riparian landowners are charities with limited funding and may need significant financial support to make the required improvements. This investment will have additional benefits, including helping to rejuvenate The Queen's Walk, enhancing the South Bank's appeal while protecting local communities."

The Environment Agency is producing guidance for creating a riverside strategy, requirements include redesigning defences so that upgrades will improve the local area and make it greener, identifying opportunities to create and enhance intertidal habitat and enabling people to have uninterrupted access to the riverside with views of the river.[332] More green spaces along the river could provide shade and breeze for residents and workers during increasingly high summer temperatures (the Mayor has committed to increasing tree canopy cover by 10% by 2050)[333] and improve water quality by creating a break between road runoff and the river.

The deadline for upgrading defences downstream (east) of the Thames Barrier is 2040 and upstream (west) is 2050.

London's blue and green infrastructure

In March 2024, a work of art by Banksy, highlighted an absence of nature in one of the poorest parts of Islington.[334] There is widespread agreement that more blue and green space in cities globally is necessary for reducing the effects of climate change, improving people's quality of life, and addressing ecological decline. Evidence submissions to the Review support this, but we have also heard frustration at the failure to overcome barriers that have been known about for many years. We list those barriers here so that people can immediately write them into a project brief rather than discover them for the first time in delivery.

These barriers include:

Time: blue and green Infrastructure (BGI) requires a long-term approach and can be disadvantaged by decision and budget making cycles. Local authorities and the London Environment Directors Network (LEDNET) told us "Competitive funding approaches are hugely inefficient, absorbing huge local authority resource, detracting from delivery and forcing us towards short-term, responsive approaches."

Fragmentation: BGI can often be siloed into dedicated teams, which misses opportunities to embed BGI throughout related programmes across (for example) built environment and community work. BGI must be embedded into strategies and prioritised by decision makers. The

Woodberry Wetlands, Hackney
Owned by: Greater London Authority (GLA)

London Borough of Havering told us: "More joint working on natural environments which cross boundaries would support adaptation to climate change."

Shared benefits: BGI can result in many benefits, but these fall across different departments, may not be accrued directly by the funder, and vary from project to project so are difficult to standardise.

Lack of investment in maintenance: BGI requires maintenance to perform eco-system functions, lack of investment in maintenance is a common problem throughout the risks covered in this report. Westminster City Council told us: "Westminster typically has capital funding available for the introduction of greening assets and infrastructure but does not have the required revenue funding to support the maintenance of these assets in the long-term. Overcoming these barriers will require addressing these funding challenges, raising public awareness, and ensuring stakeholder collaboration." Green space, nature and tree services are non-statutory public services which are often the first to receive funding cuts when budgets are tight, and their wide public benefits can be lost when not well maintained.

Lack of investment in skills: there is a need for greater investment in BGI's development and delivery. To make it work, that means skills provision. Investment should come from public and private sources. Local authorities and other not-for-profit organisations who work to deliver BGI across London highlighted that a lack of access to skills and staff resources impact on the delivery and maintenance of BGI. The Royal Parks and Hackney Council both told us climate change impacts are increasing pressure on existing resources for maintenance.

Lack of investment overall: as previously mentioned, the Mayor has invested around £30m in green projects since 2016,[335] however the London Green Spaces Commission said in the ten years to 2019, £4billion was cut from core funding for local services in London.[336] Over the same period, spending on public green space has fallen by over 30% to just £159m while London's population has grown by around 900,000 people (11.2%).[337]

Land use pressures: BGI can be difficult to implement where its installation appears to conflict with other aims, for example the need to deliver housing. Clarion Housing Group said "a comprehensive city-scale green infrastructure plan with corresponding planning and biodiversity requirements could, if delivered well, support the adaptation to both increased extreme rainfall and overheating, as well as having major positive mental and physical health impacts for Londoners."

Fire risk: appropriate, considered planting and committed maintenance of BGI should not increase fire risk.

Climate Change itself: climate change impacts are having severe consequences for London's existing BGI. Hotter temperatures and extreme heat have caused significant tree deaths and BGI failure, new pests and diseases are threatening native tree species and can cause algal blooms, more intense wind and other climate impacts are putting London's existing BGI at risk.

To begin to overcome these barriers, we make recommendations to the following organisations.

39. **Recommendation for UK government: Increase investment in blue and green infrastructure (BGI).**

The Review's Recommendation 11 for UK government to develop funding programmes and increase fiscal devolution for regional and local organisations to accelerate climate adaptation should include dedicated funding for the delivery and maintenance of BGI. There are a range of programmes which aim to drive investment into BGI, including the Natural Environment Investment Readiness Fund (NEIRF).

The NEIRF is a competitive grants scheme providing grants of up to £100,000 to support the development of nature projects to a point where they can attract private investment. Islington Council secured funds from NEIRF to deliver urban greening and woodland creation by converting stub roads to pocket parks.[338]

There needs to be an increase in such investment, with a focus on increasing skills in the workforce. Programmes should be long-term and distribute funding according to local climate risk. The skills agenda should be a priority for the next spending review. Too often not enough attention is given to the human resources and skills required, with implications for project delivery.

The former government's Green Jobs Delivery Group was aiming to produce a Net Zero and Nature Workforce Action Plan in 2024.[339] We strongly urge that this aims to drive skills and jobs in adaptation and climate resilience.

40. **Recommendation for the Mayor: Build on existing tools to develop a strategic framework for the delivery of BGI across London; use this to inform funding programmes and convene partners to drive a strategic approach to BGI across London.**

The Mayor should build on existing green infrastructure maps and tools, such as the 10 Minute Walk Map, Green Cover Map and All London Green Grid (ALGG). Maps and tools should be kept up to date. The Mayor should continue to update the ALGG and use this to develop a spatial framework for the delivery of BGI across London. The spatial framework should inform decisions about funding to support a more strategic roll-out of BGI across London. This process should ensure tools help users to understand how to advance regional and local priorities. The Mayor should convene GLA, local authority and private sector stakeholders to overcome perceived conflicts between urban greening and development. This framework should inform BGI funding programmes where possible. The Mayor has several programmes that invest in the delivery of BGI. The Mayor should prioritise delivery of streamlined, long running programmes which reduce start-up and wind-down costs. Methods should be developed to deploy funding based on climate risk and green space deprivation. Efforts should be made to reduce burdensome application processes for grant programmes.

The Mayor should require the GLA Group to go beyond consideration of BGI, to prioritising BGI across all strategies and ensure this leads to exemplar delivery.

Francis Road, Leyton, London E10. Pedestrianised high street
Creator: Eleanor Bentall for Transport for London

For instance: Transport for London, Mayoral Development Corporations (MDCs), Housing and Land and Regeneration should integrate BGI into all future work, the Mayor should use his climate budget and other internal processes to monitor GLA Group progress on BGI delivery. TFL's Green Infrastructure and Biodiversity Plan (published March 2024) demonstrates ambition, the rest of the GLA Group to follow this example.[340]

The Mayor should convene London's local authorities, public estates and private landowners and managers, and call on them to:

- Prioritise BGI in all built environment work.
- Take action to distribute long-term benefits and maintenance responsibilities more systematically across London.
- Develop models for collaborative investment and create incentives for landowners.
- Create and deliver training, guidance, and other tools to upskill teams across the GLA Group, local authorities and community and voluntary sector on BGI.

41. **Recommendation for Local Authorities: Support a strategic London-wide approach to BGI in London and prioritise funding for BGI.**

Local authorities should engage with the GLA, and the updated ALGG, to identify strategic opportunities for BGI delivery. Local authorities should produce BGI strategies in line with London Plan policy. Collaboration is needed to join-up local authority departments as early as possible in projects. Local authorities should monitor existing and future projects, collect and share data on the costs and benefits. Local authorities should harness available funding streams such as the Community Infrastructure Levy and Section 106 contributions. Local authorities should invest in BGI skills and work to ensure adequate maintenance of BGI assets in ownership.

42. **Recommendation for London's public and private sector landowners and managers: Invest in London's BGI, embed BGI delivery in strategies, and engage with the Mayor, and local partners.**

London's public and private sector landowners and managers should engage with the GLA, local authorities, Business Improvement Districts (BIDs) and community organisations to collaborate on the delivery of BGI. Organisations should ensure BGI is at the heart of strategies and incorporate it into standards, specifications, contracts, management systems and delivery. Organisations should introduce or strengthen requirements to increase BGI across business planning, asset management and procurement.

All organisations should invest in training. This includes upskilling existing teams on BGI and developing methods to ensure BGI is considered early across any built environment project. It also involves working with London's accrediting bodies to develop training which meets London's BGI needs. TFL's Green Infrastructure and Biodiversity Plan says: "We are keen to explore the potential for greater community and youth engagement and involvement in the delivery of new, and management of existing, green spaces."[341]

Case study
Colombia's Corredores Verdes

Medellín, Colombia is known as the "city of eternal spring" because of its warm and pleasant climate all year-round. In 2010, after decades of rapid growth and Urbanisation, the average temperature in Medellín was 6°C higher than the typical average temperature and air pollution had significantly worsened. The government created a Corredores Verdes, or Green Corridors, programme in 2016.[342] By 2021, the programme had successfully created more than 30 green corridors and 124 parks by planting 880,000 trees and 2.5 million plants along the busiest and most polluted streets. These corridors have succeeded in reducing Medellín's average temperature by 2°C and improving air quality by capturing particulate matter. It is estimated that just one corridor absorbs 160,787 kg of CO^2 per year.

This project is enthusiastically supported by Medellín's citizens, who voted to fund it through the Municipal Participatory Budget. The initial investment for the project cost USD $16.3 million, with an annual maintenance cost of $625,000.[343] The citizens are reaping the benefits in the form of lower temperatures, better air quality, and easier access to green space. The programme also involves community members by training them to become full-time gardeners and planting technicians for the corridors.

Chapter 4

A climate resilient economy

This chapter looks at how to attract investment and finance for adaptation and climate resilience in London. Investors need confidence that they will benefit directly from the money they put into resilience services over the short and long-terms. While there is much that financial institutions can do to understand the investment case for greater adaptation-focused finance, this won't be a substitute for clearly defined policy ambitions and legislation, including standards for homes, buildings and infrastructure, to provide both clarity on what needs to be achieved but also, in some cases, the investment case to grow market opportunity.

Protecting London's economy from extreme weather is a matter of national economic security. London is a global centre of commerce. It has a world-leading insurance market, pioneering scientific institutions, critical national infrastructure, a thriving technology sector, international banking and around 19% of the UK's private sector businesses. In 2021 the gross value added per job in London was on average £81,400, 40% higher than the UK average.[344] This is vital to the Treasury.

Climate change is likely to impact London's GDP by 2–3% every year by the 2050s, with costs increasing further in late century. This estimate comes from the 'Review of the economic impacts of climate change on London' by Paul Watkiss Associates for the London Climate Resilience Review (Annexe 1). The results also show that London's economy is not immune from wider risks across the UK and Europe, and that advocating for global adaptation leadership will need to be part of London's strategy for reducing regional impacts.

