



The Economic Costs of the 2022 Heatwaves in London

An output of the Pathways2Resilience 1-1 support developed in support of Heat Ready London

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Executive Summary

Introduction

In support of the development of Heat Ready London – the Mayor of London’s call to action to partners across London for driving collective delivery to address risks associated with rising temperatures - Paul Watkiss Associates (PWA) and the Athens University of Economics and Business (AUEB) provided support to the Greater London Authority and London Councils (via the EU’s Pathways2Resilience HORIZON project) to estimate the economic (societal) costs of the 2022 heatwaves in London to help support the high-level economic case for the report.

In the summer of 2022, the UK experienced an unprecedented and extended period of extreme heat. This period included three official heatwave events between 15-17 June, 10-19 July and 8–15 August, totalling 21 days, with temperatures reaching 40°C for the first time in London. This resulted in the first ever Level 4 Heat-Health Alert and Red National Severe Weather Warning Service (NSWWS) Extreme Heat warnings to be issued, signifying risk to the entire population.

Met Office data highlights that the frequency and severity of heatwaves have increased between 2000 and 2025. Such extreme heat events are projected to become more frequent and severe under climate change. In this context, this study reviewed the available impact data from the 2022 heatwaves and used a range of techniques to assess the associated economic (societal) cost.

Economic impacts

The economic assessment focused on cost impacts resulting from the heatwaves associated with productivity, education, energy consumption and transport, morbidity and mortality, wildfires and emergency services, and are summarised below:

Productivity - The largest impact comes from productivity-related economic losses to businesses and the public sector. The study uses historical estimates (2000-2021) from the Office for National Statistics (ONS), which are based on heat-induced decreases to economic output, to calculate the average cost of a hot day, considering the non-linear effects as temperatures increase and the unique attributes of different sectors of economic activity. This approach suggests that the total loss in gross value added (GVA) was £1.3bn over the heatwave periods. However, whilst in line with other estimates by the ONS, it is considerably higher than estimates in other studies which highlights the importance of choices related to underlying assumptions and methodologies when assessing productivity losses.

Education - The study also examined the effects that the extreme heat had on education. Scaling findings from the GLA’s Climate Resilient Schools Programme suggests approximately 25 per cent (787) of London’s schools may have closed during the 2022 heatwaves, with an estimated 814,040 student-days of lost learning. The total cost to the education sector was estimated at £39.8m, with a range of £17m – £44m. This includes costs associated with lost school days (the institutional cost of each lost day of schooling) as well as parental work costs (lost earnings when parents were required to take time off work due to childcare responsibilities created by school closures). However, these estimates may underestimate the true costs as they do not account for the long-



term economic impacts of reduced cognitive performance in education as a result of lost learning, which would see these figures rise.

Health (Morbidity and Mortality) - The 2022 heatwaves generated severe health impacts, resulting in excess deaths (mortality) and health impacts (morbidity), with high associated economic costs. London recorded 396 excess deaths during the heatwave periods. Valuing mortality impacts is methodologically challenging because estimates depend partly on the life expectancy of those affected. For heat-related mortality, this is particularly complex, as older adults and people with pre-existing health conditions are among those most vulnerable. This makes the use of population-wide averages to estimate economic losses more difficult. To address this uncertainty, the study valued the impacts using the Value of a Life Year (VOLY) approach (the value society places on a year of life) to estimate a total cost of £52.8m. Using the value of a prevented fatality methodology as a sensitivity analysis indicates that the cost could have been as high as £941m. However, the actual figure is likely somewhere between the two estimates, reflecting the inherent complexity of valuing premature deaths during extreme weather events. Heat can also exacerbate existing respiratory, cardiovascular, cerebrovascular and psychiatric conditions. Using the ratios of mortality to morbidity from the first UK Climate Change Risk Assessment, morbidity impacts totalled approximately £36.3m, for a combined total health cost of £89.1m.

Energy - The heatwaves resulted in an increase in demand for electricity due to an increased demand for refrigeration and cooling, with associated costs to consumers and businesses. Whilst there is limited data, some evidence suggest that the UK experienced a 6 per cent increase in demand during the heatwave periods. As a proxy, the study modelled this increase against the daily average electricity demand for London over the duration of the heatwave periods. This suggests the heatwaves resulted in an extra 120Gwh of electricity demand. Based on Department for Energy Security and Net Zero (DESNZ) Long Run Variable Cost (LVRV) this suggests total additional energy costs as being £31.7m, split between £12.4m for the domestic sector and £19.3m for the non-domestic sector. Factoring in the central estimate of additional costs associated with carbon emissions from the increased energy demand accounts for a further £8.5m, providing a total energy cost of £40.2m.

Transport - Although costs were likely high, the transport sector experienced limited documented impacts. Transport for London (TfL) self-reported revenue losses of £8.4m for the week of the July heatwave alone. However, the true costs were likely much higher, as this figure does not capture wider impacts on the transport network, including staff-related costs, damages to infrastructure, and additional operational expenses. It also excludes wider economic impacts on the local economy due to travel disruptions and only reflects the July heatwave event revenue losses.

Emergency services - The 2022 heatwaves placed unprecedented pressure on London's emergency services, with both the London Fire Brigade (LFB) and London Ambulance Service (LAS) facing record levels of demand. Across the June, July and August heatwave periods, the LFB recorded a total of 9,181 incidents, with direct response costs estimated at £5.6m. Wildfires and outdoor blazes accounted for a substantial share of these incidents, but there were also numerous responses to dwelling fires, alarms, and heat-related emergencies. Ambulance services were similarly stretched, with call volumes surging to 6,600 and 6,800 on 18 and 19 July respectively—well above the daily average of 5,500. The additional heat-related demand was valued at



approximately £8.2m for the full heatwave periods, bringing combined emergency services costs to £13.8m. These figures require some caution - whilst the ambulance estimates the additional burden, the fire service numbers represent all counts, meaning they could overemphasise the additional cost to the LFB since a certain proportion of call out costs would have been incurred regardless of a heatwave. However, they also exclude wider coordination costs, impacts on staff wellbeing, and secondary pressures on health and policing services.

Wildfires – Finally, wildfires represented one of the most notable impacts of the 2022 London heatwaves, highlighting the compound risks extreme heat poses to both urban and peri-urban environments. The LFB responded to 161 wildfires during the summer of 2022. For the documented days of extreme heat, the LFB faced 45 wildfires, resulting in 195 hectares of burnt area. This, in turn, resulted in suppression costs of £295,000 and released an estimated 1,158 tonnes of CO₂-equivalent emissions and 52 tonnes of fine particulate matter (PM2.5), worsening local air quality and contributing to climate change feedback loops. Using UK government valuation metrics for carbon and air pollution damages, the total cost of these emissions was estimated at £1.3m (central scenario), with a plausible range of £0.56m to £3.3m, therefore totalling £1.6m.

The cumulative costs of the impacts across the sectors studied total £1.5bn as shown below. The table outlines the groups (households, businesses and public sector) that will have borne the associated direct fiscal and financial costs arising because of the extreme heat. Costs should be treated as indicative. Due to the lack of direct cost data, the study has made several assumptions. However, the results are likely to be an underestimate. In many cases data only partially covers the heatwave periods, underestimates wider economic impacts (e.g. the long-term economic impact of reduced cognitive performance in education), or only partially covers the impact category (e.g. impacts on the Metropolitan Police are not captured in the scope of emergency services). This analysis also does not capture impacts on all sectors (e.g. utilities are not included).



Table 1: Total estimated economic costs of the London 2022 Heatwaves by type, with associated organisations impacts. 2024 prices. Numbers rounded to nearest £'000 Source: Authors

Category	Cost	Who typically incurs associated fiscal/ financial costs?
Productivity	£1,320,000,000	Businesses, households, public sector
Health (Mortality -VOLY)	£52,833,000	Public sector (NHS, Emergency Services)
Energy Consumption	£40,221,000	Businesses, households
Education	£39,756,000	Households
Health (Morbidity)	£36,312,000	Public sector (NHS, Emergency Services)
Emergency Services	£13,782,000	Public sector (London Fire Brigade, London Ambulance Service)
Transport (TfL)	£8,400,000	Public sector (TfL)
Wildfires	£1,638,000	Public sector (London Fire Brigade)
Total	£1,512,942,000	

Conclusion

Extreme heat is already imposing a material economic burden on London. The results show that London experienced significant economic, fiscal and financial impacts from the 2022 heatwaves, totalling £1.5bn and that these are borne by businesses, households and the public sector.

Left unchecked, these costs are likely to escalate as climate change intensifies, adding to wider cost pressures, such as an aging population and increased life expectancy. Given climate projections suggest that such events are likely to become more frequent and more severe, there is a strong economic rationale for investment in adaptation which reduces such impacts.

Developing a vision and action plan for addressing heat risk would support efforts to reduce the impacts identified here. This should have a strong focus on implementing adaptation options in sectors which can deliver economic, fiscal and financial benefits today and into the future. These include sectors such as the built environment, business and economy, health and care, infrastructure (energy and transport), emergency preparedness and response and nature, discussed, some of which have been considered in this study. This should also be supported by strong capacity building and community engagement for businesses and citizens to help them better prepare. In addition, there are future research needs to further enhance the evidence base and targeting of adaptation. These include:

- Extending this preliminary work to consider monetary valuation of future climate risks across the full range of risks highlighted in the fourth UK Climate Change Risk Assessment (UKCCRA4) under a range of climate scenarios.



- Continuing work like the London Climate Ready Partnership Climate COST forum to put in place more systematic methods and processes for capturing data from extreme weather events to allow the collection of a stronger evidence base for costing.

The economic and social costs associated with the 2022 heatwaves strengthen the case for focus areas set out in Heat Ready London, despite inherent limitations. Monetary valuation of human life remains challenging, and current models may underestimate costs by missing tail events and socio-economic feedback loops. Robust cost assessment requires standardised local data collection and spatially resolved, bottom-up approaches capturing metropolitan idiosyncrasies. Advancing methodologies to include indirect costs, behavioural effects, and long-term impacts is essential. Better inter-organisational communication and coordination can help overcome reporting limitations. Successful knowledge-sharing networks—like those between the Met Office, local authorities, and first responders—enhance forecasting and early warnings. This report's findings can help catalyse cross-organisational cooperation to address data gaps and reveal the true magnitude of costs cities face from extreme climate events.



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1 Introduction

1.1 Context

As part of the Pathways2Resilience programme, the Greater London Authority and London Councils commissioned a report on the cost of the impacts of extreme heat to inform the economic rationale for developing Heat Ready London. This study was conducted by Paul Watkiss Associates (PWA) and Athens University of Economics and Business (AUEB).

Adaptation is typically undertaken as a cycle, which involves early preparatory work, risk assessment, identification and assessment of options, implementation, monitoring, evaluation and learning. Risk assessment is an important early stage in climate change adaptation. It is undertaken as a key input into the identification, assessment and selection of adaptation options to be taken forward as part of a place's climate change adaptation strategy and plan. Whilst the Pathways2Resilience programme is piloting the development of a more ambitious adaptation planning cycle with 100 subnational governments, the typical adaptation cycle as embodied in the European Environmental Agency's (EEA) Regional Adaptation Support Tool (RAST) is shown in Figure 1 below:



Figure 1: The adaptation policy cycle according to RAST. Source: Climate ADAPT, 2024.

Costing current and future climate impacts can help explore risk and prioritise adaptation action needed. By examining the potential costs and consequences of taking no action—such as damage from floods, extreme heat, or storms—communities and decision-makers can better understand why investing in protection and adaptation makes sense both strategically and when evaluating specific solutions. Collecting such information can also be useful to build the socioeconomic narrative for adaptation and inform the case for action. This study helps to build the evidence to inform the case for addressing heat risk in London.

The report is aimed at policymakers and practitioners helping to develop and implement heatwave responses in London – however, it may also be relevant to others working on adaptation to extreme heat.

1.2 The London 2022 Heatwaves

In the summer of 2022, the UK experienced an unprecedented and extended period of extreme heat (Figure 2). This culminated in three official heatwave events. In the UK a heatwave is defined as a period whereby daily maximum temperatures meet or exceed 28C degrees for three consecutive days. This definition is then applied retrospectively to encompass all days above this temperature. Global development of heat thresholds relies on statistical links between temperature and excess impacts, which are then tailored locally according to local climate, acclimatisation, vulnerability, and operational feasibility.

Using this definition, and based on Met Office data supplied to PWA and AUEB by the Greater London Authority, London experienced three heatwave periods in 2022 – between 15 -17 June, 10-19 July and 8-15 August, totalling 21 days.

For the July heatwave, the Met Office issued its first ever red extreme-heat warning level as part of the Extreme Heat National Weather Warning Service, whilst for the 11 to 14 August heatwave, the Met Office issued an Amber Extreme Heat warning, as hot air moved north from the near-continent (Met Office, 2022a). Since June 2023, Weather Health Alerts have moved to impact-based alerting, using temperature thresholds as decision making aids, but for 2022, the system was based on probabilities of reaching threshold temperatures (UKHSA and Met Office, 2025).

This heatwave marked a milestone in UK climate history, with 40°C being recorded for the first time in the UK (Met Office, 2022b). The event resulted in a wide range of impacts on society, the economy and the environment (see for example Howarth et al., 2022).