Resilience services support productivity by "avoiding the costs of downtime". Since 2008/2009, UK productivity growth has been "sluggish",[345] additional pressures from climate impacts are highly undesirable. The UK economy needs adaptation and resilience so that people in the workforce can perform at their best in adverse conditions like heatwaves, and so that organisations can continue to operate despite disruption to transport and supply chains of energy, water, and food. Lost output from heat related reductions in productivity are already significant in London, losses in a typical year are valued at £577 million by research carried out by Vivid Economics for Arsht-Rock.[346] During the week of the July 2022 heatwave, TfL lost £8.4 million in revenue across their operations.[347] The Infrastructure and Projects Authority has said: "Investments in London's transport network will benefit not only London residents, but also those who work in London but live elsewhere, in addition to business and leisure visitors to the city."[348]

London should become the world's go-to financial marketplace for climate resilience services. London is the headquarters of many global businesses. Financial markets are cross-border systems, where events, changes and trends in other parts of the world influence asset values, operations

The City, London England
iStock (istockphoto.com)

and profits.[349] This means that London's economy is exposed to risks all over the world; it is also an opportunity to export innovation and best practice. The Intergovernmental Panel on Climate Change has said: "Urban areas are now home to 4.2 billion people, the majority of the world's population. Urbanisation processes generate vulnerability and exposure which combine with climate change hazards to drive urban risk and impacts."[350]

Implementing a strong resilience agenda in London could help pave the way for corporates to understand what and how they could implement similar measures elsewhere in the world. In December 2023, a report from the investment company BlackRock Climate Resilience: an emerging investment theme said: "We expect demand to grow for products and services that increase resilience and help society assess and manage risks. Some market growth is already evident – and we think policy, regulation and markets will spur more. We also expect greater spending on rebuilding after climate disasters. As this market grows, we see climate resilience emerging as a new investment theme."[351] The new government's manifesto said: "Labour will make the UK the green finance capital of the world, mandating UK-regulated financial institutions – including banks, asset managers, pension funds, and insurers – and FTSE 100 companies to develop and implement credible transition plans that align with the 1.5°C goal of the Paris Agreement."

While many global corporations have headquarters in London, small businesses make the local economy. There are estimated to be around one million small businesses in London.[352] These are vital for job creation and supply chains, as well as London's culture and attractiveness. SMEs are less likely than large companies to be able to allocate resources (e.g. full time employees or consultants) to challenges like overheating, water efficiency, or even regulatory compliance. The Federation of Small Businesses told us: "Whilst, we do not have specific London data, we know from a UK perspective that Government data (in 2022) shows over half (57%) of UK firms believe their business will in some way be affected by climate change, extreme weather and flooding over the next 10 years. However, despite the concerns and risks, very few businesses (20%) have put together continuity plans should the worst happen." Analysis from Zurich UK said the average cost of flooding to a business is £82,000.[353]

There is currently a global gap in funding adaptation. The UN's Adaptation Gap Report 2023 found that "due to growing adaptation finance needs, and faltering flows, the current adaptation finance gap is now estimated at US$194-336 billion per year".[354] The world of finance won't save the planet, and neither will any other individual sector or profession, but the need for climate resilient finance is clear.

Climate resilience protects jobs. Responding to events and repairing damage is more costly than investing in adaptation and climate resilience. The City of London Corporation told the Review: "The 'resilience dividend' can come from either business continuity (continuing to operate whilst others don't during a climate incident), quick recovery (the ability to speedily return to business following

an incident), and ultimately the long-term viability of business operations (remaining whilst others fail). The stability and guaranteed service that increasing resilience can provide will make the business function more attractive to customers, enabling a greater market share or the ability to charge a premium." The Thames Barrier, and its associated defences, has allowed significant development in London, including Canary Wharf and London Docklands; it continues to protect billions in revenue generation. Action on adaptation and resilience can provide returns on investment between 2:1 to 10:1, and sometimes further.[355]

Investing in skills to manage weather impacts and to adapt to climate change is a growth opportunity. There is currently a skills gap in England. A step change in London's adaptation delivery is needed to increase demand for new and existing skills, including monitoring and data analysis, Geographic Information System spatial analysis, adaptation economics, project management, construction and building skills, communications, and landscaping. Relevant skills are needed in all sectors from maintenance of infrastructure, nature-based solutions, construction, tourism, finance, public health, and more. The specific adaptation and resilience sector will also continue to grow, but it needs a workforce capable of meeting the demand. Technical apprenticeships and education in science, technology, engineering, and mathematics (STEM) subjects should be incentivised or the country will be increasingly dependent on foreign investment to manage domestic climate impacts.

National, regional, and local governments must work to overcome barriers to private investment. The report Barriers to financing adaptation actions in the UK, for the Climate Change Committee said: "Future investment is dependent on this willingness to pay, which is affected strongly by the level of awareness, understanding and engagement with adaptation issues."[356] Better data and guidance on the risks to prepare for, combined with guidance on what resilient systems need to look like, would help address the common view that investing in adaptation is difficult, due to a lack of information and support, and would help foster collaboration between the public and private sector to develop solutions for the common good.[357] One small example of where this is beginning to work is the Wyre Natural Flood Management Investment Readiness project, in Lancashire, which uses a green investment financial model that sees upfront investment repaid through contracts with organisations that benefit from reduced flood risk, including water and insurance companies.[358] However, despite some successful pilots, another barrier is that there are not enough investible adaptation projects in London ready to receive finance even if it were available. The Mayor's Green Finance Programme is currently procuring technical support for project development (and our recommendations 28 and 50 for an "adaptation accelerator" and a "climate resilience challenge" would also help).

A "gold standard" regional economic plan must factor in future weather extremes. This is needed both to avoid the costs of disruption and to create local job opportunities in resilience services. In May, the Prime Minister hosted a summit of regional Mayors to look at "growth across every region" and to create a "gold standard" for boosting local economies. He praised the Mayor of London's Community Wealth Building programme, which has invested over £1.75billion in small and medium sized businesses, as well as the new London Growth Plan.[359]

The need for more private investment does not mean the public sector is doing enough. More climate ready allocation of taxpayers' money is needed across all government departments, not just for environmental schemes. The National Infrastructure and Construction Pipeline says there is £700–775 billion of [public and private] planned and projected investment expected in the UK over the next 10 years.[360]All of that infrastructure investment must be able to withstand and recover quickly from the extremes of weather we can reasonably expect by 2050, 2100, and beyond.

Public funding has a role in innovation, testing solutions, and incentivising others to follow. It also has a role in supporting local identification, development, and delivery of adaptation investment. A well-resourced intermediary (such as a Local Authority Advisory Hub) could provide end-to end professionalised and integrated services to local authorities keen to work with the private sector to deliver greater investment into resilience. The GLA is looking to procure technical assistance of this sort to support boroughs with both mitigation and additional efforts.

In June 2024, a catalogue of sources, instruments and best practice case studies to support financing regional adaptation was published.[361] The first draft catalogue from Pathways2Resilience includes 57 sources (institutions that provide finance for adaptation) and 78 financial instruments (mechanisms that enable the transfer of funds) for EU regions, cities and local authorities to use to support their adaptation efforts. You can **read it here**.

Adaptation underpins net zero investments. If green energy infrastructure is not built to withstand rapid and overlapping successions of storms, heatwaves, cold snaps and floods, the transition to a net zero economy will be derailed by the need to manage immediate physical threats on a rolling basis. Preparing for more extreme weather and reducing emissions are mutually beneficial and non-negotiable.[362]

The report "**Mission Climate Ready**" said: "Adaptation must learn from the mitigation playbook on mobilising investment. Market-based mechanisms have played a big role in mobilising private investment to decarbonise the UK economy and yet are largely unexplored for adaptation. Similarly for adaptation, there is a market failure to be resolved; the huge positive resilience 'spill overs' from investing in resilience today and in the future for society are difficult to capture and monetise, leading to a common underinvestment by the private sector."

The taxpayer should not be the insurer of last resort for inevitable weather. At a roundtable meeting hosted for the Review by the Association of British Insurers, attendees expressed concern that property prices were often overinflated because buyers and sellers were not fully informed of physical climate risks that threaten land or buildings.

Finance for adaptation and resilience is growing, but not fast enough. While we know where gaps in data and lack of clarity in financial taxonomies create hurdles, we also know that heat exposure led to 470 billion potential labour hours lost globally in 2021.[363] In the UK an estimated 6 million potential labour hours were lost, costing an estimated £94m.[364] The National Audit Office said: "The economic costs of the 2012 drought in England were £165 million in revenues and £96 million in profits, based on a 2013 estimate."[365] Flooding from torrential rain threatens 42% of the capital's 301,000 commercial buildings.[366] And, around 43% of properties are likely to be affected by subsidence in London by 2030.[367] Sarah Breeden, Deputy Governor for Financial Stability, at the Bank of England, has said: "Waiting for certainty and perfect information creates an excuse to go slowly. But this is a collective action problem where seemingly rational individual inaction makes our collective future problems much bigger. So we must not let perfection be the enemy of progress."[368]

Heat exposure led to 470 billion potential labour hours lost globally in 2021.

The economic costs of the 2012 drought in England were £165 million in revenues and £96 million in profits.

Flooding from torrential rain threatens 42% of the capital's 301,000 commercial buildings.

Recommendations

43. Recommendation for UK government: A Stern, or Dasgupta, style review into the economics of adaptation and climate resilience.

Responding to events and repairing damage is more costly than investing in adaptation and climate resilience. However, the medium to long-term returns of ensuring investments are resilient and well maintained are often overlooked. Climate adaptation for example including nature-based solutions like natural drainage systems, or planting trees on city streets, is often viewed as an additional expense. A survey by the Institution of Civil Engineers in 2021 found that "Engineers are limited in their ability to consider climate issues by a lack of joined-up thinking, "it's not part of the brief/there's no incentive" and an industry perception that it adds time and money."[369] Climate adaptation is not a 'nice to have'- it is now critical to London's survival on a warming planet.

There is a chorus of organisations and institutions calling for this perception to be challenged with evidence. The London Legacy Development Corporation is a Mayoral Development Corporation which is responsible for Queen Elizabeth Olympic Park. They told us: "There is scope to improve the consideration of the cost benefits (including wider socio-economic value) of early action to improve resilience (and support decarbonisation). If "prevention is better than cure" for climate resilience, better models for making this argument are required. Particularly against better-established, near-term competition for financial priority."

There is much more to do to articulate the actual costs of climate change and non-adapted systems. This should span the value of physical assets, as well as loss of productivity, impact on access to healthcare and essential infrastructure. There are both social (number of homes and lives at risk) and economic (business interruption) ways to quantify this.

Evidence submitted to this Review has set out many barriers to achieving a step change in driving both public and private finance to adaptation action. This includes understanding of the economics of adaptation action. Setting out the benefits, identifying who those benefits accrue to, ways of creating viable financing models from 'costs avoided' rather than direct returns, and a lack of data were repeatedly identified across the Review's evidence gathering. The report **Barriers to financing adaptation actions in the UK**, sets out some of the challenges to embedding adaptation action in projects "... stakeholders described the challenges of getting adaptation investments approved due to the higher uncertainty and information gaps that existed around them. There also exists uncertainty about the exact costs and benefits of each project, often caused by a lack of precedent. Most adaptation projects are context and site specific, and costs and benefits from one project can not necessarily be translated to another."[370]

The Stern Review on the Economics of Climate Change was catalytic for the public and private sectors in moving towards a low-carbon economy.[371] **The Economics of Biodiversity: The Dasgupta Review** on the economics of biodiversity appears to

be having a similar impact for nature, natural services and systems.[372] The Chair of this Review has previously called for the Treasury to review the costs and benefits of climate resilience and what is the appropriate balance between public and private investment.[373] The Institution of Civil Engineers have echoed this call and the Joint Committee on the National Security Strategy have said government "should also consider a more wide-ranging review into the economics of adaptation."[374]The Climate Change Committee has said: "The Office for Budget Responsibility should undertake a full review of how the impacts of climate change in the UK will affect the UK's macroeconomic performance and public finances, building on the analysis in their 2021 Fiscal Risks Report, to enable a full-cost benefit analysis for public investment in adaptation."[375]

44. **Recommendation for the Mayor: Commission work to strengthen the evidence base on the costs and benefits of adaptation and climate resilience.**

As the costs of climate impacts increase in London, clear analysis of costs and benefits would support local organisations to make climate ready decisions and investments. The London Borough of Hammersmith and Fulham told us that 18 lifts failed in council housing blocks during the 2022 heatwave. These buildings must now be fitted with air conditioners at a cost of £500,000. Many organisations told us they need data on the benefits of retrofitting buildings to be passively cooled, set against the costs of other adaptation options.