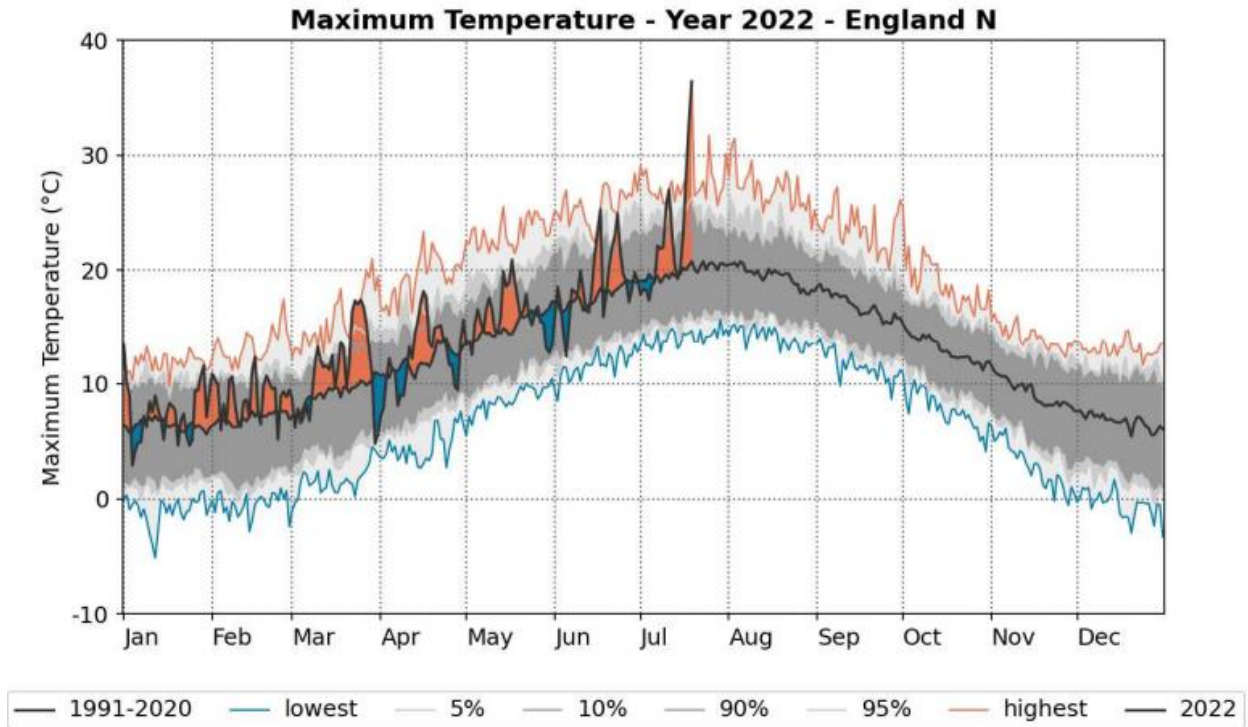


Figure 2: UK daily area-average maximum temperatures for the year 2022. Source: Met Office (2022a).

Such heatwaves (and the associated impacts) are expected to increase in severity and frequency in the UK as a result of climate change (Met Office, 2022c). The preliminary data provided by the Met Office for this study indicates a gradual increase in the number of heatwave days over the past 25 years (Figure 3).

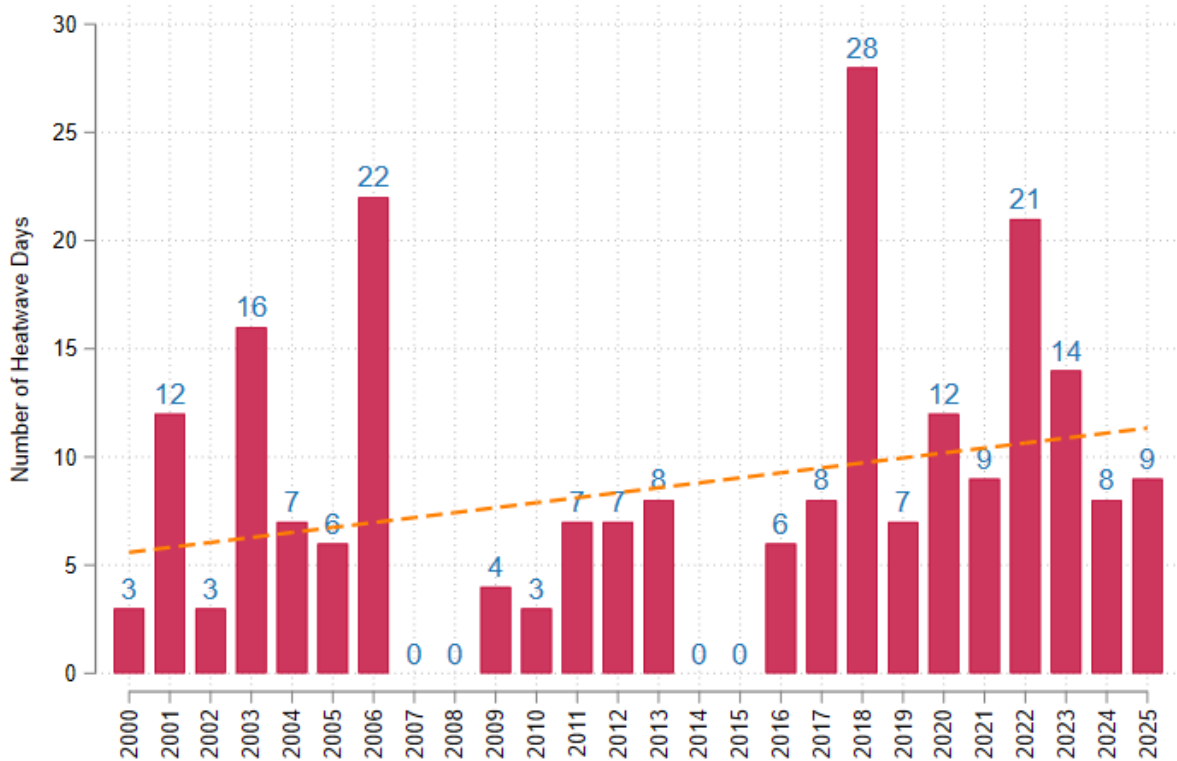


Figure 3: Number of heatwave days in London, 2000 - 2024. Source: Authors, based on Met Office (2025). Linear trend estimated from the simple OLS regression of the number of hot days on time.

The effects of heatwaves are particularly acute in cities. Urban environments contain predominantly non-reflective, impermeable building materials that absorb and retain heat. The absence of vegetation and moisture-retaining soil—which would typically provide cooling shade and evaporation—causes urban temperatures, such as in London, to be up to 12 degrees warmer than in rural areas, creating what researchers call the urban heat island effect (UK Green Building Council, 2022). Furthermore, there is significant variation across Greater London – and this variation is shown in Figure 4 below. To date there have been limited efforts to cost these impacts in London and this study seeks to bridge this gap.

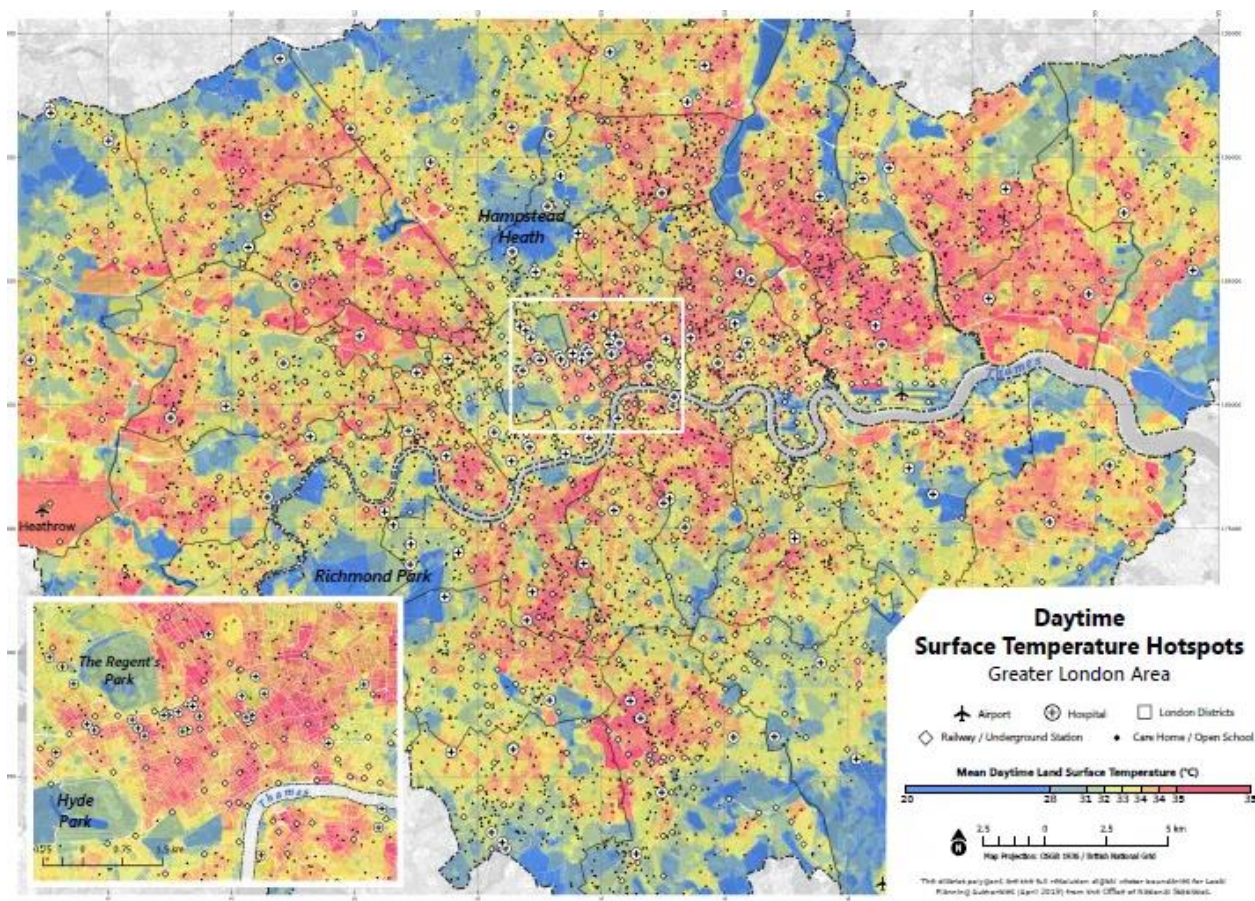


Figure 4: Daytime Surface Temperature Hotspots. Source: Extrema, 2021.

2 Methodology

The study has analysed historical impacts and their economic and financial costs arising from the 2022 heatwaves in the UK. The methods used are in line with both the guidelines on costing climate impacts (Metroeconomica, 2004), as well as the Green Book (HM Treasury, 2026).

2.1 Scope of appraisal

The study undertook an economic appraisal. Economic appraisals focus on the costs to society. This includes direct financial costs to individual organisations and fiscal costs to the public finances but is also broader and including non-market sectors (e.g. health), as well as intangible impacts such as societal costs associated with carbon emissions and poor air quality. These impacts are borne by households, businesses and the public sector. The societal nature of some impacts mean they cannot be attributed to specific organisations. However, where possible throughout the report we have sought to identify the main groups bearing the costs of these impacts.

2.2 Data collection

Typical studies on historic impacts begin by reviewing the range of historic weather events, as well as the available primary evidence, to determine a shortlist (see e.g., Watkiss et al. 2018, Paul

Watkiss Associates and Sustainability West Midlands, 2024). However, given the resources and evidence available, the decision was taken to focus on the 2022 heatwaves.

Information was gathered on several sectors affected by the heatwaves, and relevant indicators were identified for each sector. These are shown in Table 2 below:

Table 2: Final scope of analysis for the mini-costing study. Source: Authors.

Sector	Impacts
Health	<ul style="list-style-type: none"> Excess deaths - mortality Morbidity
Economy	<ul style="list-style-type: none"> Productivity losses
Energy	<ul style="list-style-type: none"> Electricity usage and carbon emissions
Education	<ul style="list-style-type: none"> School closures and parental days
Transport	<ul style="list-style-type: none"> Revenue losses (Transport for London)
Emergency Services	<ul style="list-style-type: none"> Ambulance callouts Fire Brigade callouts
Wildfires	<ul style="list-style-type: none"> Suppression costs Carbon Emissions Air Quality, fine particulate air pollution (PM2.5)

2.3 Geographical scope

The geographical scope of the study covers Greater London and its constituent boroughs.

2.4 Time period

The analysis focuses on the impacts that occurred within the specific heatwave periods in June, July and August 2022 heatwaves – 15 -17 June, 10-19 July and 8-15 August, totalling 21 days. However, only partial evidence was available for many of the estimates provided – such as data on ambulance emergency calls or the costs of wildfires. Due to time lags associated with some impacts, such as mortality, wider time periods were also considered in some cases. In these cases, partial data was used, or where appropriate, extrapolated to provide indicative estimates.

2.5 Use of prices

The study has updated all monetary figures to 2024 prices to provide a most accurate picture which accounts for inflation.

2.6 Limitations

Given the time available for this study, the work has focused on the existing available evidence. It has not sought to generate new results and evidence.

2.7 Valuation approach

For quantitative impacts, economic valuation was carried out in line with standard costing guidelines (Metroeconomica, 2004). The costing methodology comprises two stages. The first stage is to quantify the impacts of the weather-related events, and the second stage is to value these impacts (see details in Box 1). Where data is not available on impacts, valuation is also not possible.

The study looked at both financial and economic impacts of the high temperatures experienced. Financial impacts are those valued from the standpoint of the individual household or organisation involved, whilst economic impacts are those valued from the standpoint of the nation as a whole. This includes non-market values (e.g. health or carbon emissions). The quantitative values and the valuation approaches used for impacts are described throughout the results.

Box 1: Costing approach for historic climate impacts.

The standard approach used for valuing climate impacts is as follows:

Cost (or benefit) = Number of physical units in a year x Economic unit value

Specifically:

Cost (or benefit): of a weather-related event on a specific vulnerable receptor (or group of receptors), under selected climate and socio-economic scenarios (£ per event in a given year).

Number of physical units in a year: The predicted 'physical' impact on the vulnerable receptor(s), under selected climate and socio-economic scenarios (the number of physical units affected by the event in a given year).

Economic unit value: The appropriate economic unit value or 'price' (£ per affected unit in a given year).

Source: Metroeconomica (2004)

To value the risks, the study relied on the quantification of current and potential future impacts for London. This involved using different types of evidence to construct estimates of the potential economic impacts over time. Table 3 below shows the approach used to prioritise and select evidence. It is structured in order of preference, from most preferred to least preferred.

Table 3: Valuation approaches used depending on available evidence listed in order of preference (descending from most preferred to least preferred). Source: Authors.