Data on the costs, benefits, who benefits if not a direct return, and timeframes of climate adaptation projects across London should be collected and made accessible. Such an exercise should collect data on projects already delivered, as well as projects currently underway. The Mayor should commission a review of the economics of climate change in London which sets out the costs of climate events over the last decade and projections on the cost of future climate risks. This work should also seek to clarify the risk appetites of public and private organisations. Work to analyse data on the costs of climate impacts should also aim to set out how those costs are distributed across different owners and socio-economic groups.

The project should produce findings which help public and private sector organisations across London to consistently record data on costs and benefits of adaptation and climate resilience action. This could be in the form of guidance or templates. The methodology itself would be useful to other organisations. The GLA should also join-up with London local authorities undertaking comparable work at the local level to contribute to a wider evidence base. The GLA should also engage with other cities and regions who are undertaking comparable work to analyse adaptation costs and benefits.

45. Recommendation for the Mayor: The Mayor's London Climate Finance Facility takes forward approaches that can mobilise greater levels of private finance into climate adaptation projects, this could include launching a green bond.

Adaptation is non-negotiable, that means where finance is not an option direct government funding will be needed, but where it is possible to create markets and invest in adaptation and climate resilience these opportunities should be encouraged with incentives and regulation.

A new institutional approach is needed to create structured finance mechanisms that enable flows of private finance into climate adaptation that meet public policy objectives. "There is a need for the government to review how to assist the creation of markets and additional revenue streams."[376] All of this should ensure UK infrastructure is built to last.

The previous UK government said: "To maintain the UK's energy supply and deliver our net zero ambitions, we estimate that additional capital investment averaging £50–60billion per year is needed through the late-2020s and 2030s across the economy. A combination of public and private investment will be crucial for any path to net zero but a substantial portion of this investment will come from the private sector, providing new opportunities for businesses and investors."[377] Unless this investment is climate resilient over the coming decades, the benefits will be pyrrhic.

The new government has begun work to design a National Wealth Fund with a proposed £7.3billion of public capital over the course of this Parliament to "invest in the jobs that can rebuild Britain's industrial strength, and crowd in private investment in our ports, gigafactories, hydrogen, and protect our steel industry." The manifesto said, "The fund will have a target of attracting three pounds of private investment for every one pound of public investment."[378]

Capital is deployed in places, which means regional government has a key role by virtue of its local knowledge and connections. In our interim report we recommended that the Mayor's Green Finance work programme should develop a workstream to accelerate public and private investment in climate adaptation. The workstream should address barriers to investment in services that support Londoners to overcome disruption or danger from heat, flooding and water scarcity. This includes specific work to better identify returns on investment in adaptation, and who they should accrue to, and technical assistance to develop investible adaptation projects.

The benefits of resilience can be spread over many stakeholders which often deters investors who want direct returns and expect governments to act as insurer of last resort. But specific services such as installing shading to cool homes and business properties, installing water efficiency measures (reducing reliance on mains water) and strengthening property flood protection, all deliver clear benefits to private individuals and organisations. The Mayor can play a unique role in boosting understanding of the rewards of resilience services and take steps towards increasing

mainstream finance for resilience services.

An adaptation finance workstream should build on existing work by the GLA and London's local authorities towards the development of financial models which enable investment in nature-based solutions and can standardise benefits and returns, for example de-risking mechanisms. The Mayor should also deliver financial and project support to build technical knowhow and local authority capacity on adaptation finance. The Mayor could introduce grants or concessional financing for local authorities to pay for technical assistance services. While it is not necessary for local authorities to have the same financial knowledge as a financier, the Mayor and London Councils should work towards increasing the financial knowledge of local authority staff. This will contribute to improving communications and collaboration between local authorities and London's leading financial services sector. There are many pilots, toolkits, and projects which aim to address climate risks, but few clear pathways for local authorities who lack resources.

The Mayor's existing and forthcoming project development support, for example the Zero Carbon Accelerators, must consider climate resilience, and net zero projects financed through the Mayor's London Green Finance Fund (GFF) should be supporting adaptation. This would best be designed with early involvement from the investment community to align policy objectives with commercial incentives. The GFF was one of the recommendations from the Green Finance Institute report **Mobilising Capital at Scale for Net-Zero Projects: London's Climate Finance Facility**.[379] This builds on proposals

A new institutional approach is needed to create structured finance mechanisms that enable flows of private finance into climate adaptation that meet public policy objectives.

from the London Sustainable Development Commission to establish a London Climate Finance Facility.[380]

The criteria of future rounds of the GFF should be expanded to support adaptation projects, this is not easy and will require a high proportion of public finance, but not beginning to undertake this would prolong the start of something that must happen. The GFF should engage with London's financial services sector to co-create financial instruments and models schemes that unlock capital for urban climate resilience services. This could include shade and cooling for residential and business properties, sustainable drainage, and also water efficiency measures where "the financial returns are potentially high, because they offer immediate economic benefits."[381] This work should also involve local authorities, other public estates, anchor institutions and social housing providers.

Through the Green Finance Programme, the Mayor has also made £15m worth of technical assistance available to help organisations achieve net zero by 2030.[382] Such assistance must urgently be made available for climate adaptation and resilience.

It is not down to the Mayor alone to embed climate resilience, all investment initiatives across London have a role to play. Opportunity London should lead the way and ensure the projects they support consider climate projections and are adapted to be resilient to climate impacts.[383]

The potential role of green bonds

Climate resilience bonds or climate resilience guidelines for green bonds could be an incentive for investment in urban resilience. Ashden's evidence to the Review suggested convening "public and private experts in green finance to explore potential use of Local Climate Bonds for adaptation projects."

Speaking at the London School of Economics in March 2024, Professor Lord Stern said: "Borrowing for good investment is fiscally responsible and some of the quality of the argument in this country has been very poor on that particular subject. I'll say it again: borrowing for good investment is fiscally responsible. It brings down the debt to GDP ratio overtime. Why? Because it kicks up and gives you the kind of growth you need."[384]

The GLA has previously explored the idea of issuing a green bond to fund net zero and nature projects in the capital, but market conditions were not then right. We welcome the ambition to launch a green bond for London. This could be realised with a framework that supports adaptation projects.

Adaptation bonds are not without precedent. In 2019, the European Bank for Reconstruction and Development launched the first ever dedicated climate resilience bond, raising $700 million to specifically finance investments in climate resilience projects.[385] The UK Green Financing Allocation and Impact Report 2023 said: "Of the £3,342 million invested [in the Environment Agency's Floods Programme]

between 2015 and 2022, £2,114.97 million was provided by the Green Financing Programme (63.3%)." This better protected 220,000 properties and 163,000 hectares of agricultural land from flooding, and it also created 2,800 hectares of natural habitat.[386] That money was raised via green gilts and Green Savings Bonds.

California lawmakers are currently negotiating issuing bonds amounting to $15.5billion to finance projects for drought, flood, and water resilience, wildfire and forest resilience, coastal resilience, extreme heat mitigation, biodiversity and nature-based climate solutions, climate smart agriculture, park creation and outdoor access, and clean energy programmes.

As well as raising funds for adaptation and climate resilience projects, a green bond could be designed to support collection of data which demonstrates the costs and benefits of investing in adaptation.

Through the Green Finance Programme, the Mayor has also made £15m worth of technical assistance available to help organisations achieve net zero by 2030.

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Case study
Resilience bonds

Resilience bonds, or catastrophe bonds, are different from green bonds, but they are increasingly being used around the world to help pay for insurance premiums in places previously considered uninsurable. One example came after Hurricane Sandy in 2012, which inflicted $4.8 billion in damage on New York's Metropolitan Transportation Authority (MTA), the largest transportation network in North America.

The Green Finance Institute told the London Climate Resilience Review: "In preparation for more frequent and severe weather events, in 2013 the MTA raised the first-ever storm surge–focused catastrophe bond worth US $200 million... Bond payments are triggered on the basis of storm surge heights at two tidal gauges in New York Harbor [that were] most closely correlated with the MTA's exposure at different subway and transit tunnels."

The MTA's success with the bond (it's first iteration was priced with an interest rate of 4.5 percent and it's second 3.7 percent) "shows how other large organisations with catastrophe and climate related exposures can secure efficient insurance protection from diversifying sources and on a multi-year basis."[387]

Other examples include a catastrophe bond that provided the Government of Jamaica with financial protection of up to US $185 million against losses from named storms for three Atlantic tropical cyclone seasons.[388] And, a reinsurance programme to replenish the International Federation of Red Cross and Red Crescent Societies' Disaster Response Emergency Fund when funding allocated for natural hazards hits a certain threshold.[389]

"The MTA's success with the bond (it's first iteration was priced with an interest rate of 4.5 percent and it's second 3.7 percent) "shows how other large organisations with catastrophe and climate related exposures can secure efficient insurance protection from diversifying sources and on a multi-year basis."

The Green Finance Institute

46. Recommendation for the Mayor: Include climate resilience as part of Grow London Local's offer to small businesses.

The Federation of Small Businesses told us: "It will be important to ensure the small business community is provided with clear guidance, a step-by-step process of how to be climate resilient and understand how this links to their net zero journey." Glasgow City Council is using the UK Shared Prosperity fund to provide consultancy services to SMEs and Social Enterprises that includes climate risk and opportunity assessments.[390]

The London Chamber of Commerce and Industry said: "We believe that climate change will impact business in more than just a modal-specific manner, and therefore a GLA-led forum for sharing of best practice, risks and tangible climate change adaptation action – with energy providers, water providers and other key utility stakeholders and transport providers – will be critical to ensure a joined-up approach to climate change adaptation."

In January 2024, the Mayor launched the £8.7 million Grow London Local, London's 'single front door' for business, matching entrepreneurs and business owners to the help they need to thrive.[391] Grow London Local offers support and guidance on business planning, skills, sales and marketing, as well as opportunities to connect with other business owners. Alternatively, business owners can request a free consultation with community-based Business Support Managers, who will help small businesses navigate all the support available. The Grow London Local programme should explore offering support to small businesses to help them adapt and remain climate resilient. This could begin by signposting resources that are already available like the Environment Agency's flood alerts, or Waterwise's advice for businesses on saving water.[392, 393]

47. Recommendation for the Mayor: Works with public and private sector organisations to introduce a market-based system to enable the delivery of Sustainable Drainage Systems (SuDS) with funding through planned Street Works Programme.