	Available evidence	Approach for valuation
Most preferred	Direct economic cost estimates (for example, after flooding events)	Values used directly, after checking consistency with existing government appraisal guidance.
	Quantified risk information, but no previous valuation	Unit values used from existing government appraisal guidance.
	No quantitative information available	Estimates of the order of magnitude of the economic costs are made using available information and expert judgement. When unit values are used, these are based on guidance from HM Treasury Green Book and Supplementary Guidance from Departments and Ministries, e.g., for transport, we would draw on the Department of Transport WebTAG guidance on appraisal.
Least preferred	No government appraisal guidance or unit values available	Estimates based on the relevant literature for the risk or opportunity. Ideally, these are based on valuation estimates from market values or willingness to pay estimates. However, where such data are not available, we use alternative approaches for valuation (e.g., repair or adaptation costs) to provide indicative estimates.

3 Sectoral results

3.1 Health - Morbidity and mortality

Extreme heat can have significant impacts on health, including exacerbating existing health conditions (morbidity) and resulting in excess deaths (mortality) (Arbuthnott and Hajat, 2017). The UK Health Security Agency (2023b) identified 387 excess deaths in London in the heatwave periods for summer 2022, covering five periods of hot weather:

- **Episode 1 (16–19 June)** lasted 4 days with Level 3 Heat Health Alerts (HHAs) in the East, Southeast, and London.
- **Episode 2 (10–25 July)** was a 16-day heatwave where all regions eventually reached Level 3, and a national Level 4 HHA was issued for 2 days (18–19 July).
- **Episode 3 (30 July–5 August)** lasted 7 days with no Level 3 alerts, although Central England Temperature (CET) reached 20°C.
- **Episode 4 (8–17 August)** lasted 10 days with Level 3 HHAs across all regions.
- **Episode 5 (23–25 August)** lasted 3 days with no HHAs, despite CET reaching 20°C.

Data on excess deaths for these periods is collated by the UKHSA (2023b). The results are shown in Table 4 below.

Table 4: Estimated all-cause excess mortality for London attributable to the heatwave periods, 95per cent confidence intervals.
Source: UKHSA (2023b)

Heat period	16-19 June	10-25 July	30 July - 5 August	8-17 August	23-25 August	Total
Estimated excess deaths	38	184	1	174	-11	387
Confidence interval (CI)	(-30-107)	(19-349)	(-96-99)	(53-295)	(-67-45)	(158-615)

Due to a lack of data for the specific heatwave periods examined in this study, we considered three out of the five heat episodes that occurred during those dates: Episode 1 (16-19 June), Episode 2 (10–25 July) and Episode 4 (8–17 August). Over this period, 396 excess deaths occurred.

To calculate the economic impacts, the study multiplied the number of excess deaths by an appropriate economic unit value. While heat-related mortality represents a non-market cost, several studies have assigned monetary valuation using values commonly applied in government economic appraisals (e.g., Watkiss, P., 2021; Paul Watkiss Associates and Sustainability West Midlands, 2024). Such studies have typically used the three metrics – the Value of a Life Year (VOLY, sometimes called a statistical life year, SLY), the value of a prevented fatality (VPF) and the Quality Adjusted Life Years (QALYs), accounting for longevity and quality of life.

VOLY focuses on the value society places on one additional year of life. A VOLY is used as the baseline valuation metric because it reflects willingness-to-pay (WTP) to return to normal health in mortality risk expressed in terms of life-years, and is widely applied in climate impact

assessments and in general, in the health economics discourse. It is derived by dividing the Value of a Statistical Life (VSL) by the total number of discounted remaining life years (based on life expectancy) at a given age. The study updated the 2022 VOLY value to 2024 prices. Valuing the impacts based on one additional life year for each death suggests mortality costs from the 2022 heatwaves are in the order of £26.4m (Table 5).

Table 5: Mortality estimates of 2022 heatwave (VOLY). Source: Authors, based on ONS (date) and HM Treasury, 2022. 2024 prices

Excess deaths	Value of One Life Year (VOLY)	Total Cost
396	£ 66,708	£26,416,368

However, the valuation of mortality risk from heatwaves is subject to considerable uncertainty, primarily because the affected population tends to be older individuals or those with pre-existing health conditions. As a sensitivity analysis, the study used the Value of a Prevented Fatality (VPF). The VPF represents the monetary value assigned to a reduction in the risk of death, rather than the value of an individual life (Thomas and Vaughan, 2015). It reflects the additional amount people are willing to pay to reduce their risk of death by a small margin. Similar valuation methods have been used to elicit public attitudes toward renewable energy generation and their willingness to pay for the construction of a wind farm, including the mean premium they are willing to add to their bi-monthly electricity bills (Koundouri et al., 2009). This approach is widely used in cost-benefit analyses to assess the economic benefits of policies that mitigate mortality risk, such as those related to air quality, traffic safety, and public health interventions.

The VPF comprises the sum of net output, willingness to pay (WTP), and medical & ambulance cost (Department for Transport), where net output is the remaining 20 per cent of lost output (in terms of savings), WTP is the sum of the human costs and the 80 per cent of lost output (in terms of consumption). This breakdown is shown in Table 6. To estimate the total cost the study multiplied the VPF value by the 396 excess deaths, resulting in a total VPF-based cost of £940,551,480. This estimate is significantly higher but is likely an overestimate in this context because the VPF applies a full prevented-fatality value to each excess death, rather than adjusting for the potentially lower average life expectancy lost in heat-related mortality.

Table 6: Breakdown of components of Value of Prevented Fatality. Source: Authors, based on the Department of Transport. 2024 prices.

Net output	Willingness to pay	Medical & Ambulance costs	Total	Total Cost
£155,730	£2,218,060	£1,337	£2,375,130	£940,551,480

The true economic value is likely to fall between these two estimates. For this study, the VOLY approach has been used to estimate aggregate mortality costs, with the value doubled as a pragmatic adjustment to reflect that some heat-related deaths may involve impacts beyond a single lost life year. This gives a final value of £52,832,736m.

Finally, climate change can also exacerbate existing respiratory, cardiovascular, cerebrovascular and psychiatric conditions (UKHSA, 2023). To estimate the cost associated with morbidity-related impacts, the study utilised the mortality to morbidity ratio of 1:102 and the unit value of £625 per case, as used in the first UK Climate Change Risk Assessment (Hames and Vardoulakis, 2012). Considering the 396 reported deaths this yields 40,392 cases of morbidity. Updating the unit cost using 2024 price levels this results in an additional £36m in induced costs associated with impacts to health and well-being (Table 7).

Table 7: Estimated morbidity costs for the 2022 Heatwave periods. 2024 prices. Source: Authors.

No. cases	Cost per case	Total Cost
40,392	£899	£36,312,408

Combining these values (using the double value of the VOLY) provides an estimate of the total health costs from the heatwaves of close to £89.1m.

Table 8: Total morbidity and mortality costs for the 2022 heatwave periods (2024 prices). Source: Authors.