There are more than 160,000 planned street works in London every year (excluding emergency works).[394] The GLA's Infrastructure Coordination Service is working with utilities and highways authorities to ensure that a "Dig Once approach" means that there is reduced road network congestion and fewer days of disruption.[395] When a hole is dug, such as for roadworks, efforts are made to coordinate with other organizations to utilize the same excavation for tasks like repairing pipes or cables, thereby minimizing the necessity of digging another hole in the same location shortly thereafter. Dig Once is now being used to ensure that SuDS are integrated as part of the reinstatement of street works. If this work were better mapped against a strategic plan for managing surface water flood risk across the city, it could deliver significant results at pace. Not only that, but it could also create a market-based system to help pay its own way. The Review recommends the Mayor convenes partners to introduce a market-based system to pair SuDS with funding through the Street

Works Programme. The objective of a market would be to provide incentives for utilities companies (suppliers) to efficiently deliver SuDS in conjunction with planned street works across London. These could be financed by the sale of credits based on a measurable reduction in impermeable area to buyers like private landlords, local authorities, or utilities companies like Thames Water.

This recommendation would be helped by a revenue stream that could come from, for example, a stormwater charge for the creating of impermeable land (recommendation 35).

The Environmental Markets Board could oversee an independent market operator to provide assurance of market integrity; the Mayor, a Strategic Surface Water Authority or another public-sector body could ensure the market meets strategic needs.

As previously mentioned in this report, in order for this market to be fully effective and for SuDS to be implemented at a scale that would make a net reduction to London's flood risk, there needs to be a significant increase in green skills in the workforce (in London and nationwide) to deliver it. We also recommend the GLA makes the case for more investment in green skills for people entering the workforce, or retraining, as part of the next spending review.

48. **Recommendation for the Mayor: Ensure the Mayor's skills agenda addresses climate adaptation. This includes the use of the Mayor's Adult Education Budget and other skills programmes to ensure adaptation is addressed across all skills provision, including the Mayor's skills academies. Work with London employers through existing structures, like the London Partnership Board and the Jobs and Skills Business Partnership, to coordinate delivery of training and apprenticeships to provide employment pathways which support London's climate resilience.**

A clear national commitment to investing in climate resilience will support employers and training providers to invest in skills and training. Training providers need to be sure there is a critical mass of people looking to be trained in climate adaptation and resilience to make investment viable. The market for transition to net zero is taking time to develop, UK government must learn from this. Research from the Grantham Research Institute on Climate Change said the government should "Develop a lasting, consistent and predictable policy framework, based on a national growth, innovation and skills strategy, to provide investors with greater clarity and confidence that investment in heavily policy-driven and regulated sectors like energy, housing and transport will be profitable."[396]

The National Infrastructure and Construction Pipeline says "To deliver the £164 billion of planned investment over the next two years, the IPA estimates an annual average of 543-600,000 workers will be

required across different industry groups including construction and engineering construction. Of this, approximately 60% are construction jobs."[397] Those workers need the skills to ensure that infrastructure is built, and maintained, to withstand twenty-first century weather.

More frequent and extreme weather events should be central to the UK government's whole of society approach to building resilience capabilities. It should be addressed by the UK Resilience Academy (referenced in the **Resilience Framework: 2023 Implementation Update**).[398]

Technical apprenticeships and education in science, technology, engineering, and mathematics (STEM) subjects should be incentivised with UK government devolving further powers to the Mayor to support this. However, students in all disciplines should be made aware that their working lives will be unavoidably affected by extreme weather, and gaining relevant skills will help them secure careers. Global competition for people with skills in designing and developing climate resilient infrastructure, or undertaking climate risk assessments and developing adaptation plans, will only increase.

The Mayor, training providers, awarding bodies, including higher education institutions, and employers should embed climate adaptation in the green skills agenda and learn from net zero focused work to provide skills and employment pathways in this sector. Employers have said there is a growing need for skills in adapting buildings so they can withstand the impacts of climate change.[399] London's adult education offer must meet demand for new skills as well as enhancing green skills in existing occupations.

Work to transition to net zero is a key opportunity to embed climate resilience. Research by the GLA has found that the following key industrial sectors have an important role to play in transitioning to net zero: Building & Construction; Transport & Logistics; Environment, Conservation & Agriculture; and Energy & the Circular Economy- these sectors will also need adaptation skills. In addition to a need for adaptation skills across existing work, adapting London will require more people who are specialists in adaptation delivery.

The Mayor should work with awarding bodies, employers and training providers to identify opportunities for including climate adaptation skills across existing funding and programmes, such as the Adult Education Budget (AEB). The AEB supports adult learners in education and training, mainly at Level 3 and below. It funds a broad range of learning, from technical and vocational training, through to English for Speakers of Other Languages (ESOL) as well as maths and digital skills. The Mayor introduced greater flexibility for AEB providers to respond to local skills needs with short courses to enable Londoners to progress into work. While many of the skills required to adapt London are technical and may require higher level qualifications, level 1-3 training can provide an important route into apprenticeships and further learning. This has been welcomed by employers in the construction sector and the GLA has told us that, for the first time, 10% of the previous AEB went towards supporting green skills.

London's employers have a critical role to play alongside national government and the Mayor. Research on Green Skills found that: "It would be helpful to have a group of employer champions who embrace the decarbonisation agenda and who can clearly explain what their skills needs are so that colleges can invest with some confidence in the facilities and equipment the sector will be demanding."[400]

Climate adaptation must be included in this agenda. The Mayor should also work with London employers through existing structures, like the London Partnership Board, to deliver training and apprenticeships that lead to specific employment opportunities. This includes formal and portable accreditations.

Placemaking and ensuring London's public realm contributes to other goals for the city, such as the Mayor's target for 80% of all trips in London being made on foot, by cycle, or by public transport by 2041, requires adaptation skills. This means improving and expanding sustainable methods of public transport and promoting a healthy streets approach. The Institute for Employment Studies has found that demand for green jobs relating to green finance, homes and buildings, green and blue infrastructure and climate change strategy, policy, monitoring and planning will grow consistently over the next three decades.[401]

Top up qualifications to embed climate adaptation in existing work will be needed. A shortage of climate adaptation skills across the planning sector, particularly in local authorities, is a barrier to advancing adaptation. Specific training should be rolled out to unblock this barrier, targeting local planning authorities. At present, the lack of steady jobs in, for example sustainable drainage, means that even if laws changed tomorrow and investment immediately flowed into solving England's surface water flood risks, the country would struggle to scramble a skilled workforce to deliver the necessary changes. The report **Green Jobs and Skills in London** says "Natural flood risk management, large scale flood risk engineering schemes, as well as property flood resilience will need to play a bigger role, and all these have a potential to be a source of employment."[402] Ensuring that this potential is met and delivers good jobs for Londoners will require a targeted set of training programmes and pathways into work.

49. **Recommendation for UK government: Review taxation for products and incentives for activities that support its climate ambitions and strengthen adaptation and resilience.**

The National Adaptation Programme (NAP3) makes several commitments towards preventing and managing climate risks. These aims should be reflected in taxation. This is happening on climate mitigation where the government has reduced VAT on energy saving measures to 0% from April 2022 through to 2027.[403]

The government should review VAT on adaptation and resilience goods and services to ensure that individuals, organisations, and investors are not disincentivised from making choices in line with the country's climate ambitions and statutory responsibilities. The National

Trust has said: “Research shows a national strategy to make historic buildings greener could reduce their carbon emissions by over 60 per cent by 2050. While VAT on new build construction is set at zero, VAT on housing repair, maintenance and restoration is 20 per cent. The Trust wants to see that equalised. It also wants to see a green workforce with tradespeople given the skills to retrofit homes and businesses.”[404] We recommend the government conducts research on products that help reduce overheating in the built environment and those that enhance flood resilience to property and infrastructure. Government should then develop financial incentives to drive investment in these products.

This should also apply to consumer spending. Given there are 16,000 new cases of melanoma diagnosed in UK each year, and heatwaves are becoming more frequent, the Review supports the campaign to remove VAT from sunscreen.[405]

50. **Recommendation for the Mayor: Launch a Climate Resilience Challenge to promote innovation in the capital and help find solutions to address the impacts faced by Londoners as a result of climate change.**

The GLA runs an open innovation programme, Challenge LDN, that seeks to pioneer a new way of working with Boroughs, Business Improvement Districts, charities and third sector organisations to solve the city’s challenges through innovation designed with diverse Londoners.[406]

An innovation competition focused on adaptation and climate resilience would support London to become a leader in climate readiness. It could link to green finance work on quantifying the benefits of specific measures, support an adaptation cluster and reinforce London's position as a green finance leader.

One example of this kind of work was the Climate Resiliency Challenge in the United States which distributed $1m in prize money to 13 organisations creating solutions to help frontline communities prevent, prepare for and recover from events like wildfires, floods, and extreme weather.[407] Another model could be the Global Challenge Lab, a competition for students to generate innovation towards the UN Sustainable Development Goals.[408]

The Global Challenge Lab is in part run by Undaunted a partnership between two world-renowned scientific institutions: Imperial College London and the Royal Institution with private sector funding and support.[409] Should an innovation competition secure funding, it could be run from the GLA as part of Challenge LDN’s open innovation challenges.

Acknowledgements

We would like to thank everyone who has submitted evidence or in some other way helped us understand how climate resilience can make this great city even better.

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- AtkinsRéalis
- Bloomberg Associates
- C40 Cities
- Headland Consultancy
- London Climate Ready Partnership
- London Councils
- London Sustainable Development Commission
- Major Projects Association
- Mott MacDonald
- National Infrastructure Commission
- Resilience First
- Ricardo

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- Arup
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- Association of British Insurers (ABI)
- AtkinsRéalis
- Better Buildings Partnership (BBP)
- British Association for Sustainable Sport (BASIS)
- Business LDN
- Exhibition Road Cultural Group, the South Kensington ZEN + Programme
- GLA Group Public Health Unit
- Institution of Civil Engineers (ICE)
- Thames21
- Victoria and Albert Museum

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Sustainable Drainage Systems (SuDS) to help alleviate flooding. Rain gardens, Crescent Gardens, Wood Green, London N22.
Creator: Eleanor Bentall for Transport for London

Recommendations

Key

S Strategic
A strategic action which will guide decision makers across London to take climate resilient decisions, drive investment and provide a coherent framework and direction.

D Delivery
A recommendation which results in direct delivery of adaptation action.

CB Capacity Building
A recommendation which will build understanding about climate resilience across London, and build organisation's adaptive capacity.

I Investment
A recommendation which will facilitate public or private investment in London's climate resilience.

Enabling London to Lead					
No	**Recommendation**	**Description**	**Owners and role**		**Type**
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	Mayor of London	Convenes partners and leads action	S
			Local authorities; London Councils; London's public sector organisations; private sector organisations	Engage with and support work	
2.	A regional adaptation delivery plan	Work collaboratively to develop an adaptation delivery plan to support London's strategic vision and lead an exercise to map roles and responsibilities.	Mayor of London	Convenes partners and leads action.	S
			LCRP; Local authorities; London Councils; Public sector organisations; private sector organisations	Engage with and support work	
3.	Make adaptation an organisational priority	Build on work already underway to embed climate adaptation as a cross cutting organisational priority across the GLA's work and funding, where the GLA has discretion.	Mayor of London		S I D CB
4.	Climate Resilient Budget	The GLA and London boroughs' finance processes should include a set of questions about climate risks to ensure spending is climate resilient, and the GLA Group's functional bodies should set adaptation plans and measurable targets.	Mayor of London; Local Authorities		S I D
5.	Climate Adaptation Action Plans	Develop climate adaptation action plans, informed by climate risk and vulnerability assessments.	London's local authorities		S D
6.	Minister for Adaptation and Resilience	UK government delivers its commitment to a new process for assessing chronic risks by the end of 2025 and appoints a Cabinet Office Minister for Adaptation and Resilience with responsibility for the National Adaptation Programme.	UK Government		S

Enabling London to Lead					
No	**Recommendation**	**Description**	**Owners and role**		**Type**
7.	Systems risks and evidence	In the context of cascading failures due to increasing climate-related risks, consider how the new London Resilience Unit can further strengthen the GLA's approach to managing systemic interdependencies and risks.	Mayor of London		S
8.	Statutory Duty	Introduce a statutory duty for local authorities, other public organisations, and major landowners to adapt to climate change, based on a clear framework of local roles and responsibilities. Funding should be provided in local authority and public sector settlements to meet the duty.	UK Government		S I D
9.	Strategic Plan for Heat	A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.	Mayor of London	Lead and convene stakeholders	S D
			Local authorities; London Councils; London Partnership Board; LCRP	Engage and support work, local delivery	
			Health Sector	Engage and support work; delivery	
10.	Heat Exercise	Conduct an exercise to test London's preparedness for a severe heat episode and identify potential cascading and concurrent risks.	London Resilience Partnership		S
11.	Invest in Climate Resilience	Develop funding programmes and increase fiscal devolution for regional and local organisations to accelerate climate adaptation.	UK Government		I

Communities					
No	Recommendation	Description	Owners and role		Type
12.	Individual Adaptive Capacity	Increase action to engage Londoners on climate risks and build their capacity to adapt. Initiatives should be informed by behavioural science, insights based and targeted to ensure that interventions result in behaviour change.	Mayor of London	Support community and equalities groups, drive work to engage Londoners on climate resilience	CB
			Local Authorities	Support community groups, drive local work to engage Londoners on climate resilience	
			Equalities and Community Groups	Engage with climate resilience work	
			London Anchor Institutions	Engage Londoners on climate resilience	
13.	Invest in community climate resilience	Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.	UK Government	Make more strategic funding available; devolve funding	I CB
			Mayor of London	Develop long term funding for community climate resilience Engage communities on London's climate resilience work	
			Local Authorities	Develop long term funding for community climate resilience Engage communities on London's climate resilience work	
			Funders	Increase funding for climate resilience	
			Equalities and community groups	Engage with climate resilience work	
14.	Spaces for Resilience	Continue to grow London's spaces for resilience initiatives and drive a coherent approach	Local Authorities; Mayor of London; Voluntary & community sector; Faith and belief partners		D CB

Communities					
No	**Recommendation**	**Description**	**Owners and role**		**Type**
15.	Climate Working Groups	Convene key partners to share best practice on adaptation within specific sectors and create adaptation plans and actions.	Sector representative bodies; the LCRP	Convene and create climate working groups to drive adaptation and resilience	D CB
			Culture sector organisations including: Exhibition Road Cultural Group, Arts Council England; Association of Leading Visitor Attractions	Pilot a Climate Working Party for the culture sector and venues in London	
			London Sport & London's participatory and professional sport organisations	Pilot a Climate Working Party for Sport in London	
16.	Health Sector Adaptation Plans (1)	Provide strategic leadership and coordination to systems in London to allow them to develop and implement adaptation plans and risk assessments. Support identification of "once for London" opportunities.	NHS England in London		S
17.	Health Sector Adaptation plans (2)	Work with their organisations to collaboratively agree an approach to adaptation risk assessment and planning. Coordinate support required for providers and work with partners to set system level adaptation plans.	Integrated Care Boards		S CB
18.	Health Sector Adaptation plans (3)	Providers of NHS services should ensure they have completed a climate change/ adaptation risk assessment to support development of an adaptation plan.	NHS Services		S

Communities					
No	Recommendation	Description	Owners and role		Type
19.	Health Effects of Climate Change Priorities	Work with the London Health Board to mainstream adaptation action by ensuring that climate mitigation and adaptation are included in any future London Health and Care Vision or strategy, and by considering adaptation in its meetings in 2024/2025 (and beyond). The Mayor could act as a convenor to improve mutual understanding of what London's priorities are for managing the health effects of climate change and preparing the health sector for acute and chronic impacts.	Mayor of London		S
20.	Climate Change and Health Systems Responsibilities	Ensure responsibility for regional aspects of climate change are clearly defined.	UK Government-UKHSA		S

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
21.	A climate resilient planning system (1)	Invest in local planning to address under-resourcing and skills gaps which hinder delivery of climate resilience through the planning system.	UK Government		S D
22.	A climate resilient planning system (2)	Build on the London Plan's leading adaptive policies and ensure that climate change, both adaptation and mitigation, are given greater weight in planning decisions.	Mayor of London		S D
23.	Expand Part O	Expand Part O of the Building Regulations to refurbishments.	UK Government		S I D

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
24.	Decent and Future Homes Standards	The Decent Homes Standard and Future Homes Standard should set out specific measures for climate resilience with explicit requirements for managing excess heat (cooling), ventilation, water efficiency, flood resilience and biodiversity. The updated Decent Homes Standard must be accompanied by investment from UK government to bring existing homes to this standard.	UK Government		S I D
25.	National Infrastructure Assessments	In line with the Second National Infrastructure Assessment (Recommendations 28 to 31) by 2025, government should work with relevant sectors and update resilience and technical standards above and beyond the minimum projected rise in global temperatures.	UK Government		S
26.	A step-change in Sustainable Urban Drainage	Enact Schedule 3 to The Flood and Water Management Act to ensure that Sustainable Drainage Systems (SuDS) are considered and used to manage surface water, ensuring resilient drainage systems for new developments in both urban and rural areas. Prioritise action to adapt existing buildings and create climate ready streets and roads.	UK Government		S D

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
27.	A climate resilient built environment	Prioritise action to adapt existing buildings and create climate ready streets and roads.	Mayor of London; Transport for London; Mayoral Development Corporations; local authorities; social housing providers; businesses; national highways; Business improvement districts; land owners and managers		I D
28.	Adaptation Accelerator	Create an “adaptation accelerator” programme which supports organisations to develop climate action plans, as well as the development and delivery of projects.	Mayor of London		D CB
29.	Climate ready buildings	Ensure both net zero and adapting to climate change are considered in all building upgrade policies and programmes and national funding is made available to support delivery.	UK Government, Mayor of London and Local Authorities		S I D
30.	Subsidence Risk	Public bodies in London should incorporate subsidence risk into their plans and take a risk-based approach.	Mayor of London; GLA Group; Local Authorities		S

Climate Resilient Built Environment					
No	**Recommendation**	**Description**	**Owners and role**		**Type**
31.	London's Water Security	Plans must be developed to secure the investment and deliver the action required to meet 1 in 500-year resilience standards to droughts.	Water Companies	Ensure water resources management plans meet 1 in 500 year droughts resilience standards Accelerate delivery of smart meter roll out; infrastructure upgrades and new supply options	S I D
			UK Government	Respond to Water Resource Management Plans and provide direction to water companies urgently	
			Ofwat	Facilitate investment in the maintenance of existing assets and development of new assets to meet 1 in 500 year drought resilience standards	
			Mayor of London	Engage with Ofwat and convene stakeholders to ensure the proposed Water Efficiency Fund delivers results for London	
32.	Integrated Water Management Strategies	Continue work on the development of sub-regional integrated water management strategies and convene partners to deliver the East London pilot strategy.	Mayor of London	Convene partners to deliver actions in East London IWMS Assess appropriate scale and develop further IWM strategies for London	S D
			Environment Agency, Thames Water, local authorities, Natural England,	Engage with, support and fund delivery of East London IWMS Support further work on IWMS	

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
33.	Strategic Surface Water Authority	Based on the work of the London Surface Water Strategic Group, UK government creates a Strategic Surface Water Authority for London, led by an independent and non-political Chair, to promote, enforce, and allocate funds in-line with a strategic London-wide approach to flooding.	UK Government		S
34.	Managing impermeable land	As part of the UK government's review into managing the surface water impacts of increases in impermeable surfaces in public and private spaces, it should consider introducing stormwater charges for people who pave over gardens and incentives to remove paving.	UK Government		S
35.	A National Approach to Managing Wildfire	Produce a National Wildfire Strategy and Action Plan by 2025. This should define effective wildfire risk reduction measures, including at the rural/urban interface, and be informed by a real-time and dynamic England Wildfire Risk Map by 2028.	UK Government		S
36.	Adaptation of Transport	Support the Transport Adaptation Steering Group to connect with transport providers in other cities nationally and internationally to develop best practice adaptation for city transport.	Mayor of London; Transport for London		S

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
37.	TE2100 Plan	As part of the Defra review of the statutory powers and responsibilities to map, monitor, inspect and maintain all assets across all flood risks and coastal erosion, (including watercourses and riparian landowners' role and responsibilities), due in March 2024, Defra should reconsider the Thames Estuary 2100 10-Year Review Advisory Group's recommendations.	UK Government		I D
38.	Riverside Land Audit	The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.	Mayor of London, Local Authorities, Thames Water, public and private riparian land owners		I D CB
39.	Blue and Green Infrastructure (1)	Increase investment in blue and green infrastructure (BGI).	UK Government		I
40.	Blue Green Infrastructure (2)	Build on existing tools to develop a strategic framework for the delivery of BGI across London; use this to inform funding programmes and convene partners to drive a strategic approach to BGI across London.	Mayor of London		S I CB
41.	Blue Green Infrastructure (3)	Support a strategic London-wide approach to BGI in London and prioritise funding for BGI.	Local Authorities		I D

Climate Resilient Built Environment					
No	Recommendation	Description	Owners and role		Type
42.	Blue Green Infrastructure (4)	Invest in London's BGI, embed BGI delivery in strategies, and engage with the Mayor, and local partners.	London's public and private sector landowners and managers		I D

A Climate Resilient Economy					
No	Recommendation	Description	Owners and role		Type
43.	Review of the Economics of Climate Adaptation	A Stern, or Dasgupta, style review into the economics of adaptation and climate resilience.	UK Government		S I CB
44.	Costs and benefits of adaptation	Commission work to strengthen the evidence base on the costs and benefits of adaptation and climate resilience.	Mayor of London	Lead	S I CB
			LCRP	Support development of the scope; engage in the work; share data and evidence	
45.	Enabling investment in climate resilience	The Mayor's London Climate Finance Facility takes forward approaches that can mobilise greater levels of private finance into climate adaptation projects, this could include launching a green bond.	Mayor of London		I
46.	SME Climate Re-silience	Include climate resilience as part of Grow London Local's offer to small businesses.	Mayor of London and London & Partners		CB
47.	Streetworks and Sustainable Urban Drainage	Work with public and private sector organisations to introduce a market-based system to enable the delivery of Sustainable Drainage Systems (SuDS) with funding through planned Street Works Programme.	Mayor of London		I D

A Climate Resilient Economy					
No	**Recommendation**	**Description**	**Owners and role**		**Type**
48.	Skills for a climate resilient London	Ensure the Mayor's skills agenda addresses climate adaptation. This includes the use of the Mayor's Adult Education Budget and other skills programmes to ensure adaptation is addressed across all skills provision, including the Mayor's skills academies. Work with London employers through existing structures, like the London Partnership Board and the Jobs and Skills Business Partnership, to coordinate delivery of training and apprenticeships to provide employment pathways which support London's climate resilience.	UK Government	Devolve further powers and funding to the Mayor for adult education and skills in London	I D CB
			Mayor of London	Ensure skills agenda and AEB addresses need for climate adaptation skills Work with awarding bodies, training providers and employers	
			Training providers; awarding bodies; high education institutions	Develop dedicated adaptation skills training and embed adaptation in existing training	
			Local Authorities, London Anchor Institutions/ Employers	Embrace climate adaptation agenda; work with training providers; develop apprenticeships and pathways into employment Integrate investment in adaptation action with skills and apprenticeship initiatives	
49.	Incentivise investment in adaptation	Review taxation for products and incentives for activi-ties that support its climate ambitions and strengthen adaptation and resilience.	UK Government		I
50.	Adaptation Challenge	Launch a Climate Resilience Challenge to promote innovation in the capital and help find solutions to address the impacts faced by Londoners as a result of climate change.	Mayor of London through Challenge LDN		I CB

Annexe One: Review of the economic impacts of climate change on London

Summary

This rapid review of evidence for the London Climate Resilience Review indicates that the **economic cost of climate change in London could be large, equivalent to 2 to 3% of annual regional GDP by the 2050s, and with costs increasing further towards late century**. The results also indicate that there would be significant economic benefits from global mitigation to London. However, even in ambitious mitigation scenarios, and especially in the next twenty years, there will still be residual impacts that can only be reduced by adaptation. This makes a compelling case for investment in adaptation. The results also show that London's economy would be affected by risks across the UK and Europe.