Mortality cost (VOLY)	Morbidity cost	Total Cost
£52,832,736	£36,312,408	£89,145,144

It is important to note that costs associated solely with morbidity and mortality only represent a fraction of the total economic burden placed on the health sector as a result of high temperatures and climate change (Climate Change Committee, 2022; Williams et al., 2019; 2024). While the current economic cost of heat-related mortality in the UK is estimated to be between £260m and £330m per year, not including the cost of illness, this figure could rise substantially by the 2050s, potentially reaching £4bn per year when using the Value of a Prevented Fatality approach (Climate Change Committee, 2022).

Furthermore, healthcare systems face costs from significant operational disruption to services, facilities, and equipment during hot weather (Brooks et al., 2023). For instance, a heatwave can be costlier than other severe weather events due to loss of staff days and the costs of additional welfare support (Williams et al., 2024). Other costs include the heat-related IT failures and their severe repercussions as demonstrated at Guy and St Thomas’ hospital in July 2022 (see Box 2). Although we acknowledge these costs, due to data limitations they have not been included in the calculations in this report.

Finally, London exhibits a high vulnerability to heat-related risks, recording the highest heat-related standardised excess mortality rate (3.21 deaths per 100,000 person-years) among English regions (Gasparini et al., 2022). While mortality risks generally increase with age (meaning the older population face more than twice the risk compared to the younger population), the economic valuation method used (VOLY) significantly alters the perceived financial burden across age groups



as it does not account for the *expected* years of life lost (Gasparini et al., 2022; Simpson et al., 2025). Economic costs related to morbidity and mortality could differ slightly utilising age-weighting methods such as age-adjusted VOLY or Years of Life Lost (YLL), or the use of Quality Adjusted Life Years (QALY) beyond the simple doubling assumed here. Alternatively, the range could be better represented through a fuller sensitivity analysis using VSL for premature deaths and VOLY for displaced deaths, but both data and resource availability meant it was not possible.

Box 2 – The impact of heatwave-induced IT system failures on health services

The failure of critical information technology (IT) systems due to extreme heat poses an additional direct and potentially catastrophic threat to patient safety and healthcare delivery in the UK. This threat was starkly demonstrated on 19 July 2022, when record-breaking high temperatures reached up to 40°C (Guy's and St Thomas' NHS Foundation Trust, 2023). The extreme heat caused the cooling systems at two separate data centres supporting Guy's Hospital and St Thomas' Hospital to fail simultaneously. This failure took down most of the Trust's 371 clinical IT systems, which included electronic patient records, prescribing systems, and electronic ordering for investigations at Guy's, St Thomas', and Evelina London hospitals.

The incident forced the Trust to declare a critical site incident and move to a paper-based operating model. The disruption lasted several weeks before nearly complete restoration, with the critical incident standing down on 21 September. This outage led to widespread service disruption, causing activity levels to fall significantly relative to normal: referrals dropped to 64 per cent, elective surgical admissions to 71 per cent, and diagnostic tests to 68 per cent of typical July levels. Clinically, over 100 treatment delays were reported, including a case of moderate harm where a patient missed an organ transplant (NHS England, 2025). The recovery alone incurred £1.4m in additional costs.

Health information systems are essential for climate adaptation in healthcare, serving two key functions: enabling immediate response to extreme weather events and supporting long-term monitoring and prevention. These systems quantify climate-related health risks, guide interventions, and track resilience by integrating data from mortality surveillance, hospital statistics, and service disruption reports. They also support research, risk monitoring, and early warning systems, helping professionals identify emerging risks and intervention opportunities (NHS England, 2025).

This critical incident underscores the importance of cascading and converging climate risks within the UK health system to climate change. Healthcare infrastructure in England is generally not designed to cope with extreme heat, with an estimated 90 per cent of hospital buildings vulnerable to overheating (Brooks, 2023). Overheating incidents are already rising, with provisional data showing a 53 per cent rise in incidents triggering a risk assessment between 2016/17 and 2023/24, peaking during the 40°C temperatures of summer 2022. Beyond IT failures, overheating facilities compromise patient safety and are an occupational health hazard, reducing staff productivity and increasing stress in already strained environments (Climate Change Committee, 2022). Prioritising investment to improve the resilience of critical NHS infrastructure is material, focusing on passive cooling measures and adequate ventilation to mitigate overheating risk.

3.2 Productivity

Extreme heat impairs both physical and cognitive performance, particularly in sectors involving outdoor labour such as construction and agriculture (Morabito et al., 2021). At the regional scale, this translates into reduced economic output, delayed public works, and higher operational costs for local governments.



To estimate the economic impact of the 2022 heatwaves in terms of productivity loss, the study employed a multi-step approach using time series data. The study used historical data on the annual productivity losses due to heatwaves spanning the period from 2000 to 2021, derived from the Office for National Statistics (ONS) to integrate a robust estimate of the daily heatwave cost on productivity and extrapolate the cost for the 2022 incident. First the study drew on the underlying descriptive statistics to assess the average impact on productivity for the 2022 heatwaves. The study used the ONS projections for the 22-year period to calculate average daily costs from heatwaves. These were combined with the number of hot days in 2022 to extrapolate the total productivity losses from the London 2022 heatwaves. We use the underlying distribution to enhance the robustness of our results by providing realistic ranges of Gross Value Added (GVA) losses for Greater London. More details are provided in Annex 1.

The underlying historical data represent estimates of annual heatwave costs in the form of losses in GVA, using the methodology developed by Costa et al. (2016), according to which specific shares of GVA are lost due to temperatures above 28° C (using Wet Bulb Globe Temperature indicators). These account for the fact that work intensity differs across sectors. Losses are then embedded in sector-specific production functions that consider how easily each sector can substitute labour with capital, as well as its labour intensity. This enables the calculation of heat-related output losses across manufacturing, construction, services, and other activities, then aggregated to estimate city- or economy-wide impacts. The method therefore highlights how labour-intensive sectors with low substitution possibilities are most vulnerable, providing an evidence-based foundation for adaptation planning.

It is important to highlight that the ONS data includes two sets of estimates: one that factors in adaptation, and one that does not, using an adjusted loss multiplier. This does not tie loss reductions to specific adaptation measures, but instead adjusts losses to account for a basket of potential adaptation measures such as avoiding early afternoon working, increasing ventilation, solar blinds and air conditioning. We rely on data reporting GVA losses that assume adaptation actions have been undertaken (data series labelled ‘with adaptation’), primarily because of the large share of services in London’s economy, where workplaces are more likely to have some form of passive or active cooling (e.g., air conditioning in office buildings). However, actual losses are likely much higher because there is an existing adaptation deficit, for example since most homes, schools, care settings or smaller workplaces lack adequate cooling, shading or ventilation which impacts productivity.¹

Figure 5 depicts the historical productivity costs, with adaptation assumed, for London in terms of GVA lost between 2000 and 2021. The left panel shows the spikes in annual costs, broadly in line with the annual heatwave days up until 2012 (the number of heatwave days are captured above the graph markers). Recent episodes of 2019 and 2020 exhibit a non-negligible rise in total productivity losses, even though the heatwaves lasted fewer days compared to the high-cost incidents of the first decade of the century. This points to a relative increase in the adversity of impacts of heatwaves over time. This observation is also evident on the right panel of the graph

¹ Table A2 and Figure A3 in Annex A report the GVA losses from extreme heat under the ‘without adaptation’ scenario.

which shows the daily costs, where 2020 is a clear outlier combining substantial productivity losses with a relatively low number of days of extreme heat.

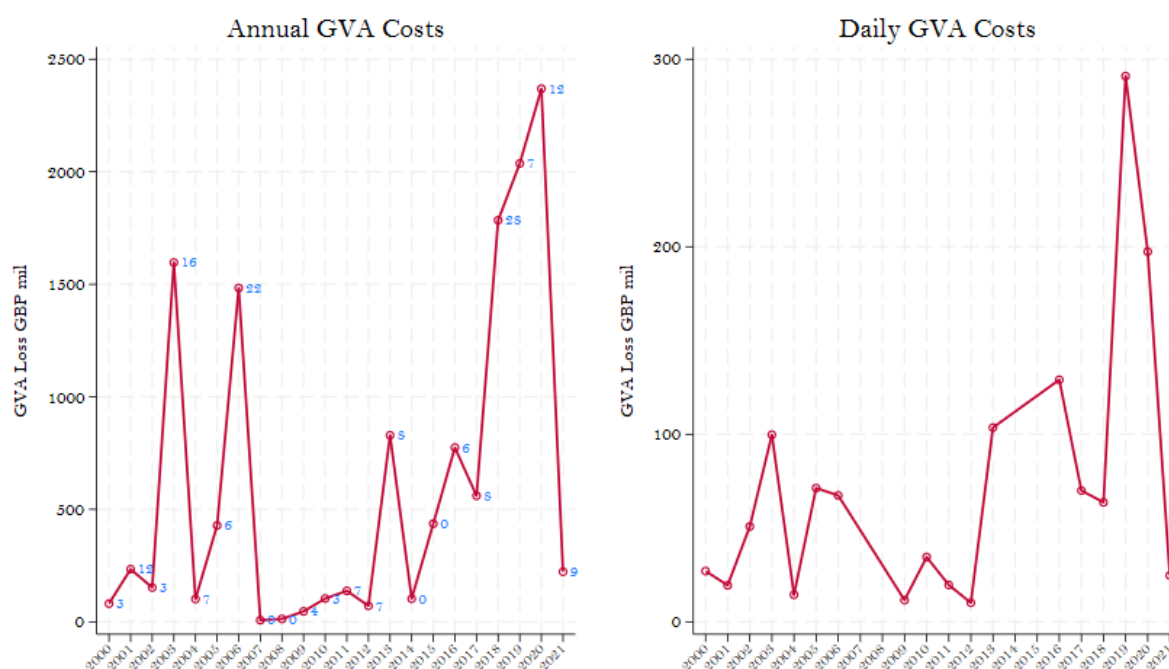


Figure 5: Annual (left) and daily (right) historical productivity costs for London. With adaptation – 2000-2021. 2024 prices. Source: ONS and Authors' calculations

The underlying data indicates that an average daily GVA loss considering the number of hot days in a year in London (as defined by the trigger points for GVA loss in Costa et al., 2016) is £68m. This figure is underpinned by some important details. First, the impact of heat on productivity is influenced by various factors. As heat adversely affects workers, the productivity effect for different sectors and occupations depends on the degree to which labour can be substituted by capital – known in economic terms as the elasticity of substitution between capital and labour. That is, in activities where human labour is difficult to substitute (labour-intensive activities) the GVA losses on hot days will be higher. Additionally, the relative share of different economic sectors in total economic activity in a city is a factor to consider (Costa et al., 2016). In cities where highly affected sectors (such as construction and retail trade) are hotspots of economic activity, total GVA losses will be more pronounced. Finally, any physical and or physiological variations, age factors and any morbidities could also play a significant role in the work capacity of workers (Morabito et al., 2021).

The study primarily used average annual costs for calculation. However, given the variation in historical annual GVA losses, it also considered other metrics to estimate a plausible cost range. This included using average values for daily costs to extrapolate the total cost of productivity losses during the documented days of the 2022 heatwaves. The calculation was based on multiplying the average daily costs by the number of hot days (i.e., days above 28 degrees) which was 19 days, rather than the full 21-day heatwave period. This approach is in line with Costa et al.

(2016), where economic losses are assumed to occur in days where average temperatures exceed 28°C.² Applying this method to the 19 hot days identified during the 2022 heatwaves, this study estimates an productivity loss of £1.3 billion. Using the minimum and maximum documented daily costs from the sample period suggests a wider range of £193m to £5.5bn. A more conservative estimate which excludes outliers yields an expected cost range between £374m and £1.6 bn.³ This implies a range of losses between 0.06-0.28 per cent of total GVA across all industries and service sectors in London (using ONS data for 2022). Table 9 summarises the estimated productivity losses associated with the heatwave.

Table 9: Associated Total productivity losses for 2022 by method. With adaptation. 2024 prices. Source: Authors.⁴

Method	Productivity Losses (£m GBP)
Average Daily Cost (2000-21)	£1,320
Median Daily Cost (2000-21)	£966
Range (Min-Max)	£193- £5,530
Interquartile Range	£374- £1,630

Even using the numbers with assumed adaptation, the GVA losses for London (when using the average daily cost of a heatwave) are quite sizable and larger than recent projections by others (Watkiss et al. 2021, Climate Change Committee, 2022) who estimate annual costs to the UK economy in the range of £260–300m per year, with a high probability of increasing to £720–950m by 2050. Moreover, similar cost figures for London are included in the report by Atlantic Council (2024) for selected cities around the world, placing the current annual costs at \$730m (£577m) with an expected surge to \$850m (£664m) by mid-century under an RCP7.0-SSP3 scenario.

Our findings reflect the importance of sectoral distribution of economic activity in the work of Costa et al. (2016) used in the calculations from ONS. Sectors with higher labour shares and low elasticity of substitution between labour and capital, such as construction and wholesale and retail trade exhibit historically the highest GVA losses (Figures A1 and A2 in Annex 1). The high relative share of these activities in London's economy partly justifies the substantial economic losses during the days of extreme heat.

It should be noted that the methodological differences between the results presented in this report and other studies are non-negligible. In particular, the methodology of Costa et al. (2016) accounts for non-linear effects of temperature increases above certain thresholds and for significant variations in adverse effects across sectors of economic activity.

There are also a broader range of associated economic and fiscal impacts from labour productivity losses that have not been quantified but which merit consideration. For example, economic losses

² We use the number of days where temperature in at least one of the London meteorological stations exceeded 28 C using data from the London Met Office, as this is the critical threshold for the methodology of Costa et al. (2016). Official heatwave days are based on 3-day temperature moving averages.

³ We use the cut-off points for the 1st and 3rd quartile of the distribution (inter-quartile range).

⁴ Note: The different figures arise from using the mean, median, minimum and maximum value for historical daily productivity costs and multiplying by 19. The last row uses the cut-off values for the 1st and 3rd quartile of the distribution of daily costs to calculate the interquartile range of total costs for the 2022 heatwave.

from extreme heat reduce tax revenues for cities primarily by lowering labour productivity, which results in decreased income, sales and real estate values that underpin tax bases such as council tax and business rates. Reduced economic activity means individuals and businesses earn less, pay less in taxes, and may even be forced to close, further diminishing municipal revenue. The current report does not account for forgone tax revenues. However, given the level of economic activity in the region, it can be assumed that some of the GVA losses calculated above may crystallise as lost revenues for government, although the precise share is not estimated in this report.