1. Introduction

In support of the London Climate Resilience Review, Paul Watkiss Associates has provided pro-bono support to produce some indicative, high-level estimates of the overall economic impact for London, based on existing literature.

2. Studies reviewed

There is a small but established literature on the economic costs of climate change, which uses various modelling approaches. This includes studies at the global, regional, and national level.

A number of these studies have produced regional level analysis of the economic costs of climate change for Europe and the UK. These studies use sectoral impact assessment models or sectoral econometric analysis, and then feed these results into an economic model (such as a computable general equilibrium model) to estimate the effects on GDP, or aggregate the results from sectors and report as an equivalent % of GDP.

It is stressed that assessing the economic impacts of climate change is extremely challenging, and that there is high uncertainty and only partial coverage of risks. Any estimates – including these below – can be considered indicative only.

For this rapid review, this paper has considered two alternative modelling studies of the economic costs of climate change that produce output for London. The first uses the outputs from a Horizon Europe research project on the costs of climate change, COACCH (CoAssessment of Costs of Climate Change[i], Bosello et al., 2020)[ii].) and the second a recent paper from the London School of Economics (Rising et al., 2022)[iii].

The two studies use different methodological approaches and have different coverage, and so their results are not directly comparable, though the indicative range of the two can provide insights.

The COACCH project estimated the impacts of climate change across Europe using a set of thirteen sector impact assessment models and econometric studies (EU27+UK). These are fed into a cross-sectoral macro-economic assessment, a CGE model, to produce estimates of regional GDP at the NUTS2 level across European Regions and the UK. This considered three Representative Concentration Pathways (RCPs) (RCP2,6, 4.5 and 6.0) with alternative Shared Socio-economic Pathways (SSP).

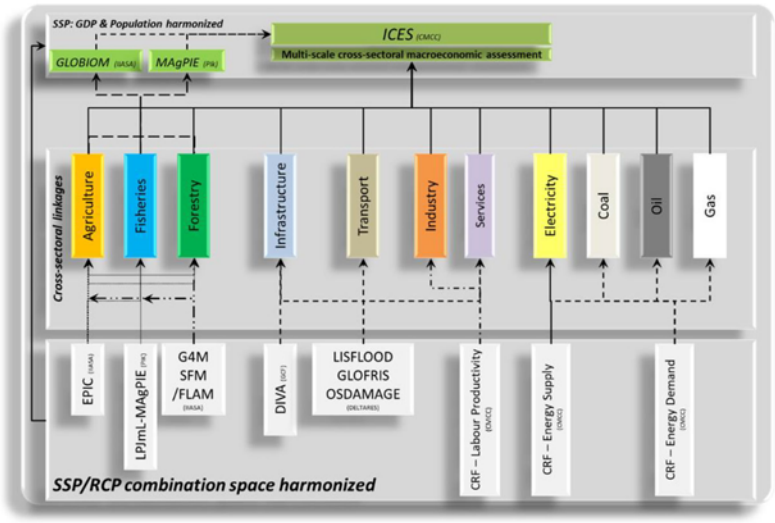


Figure 1: Representation of the vertical and horizontal integrated information exchange flows within the COACCH project. Source: Bosello and Parrado (2018).

The use of a general equilibrium structure allows for the analysis of market flows within a single economy and international flows with the rest of the world. The model structure is shown below:

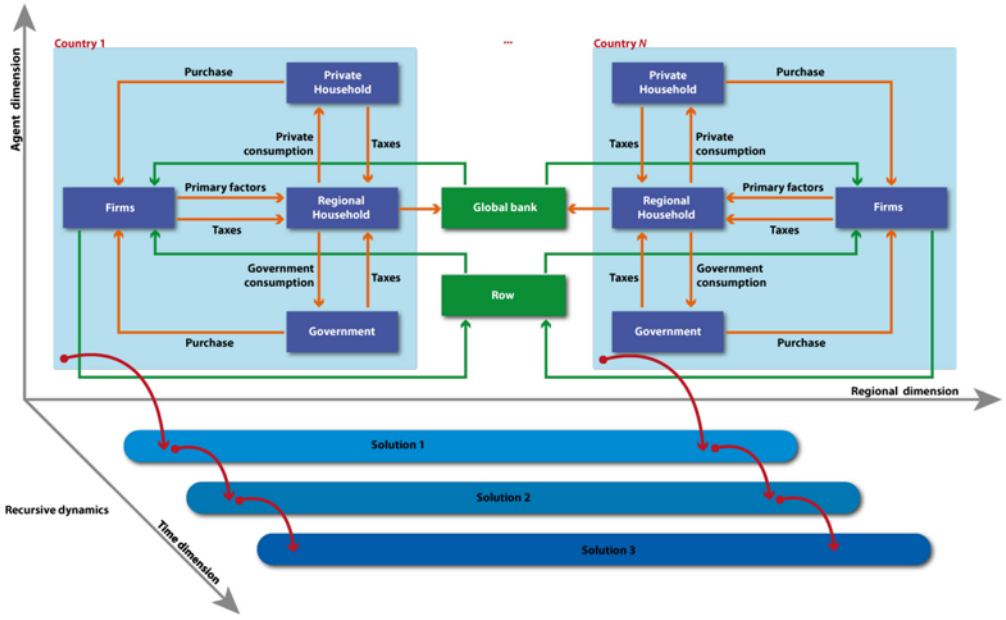


Figure 2: A snapshot of the main ICES elements. Source: ICES.

The LSE study (Rising et al.) takes results from a number of sector impact assessment models and econometric studies. Importantly, this includes the potential for catastrophic events and trade effects which were not included by COACCH project (though the COACCH project includes some impacts not covered by the LSE analysis).

The analysis explored two future scenarios (RCP7-SSP3, and RCP2.6-SSP1). It uses bottom-up projected model data and top-down warming projections to produce gridded exposure-based disaggregation and estimates of trade effects. The study took reported values at lowest level

geographies from the underlying studies and linked them to temperature changes to generate damage functions. It then applies these to the downscaled temperature effects. The grid cell level impacts and damage functions are then aggregated to the region and ADM3 level. Where multiple studies are available, statistical analysis (a hierarchical Bayesian model) is used to combine the results.

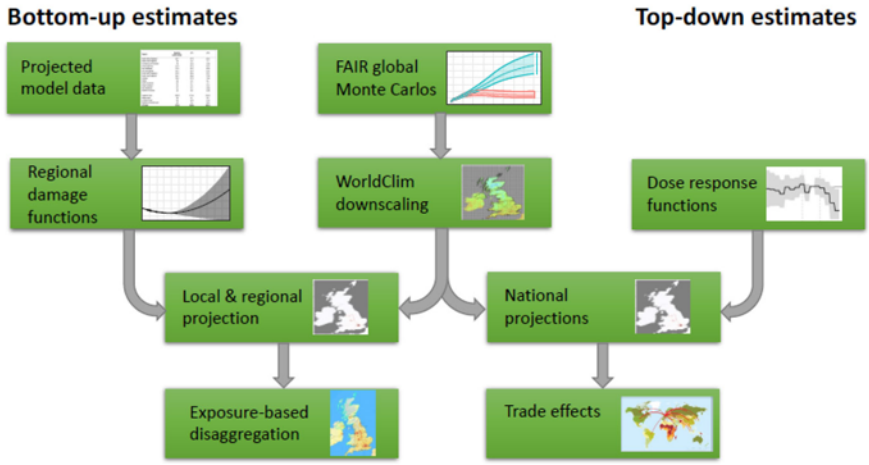


Figure 3: Steps to estimate consistent damage results. Source: Rising et al. (2022)

3. Results from the studies

The results for London from the COACCH model – using the COACCH Climate Change Impact Scenario Explorer[iv] - are shown below:

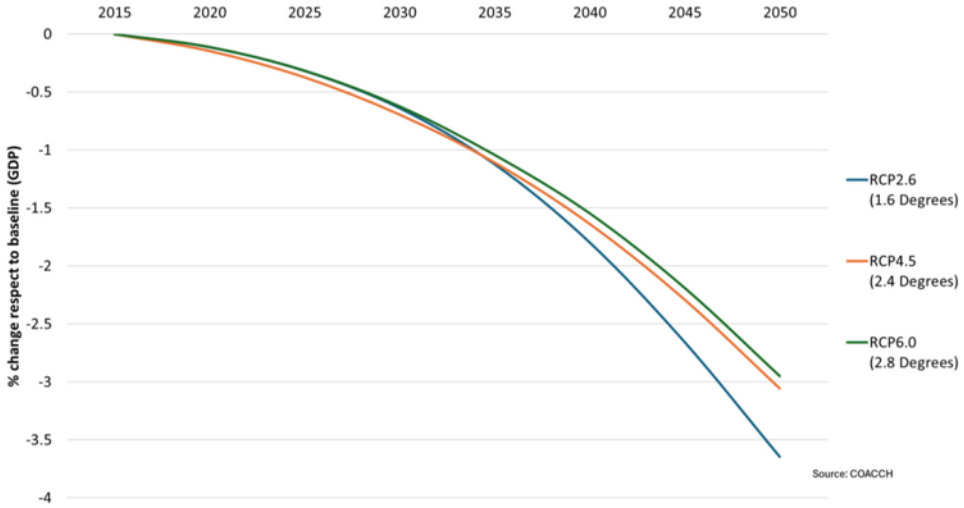


Figure 4: Impact of climate change on London economy. Impact on GDP. SSP2, RCP2.6-RCP.6.0. High Investment Mobility. Source: COACCH.

The results indicate that climate change could reduce London regional GDP significantly. The analysis indicates fairly similar costs through to 2035 for all scenarios, with a projected reduction in annual regional GDP of 1% compared to a 2015 baseline. These impacts rise to 3% – 3.6% by 2050.

The results from Rising et al (2022) are also available from a web-based tool and data[v] and are shown below. This reports an economic impact equivalent to around 0.8% of London GDP across the 2011-2030 period, rising to around 2.8% by the 2041-2060 period, and finally rising to 6.3% by 2081-2100. Under a 'high mitigation' scenario, the impacts are reduced significantly, but again, there are still significant residual damages.

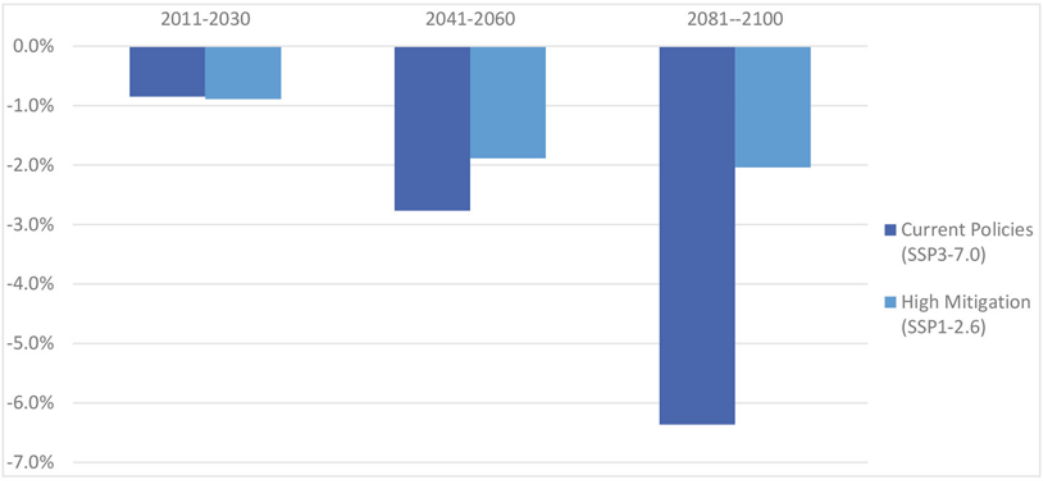


Figure 5: Impacts of climate change on GDP under 'current policies', and 'high mitigation'. Source: Rising et al., 2022.

The main category driving the higher results from the LSE study (for the high mitigation scenario) are the additional category of Catastrophic damage.

References

[i] https://www.coacch.eu/

[ii] Bosello F., Standardi G., Parrado R., Dasgupta S., Guastella G., Rizzati M., Pareglio S., Schleypen J., Boere E., Batka M., Valin H., Bodirsky B., Lincke D., Tiggeloven T., van Ginkel K. (2020). *D2.7. Macroeconomic, spatially-resolved impact assessment. Deliverable of the H2020 COACCH project*.

[iii] Rising J, Dietz S, Dumas M, Khurana R, Kikstra J, Lenton T, Linsenmeier M, Smith C, Taylor C, Ward B (2022) What will climate change cost the UK? Risks, impacts and mitigation for the net-zero transition. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science

[iv] https://www.coacch.eu/interactive-tool/

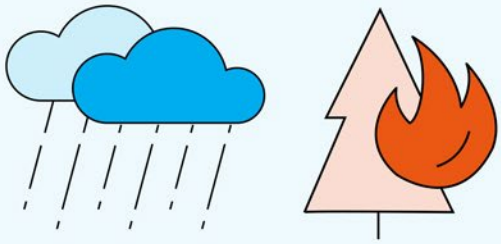
[v] https://www.lse.ac.uk/granthaminstitute/publication/what-will-climate-change-cost-the-uk/

Annexe Two:
Talk London Survey Summary

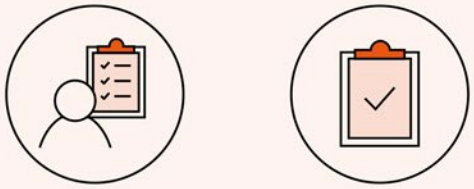
Survey summary

Preparing London for extreme weather - what Londoners think

A Talk London survey summary



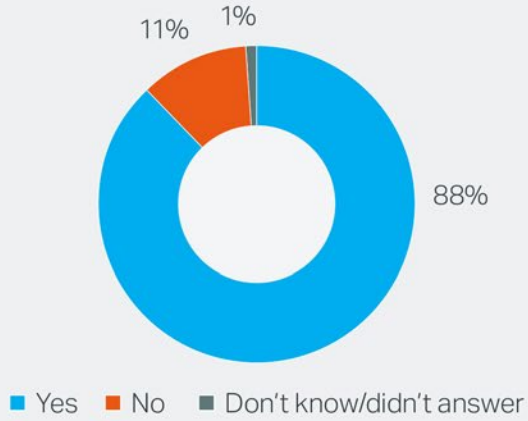
Talk London respondents, aged between 16 and 65+, contributed to the questionnaire that asked what they thought about London's extreme weather events

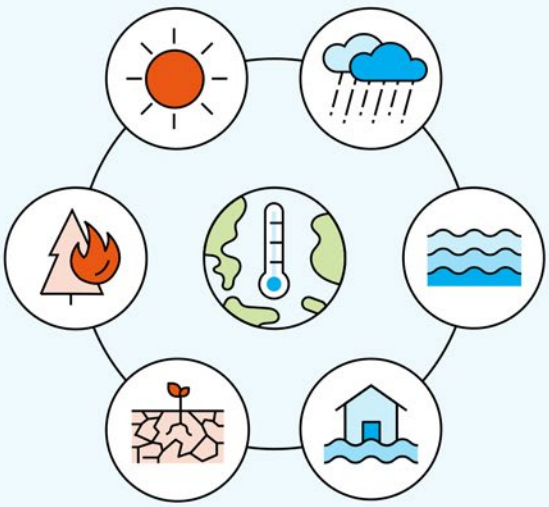


930
people took part in the survey

97%
questionnaire completion rate

Is it important to take climate action to prepare London for more extreme weather events?





"Over recent years, Londoners have lived through an increase in severe heat incidents, more frequent storms and devastating localised flooding."

Top 6 considerations to help avoid future extreme weather events:

Urban planning & design

Sustainable practices

Energy & infrastructure

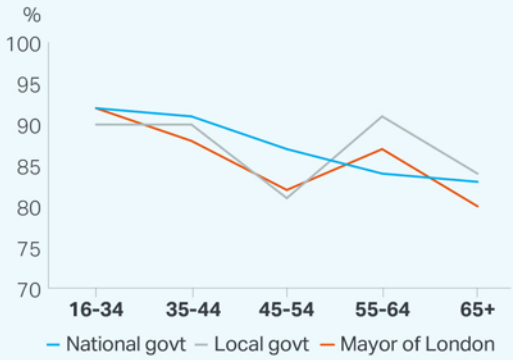
Government policies

Public transport & cycling/walking

Individual behaviours & responsibility

Respondents awareness of climate action being taken within boroughs:

Percentage of respondents (by age) who think government should be responsible for action



Areas of concern for Talk London respondents

- Higher temperatures increasing the need for cooling - both passive and air conditioning
- New buildings/tower blocks - ensuring they are built to be resilient and with access to green spaces
- Stop paving over gardens
- Retrofitting to ensure existing buildings are made climate resilient
- More green infrastructure - tree planting, drought resistant planting, more nature in the city
- Public transport and need to adapt it to a changing climate
- Increasing droughts and the loss of existing green infrastructure that help to cool the city
- Public awareness and more education on what individuals can do
- Health & wellbeing

Annexe 3: Engagement

The Review's recommendations are underpinned by evidence which has been submitted to the Review by organisations and individuals. We are extremely grateful for their engagement and the efforts they have dedicated to providing evidence to the Review, to inform and advance London's climate resilience.

The Review team:

- Received over 110 written submissions to the Review's call for evidence
- Met with over 150 organisations and individuals
- Engaged in 12 roundtables
- Heard from over 900 Londoners through a Talk London survey engagement

The Chair has met with sectors across London to develop a comprehensive assessment of London's climate adaptation and the actions needed urgently to advance London's climate resilience. This includes, but is not limited to:

- London's local authorities, London Councils and other public sector organisations across London.
- London's health sector, NHS London, NHS trusts and London's Clinical Executive Group, and the Office for Health Improvement and Disparities.
- UK Government departments and agencies, including the Environment Agency and National Infrastructure Commission.
- Infrastructure providers and advisory firms such as Thames Water, UK Power Networks, AtkinsRéalis, Arup and Mott Macdonald.
- Large, medium and small businesses and their representative bodies including BusinessLDN, Resilience First, the Federation of Small Businesses (FSB) and London Chamber of Commerce and Industry (LCCI)
- Real estate developers and housing providers.
- Community groups and equalities organisations.

Annexe 4: Recommendations by owner

Mayor of London			
No	Recommendation	Description	Page
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	30
2.	A regional adaptation framework	Work collaboratively to develop an adaptation delivery plan to support London's strategic vision and lead an exercise to map roles and responsibilities	31
3.	Make adaptation an organisational priority	Build on work already underway to embed climate adaptation as a cross cutting organisational priority across the GLA's work and funding, where the GLA has discretion.	33
4.	Climate Resilient Budget	The GLA and London boroughs' finance processes should include a set of questions about climate risks to ensure spending is climate resilient, and the GLA Group's functional bodies should set adaptation plans and measurable targets	34
7.	Systems risks and evidence	In the context of cascading failures due to increasing climate-related risks, consider how the new London Resilience Unit can further strengthen the GLA's approach to managing systemic interdependencies and risks.	37
9.	Strategic Plan for Heat	A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.	42
10.	Heat Exercise	Conduct an exercise to test London's preparedness for a severe heat episode and identify potential cascading and concurrent risks.	46
12.	Individual Adaptive Capacity	Increase action to engage Londoners on climate risks and build their capacity to adapt. Initiatives should be informed by behavioural science, insights based and targeted to ensure that interventions result in behaviour change.	53
13.	Invest in community climate resilience	Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.	55
14.	Spaces for Resilience	Continue to grow London's spaces for resilience initiatives and drive a coherent approach.	57
19.	Health Effects of Climate Change Priorities	Work with the London Health Board to mainstream adaptation action by ensuring that climate mitigation and adaptation are included in any future London Health and Care Vision or strategy, and by considering adaptation in its meetings in 2024/2025 (and beyond). The Mayor could act as a convenor to improve mutual understanding of what London's priorities are for managing the health effects of climate change and preparing the health sector for acute and chronic impacts.	64
22.	A climate resilient planning system (2)	Build on the London Plan's leading adaptive policies and ensure that climate change, both adaptation and mitigation, are given greater weight in planning decisions.	76

Mayor of London			
No	Recommendation	Description	Page
27	A climate resilient built environment	Prioritise action to adapt existing buildings and create climate ready streets and roads.	82
28.	Adaptation Accelerator	Create an “adaptation accelerator” programme which supports organisations to develop climate action plans, as well as the development and delivery of projects.	86
30.	Subsidence Risk	Public bodies in London should incorporate subsidence risk into their plans and take a risk-based approach.	88
32.	Integrated Water Management Strategies	Continue work on the development of sub-regional integrated water management strategies (IWMS) and convene partners to deliver the East London pilot strategy.	92
36.	Adaptation of Transport	Support the Transport Adaptation Steering Group to connect with transport providers in other cities nationally and internationally to develop best practice adaptation for city transport.	98
38.	Riverside Land Audit	The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.	100
40.	Blue Green Infrastructure (2)	Build on existing tools to develop a strategic framework for the delivery of BGI across London; use this to inform funding programmes and convene partners to drive a strategic approach to BGI across London.	104
44.	Costs and benefits of adaptation	Commission work to strengthen the evidence base on the costs and benefits of adaptation and climate resilience.	115
45.	Enabling investment in Climate Resilience	The Mayor's London Climate Finance Facility takes forward approaches that can mobilise greater levels of private finance into climate adaptation projects, this could include launching a green bond.	116
46.	SME Climate Resilience	Include climate resilience as part of Grow London Local’s offer to small businesses.	121
47.	Streetworks and Sustainable Urban Drainage	Work with public and private sector organisations to introduce a market-based system to enable the delivery of Sustainable Drainage Systems (SuDS) with funding through planned Street Works Programme.	121
48.	Skills for a climate resilient London	Ensure the Mayor’s skills agenda addresses climate adaptation. This includes the use of the Mayor’s Adult Education Budget and other skills programmes to ensure adaptation is addressed across all skills provision, including the Mayor’s skills academies. Work with London employers through existing structures, like the London Partnership Board and the Jobs and Skills Business Partnership, to coordinate delivery of training and apprenticeships to provide employment pathways which support London’s climate resilience.	122
50.	Adaptation Challenge	Launch a Climate Resilience Challenge to promote innovation in the capital and help find solutions to address the impacts faced by Londoners as a result of climate change.	125

Local Authorities and London Councils			
No	Recommendation	Description	Page
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	30
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5.	Climate Adaptation Action Plans	Develop climate adaptation action plans, informed by climate risk and vulnerability assessments	35
9.	Strategic Plan for Heat	A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.	42
12.	Individual Adaptive Capacity	Increase action to engage Londoners on climate risks and build their capacity to adapt. Initiatives should be informed by behavioural science, insights based and targeted to ensure that interventions result in behaviour change.	53
13.	Invest in community climate resilience	Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.	55
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27.	A climate resilient built environment	Prioritise action to adapt existing buildings and create climate ready streets and roads.	82
30.	Subsidence Risk	Public bodies in London should incorporate subsidence risk into their plans and take a risk-based approach.	88
31.	Integrated Water Management Strategies	Continue work on the development of sub-regional integrated water management strategies (IWMS) and convene partners to deliver the East London pilot strategy.	88
38.	Riverside Land Audit	The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.	100

Local Authorities and London Councils			
No	**Recommendation**	**Description**	**Page**
41.	Blue Green Infrastructure (3)	Support a strategic London-wide approach to BGI in London and prioritise funding for BGI	106
45.	Enabling investment in Climate Resilience	The Mayor's London Climate Finance Facility takes forward approaches that can mobilise greater levels of private finance into climate adaptation projects, this could include launching a green bond.	116
48.	Skills for a climate resilient London	Ensure the Mayor's skills agenda addresses climate adaptation. This includes the use of the Mayor's Adult Education Budget and other skills programmes to ensure adaptation is addressed across all skills provision, including the Mayor's skills academies. Work with London employers through existing structures, like the London Partnership Board and the Jobs and Skills Business Partnership, to coordinate delivery of training and apprenticeships to provide employment pathways which support London's climate resilience.	122

UK Government			
No	**Recommendation**	**Description**	**Page**
6.	Minister for Adaptation and Resilience	UK government delivers its commitment to a new process for assessing chronic risks by the end of 2025 and appoints a Cabinet Office Minister for Adaptation and Resilience with responsibility for the National Adaptation Programme.	36
8	Statutory Duty	Introduce a statutory duty for local authorities, other public organisations, and major landowners to adapt to climate change, based on a clear framework of local roles and responsibilities. Funding should be provided in local authority and public sector settlements to meet the duty.	40
11.	Invest in Climate Resilience	Develop funding programmes and increase fiscal devolution for regional and local organisations to accelerate climate adaptation.	46
13.	Invest in community climate resilience	Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.	55
20.	(UKHSA) Climate Change and Health Systems Responsibilities	Ensure responsibility for regional aspects of climate change are clearly defined.	66
21.	A climate resilient planning system	Invest in local planning to address under-resourcing and skills gaps which hinder delivery of climate resilience through the planning system.	73
23.	Expand Part O	In line with the Environmental Audit Committee's recommendation, expand Part O of the Building Regulations to refurbishments.	77

UK Government			
No	Recommendation	Description	Page
24.	Decent and Future Homes Standards	The Decent Homes Standard and Future Homes Standard should set out specific measures for climate resilience with explicit requirements for managing excess heat (cooling), ventilation, water efficiency, flood resilience and biodiversity. The updated Decent Homes Standard must be accompanied by investment from UK government to bring existing homes to this standard.	78
25.	National Infrastructure Assessments	In line with the Second National Infrastructure Assessment (Recommendations 28 to 31) by 2025, government should work with relevant sectors and update resilience and technical standards above and beyond the minimum projected rise in global temperatures.	79
26.	A step-change in Sustainable Urban Drainage	Enact Schedule 3 to The Flood and Water Management Act to ensure that Sustainable Drainage Systems (SuDS) are considered and used to manage surface water, ensuring resilient drainage systems for new developments in both urban and rural areas.	80
29.	Climate ready buildings	Ensure both net zero and adapting to climate change are considered in all building upgrade policies and programmes and national funding is made available to support delivery.	87
31.	London's Water Security	Plans must be developed to secure the investment and deliver the action required to meet 1 in 500-year resilience standards to droughts.	88
33.	Strategic Surface Water Authority	Based on the work of the London Surface Water Strategic Group, UK government creates a Strategic Surface Water Authority for London, led by an independent and non-political Chair, to promote, enforce, and allocate funds in-line with a strategic London-wide approach to flooding.	92
34.	Managing impermeable land	As part of the UK government's review into managing the surface water impacts of increases in impermeable surfaces in public and private spaces, it should consider introducing stormwater charges for people who pave over gardens and incentives to remove paving.	94
35.	A National Approach to Managing Wildfire	Produce a National Wildfire Strategy and Action Plan by 2025. This should define effective wildfire risk reduction measures, including at the rural/urban interface, and be informed by a real-time and dynamic England Wildfire Risk Map by 2028.	97
37.	TE2100 Plan	As part of the Defra review of the statutory powers and responsibilities to map, monitor, inspect and maintain all assets across all flood risks and coastal erosion, (including watercourses and riparian landowners' role and responsibilities), due in March 2024, Defra should reconsider the Thames Estuary 2100 10-Year Review Advisory Group's recommendations.	99
39.	Blue and Green Infrastructure (1)	Increase investment in blue and green infrastructure (BGI).	104

UK Government			
No	Recommendation	Description	Page
43.	Review of the Economics of Climate Adaptation	A Stern, or Dasgupta, style review into the economics of adaptation and climate resilience.	114
46.	Skills for a climate resilient London	Ensure the Mayor's skills agenda addresses climate adaptation. Use the Adult Education Budget to ensure adaptation is addressed across all skills provision, including the Mayor's skills academies. Work with London employers through existing structures, like the London Partnership Board, to coordinate delivery of training and apprenticeships to provide employment pathways which support London's climate resilience.	121
49.	Incentivise investment in adaptation	Review taxation for products and incentives for activities that support its climate ambitions and strengthen adaptation and resilience..	124

London's Public Sector Organisations			
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London's Public Sector Organisations			
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London Climate Change Partnership			
No	**Recommendation**	**Description**	**Page**
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	30
2.	A regional adaptation framework	Work collaboratively to develop an adaptation delivery plan to support London's strategic vision and lead an exercise to map roles and responsibilities	31
9.	Strategic Plan for Heat	A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.	42
15.	Climate Working Groups	Convene key partners to share best practice on adaptation within specific sectors and create adaptation plans and actions.	57
44.	Costs and benefits of adaptation	Commission work to strengthen the evidence base on the costs and benefits of adaptation and climate resilience.	115

Private Sector Organisations			
No	Recommendation	Description	Page
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	30
2.	A regional adaptation framework	Work collaboratively to develop an adaptation delivery plan to support London's strategic vision and lead an exercise to map roles and responsibilities	31
9.	Strategic Plan for Heat	A regional strategic plan for adapting to higher temperatures in London to be developed with a governance framework that sets out roles and responsibilities.	42
27.	A climate resilient built environment	Prioritise action to adapt existing buildings and create climate ready streets and roads.	82
38.	Riverside Land Audit	The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.	100
42.	Blue and Green Infrastructure (4)	Invest in London's BGI, embed BGI delivery in strategies, and engage with the Mayor, and local partners.	106
45.	Enabling investment in Climate Resilience	The Mayor's London Climate Finance Facility takes forward approaches that can mobilise greater levels of private finance into climate adaptation projects, this could include launching a green bond.	116
46.	SME Climate Resilience	Include climate resilience as part of Grow London Local's offer to small businesses.	121
48.	Skills for a climate resilient London	Ensure the Mayor's skills agenda addresses climate adaptation. This includes the use of the Mayor's Adult Education Budget and other skills programmes to ensure adaptation is addressed across all skills provision, including the Mayor's skills academies. Work with London employers through existing structures, like the London Partnership Board and the Jobs and Skills Business Partnership, to coordinate delivery of training and apprenticeships to provide employment pathways which support London's climate resilience.	122

London's Equalities Groups, Community Groups & Voluntary Sector			
No	**Recommendation**	**Description**	**Page**
1.	Vision for a Climate Resilient London	The Mayor leads collaborative work with local authorities, the private sector and others to set out a clear strategic vision for what it means for London to be adapting well to climate impacts by 2030 and beyond.	30
12.	Individual Adaptive Capacity	Action should be taken to engage Londoners on climate risks and build their adaptive capacity. Initiatives should be informed by behavioural science, insights based and targeted to ensure that interventions result in behaviour change.	53
13.	Invest in community climate resilience	Long term and consistent investment must be made available for sustained community engagement and capacity building on adaptation across London's community and voluntary sector.	55
14.	Spaces for Resilience	Continue to grow London's spaces for resilience initiatives and drive a coherent approach.	57
15.	Climate Working Groups	Convene key partners to share best practice on adaptation within specific sectors, and create adaptation plans and actions.	57

NHS England			
No	**Recommendation**	**Description**	**Page**
16.	Health Sector Adaptation Plans (1)	Provide strategic leadership and coordination to systems in London to allow them to develop and implement adaptation plans and risk assessments. Support identification of "once for London" opportunities.	64
18.	Health Sector Adaptation plans (3)	Providers of NHS services should ensure they have completed a climate change/adaptation risk assessment to support development of an adaptation plan.	64

Integrated Care Boards			
No	**Recommendation**	**Description**	**Page**
17.	Health Sector Adaptation plans (2)	Work with their organisations to collaboratively agree an approach to adaptation risk assessment and planning. Coordinating support required for providers and work with partners to set system level adaptation plans.	64

Sector Representative Bodies			
No	**Recommendation**	**Description**	**Page**
15.	Climate Working Groups	Convene key partners to share best practice on adaptation within specific sectors and create adaptation plans and actions.	57

London's Water Companies			
No	**Recommendation**	**Description**	**Page**
12.	Individual Adaptive Capacity/Engaging London for Climate Resilience	The Mayor identifies appropriate partners to develop public engagement work, informed by behavioural science, to help Londoners make climate ready choices.	53
31.	London's Water Security	Plans must be developed to secure the investment and deliver the action required to meet 1 in 500-year resilience standards to droughts.	88
32.	Integrated Water Management Strategies	Continue work on the development of sub-regional integrated water management strategies (IWMS) and convene partners to deliver the East London pilot strategy.	92
37.	Riverside Land Audit	The GLA and those who own land bordering the Thames west and east of the Thames Barrier conduct an audit of land they own on the riverbank. They should understand where defences need to be raised and maintained and develop an action plan by 2025 setting out financing and delivery options for raising defences, creating nature-based solutions and sacrificial zones, before 2040.	99
45.	Streetworks and Sustainable Urban Drainage	Work with public and private sector organisations to introduce a market-based system to enable the delivery of Sustainable Drainage Systems (SuDS) with funding through planned Street Works Programme.	116

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