England et al. (2026 *forthcoming*) highlight this risk in relation to flooding. They estimate potential revenue losses in Edinburgh and South Scotland through reduced Council Tax and Business Rates, linked to the suspension of taxes in affected areas and reduced business activity. Emerging estimates for the Forth Valley in Scotland suggest that climate change could reduce government funding by up to 1 per cent as a result of wider UK impacts (England et al., 2026 *forthcoming*).

In the case of heatwaves, reduced economic activity appears as a more likely route through which public revenues could be affected, although the impacts may be more severe. The London Climate Resilience Review (Howard Boyd et al., 2024) notes local authority revenues could fall through several channels. Council Tax revenues may be affected by changes in property values, occupancy rates and household incomes. Business Rates may also be affected by lower earnings, higher vacancy rates, infrastructure damage and reduced business activity. Severe economic impacts from heat stress, including reduced output and job losses could diminish business rates revenues substantially. More broadly, reduced economic output across the UK correlates with losses in government tax revenues that could amount to hundreds of millions of pounds annually (British Property Federation, 2024).

3.3 Energy consumption

High temperatures can create significant costs for the energy system. Whilst future climate change is expected to have positive effects on future energy demand for heating in winter, it may also increase the demand for cooling in the summer months (Kovats and Brisley, 2021; Alamanos et al., 2022). Higher temperatures increase the demand for air conditioning and refrigeration in homes and businesses, whilst simultaneously reducing the effectiveness of the power infrastructure (Staffel et al. 2022). There are no detailed data on the additional electricity demand for cooling in London during the 2022 heatwaves. In lieu of this, the study developed indicative estimates of the additional costs to households and businesses.

There is limited evidence on the refrigeration and air conditioning penetration in London, and the associated electricity demand. However, early analysis has suggested that on 19 July 2022 there was a 6 per cent increased demand for electricity related to cooling and refrigeration (Staffel et al. 2022). The study took the DESNZ estimates of subnational electricity consumption for London in 2022 and modelled a 6 per cent increase in daily consumption over the heatwave periods to estimate the additional electricity consumption in the heatwave periods (Table 10).

Table 10: Additional domestic and non-domestic electricity consumption during the heatwave periods.

Sector	Additional energy consumption (GWh)
Domestic	40.3
Non-Domestic	78.9

Supplementary Green Book guidance on valuation (Department for Business Energy and Industrial Strategy (BEIS), 2021) suggests that appraisals use the Long Run Variable Cost of electricity instead of the retail price since retail prices include:

- fixed costs that will not change in the long run with a small, sustained change in energy use,
- carbon costs, since these are valued separately
- taxes, margins, and other components which reflect transfers between groups in society.

These were 22p/kWh for non-domestic/industrial and 27.7p/kWh for domestic. The results are shown below. They show the total additional energy costs as being £31.7m, split between £12.4m for domestic and £19.3m for non-domestic (Table 11).

Table 11: Total additional energy cost from the 2022 heatwaves. 2024 prices Source: Authors.

Sector	Total cost
Domestic	£12,428,000
Non-Domestic	£19,267,000
Total	£31,695,000

In addition, there are also CO₂ emissions associated with the use of the grid electricity, and these can also be valued. The study used the BEIS (2021) long-run marginal emissions factors to 2100, which was 0.264 kgCO₂e/kWh for domestic and 0.257 kgCO₂e/kWh for non-domestic. Emissions factors for non-domestic were averaged between commercial and industrial. This showed that the total costs of emissions ranged between £4.3m and £12.8m (Table 12).

Table 12: Total costs of emissions associated with increased energy use in the 2022 heatwaves. 2024 prices Source: Authors.

Scenario	£/tCO ₂ e	Domestic	Non-domestic	Total
High	£415	£4,418,288	£8,401,273	£12,819,561
Central	£276	£2,938,427	£5,587,353	£8,525,780
Low	£138	£1,469,214	£2,793,676	£4,262,890

Bringing these two results together shows a total cost range of between £36m and £44.5m, with a central estimate of £40.2mm (Table 13).

Table 13: Total costs of increased electricity demand (Consumption and carbon emissions). 2024 prices. Source: Authors.

Scenario	£/tCO _{2e}	Domestic	Non-domestic	Total
High	£415	£16,846,611	£27,668,393	£44,515,004
Central	£276	£15,366,751	£24,854,472	£40,221,223
Low	£138	£13,897,537	£22,060,796	£35,958,333

These results should be treated with caution since they contain significant uncertainties, including the base demand for electricity in summer, air conditioning and refrigeration penetration in London and the additional associated energy used for cooling during the heatwaves, as well as the specific mix of tariffs, or the regional variation in the energy price. However, whilst indicative, looking forward, these costs are likely to rise. Around 1 in 20 (5 per cent) homes in the UK typically have air conditioning (BEIS, 2021). However, National Grid projects overall cooling demand to rise, with estimates of between 10-40 per cent of UK homes to have air conditioning by 2050, depending on its pathways followed (NESO, 2025).

3.4 Education

Education represents another critical area of climate impact. High temperatures pose a dual threat to learning environments: they not only put many schools at risk of overheating, potentially forcing closures (Department for Education, 2025), but also disrupt students' cognitive functions even when schools remain open, thereby impairing the learning process itself (Bo Yin et al., 2024). Heatwaves' impacts on schools and education have associated costs due to school closures or lost days of learning. Extreme heat imposes a significant cost on education by directly impeding cognitive performance and student well-being. High indoor temperatures in schools adversely affect students' health, concentration, and ability to learn, often resulting in lethargy and poor mood.

Decreasing cerebral blood flow and heat-induced fatigue have been shown to adversely affect cognitive abilities of students (Cho, 2017). Although teachers may attempt to mitigate these effects through compensatory grade manipulation, the physiological impacts of heat on cognition are significant and underscore the urgency of adaptation. This leads to substantially reduced exam performance, with hot days demonstrably decreasing scores and lowering the likelihood of passing critical assessments. These transitory cognitive shocks can have persistent ramifications for educational attainment, including a diminished probability of high school graduation, even when students have opportunities to retake failed exams (Park, 2021).

Moreover, extreme heat events cause widespread disruption to normal school operations, leading to school closures and restricted outdoor play, resulting in thousands of lost student-days of learning. London is already facing overheating issues in many schools, starkly experienced in 2022. A survey of 60 schools in the GLA Climate Resilient Schools programme found that overheating was the most widespread and pronounced climate change impact experienced by the surveyed schools (GLA, 2023).

In total, 56 of 60 (93 per cent) schools surveyed reported overheating as an issue they experience, with 18 (30 per cent) having to close due to high temperatures in the past 5 years, with 15 of these during the 2022 heatwaves. During the 2022 summer heatwaves alone, these schools experienced a total of 33 closed days, which amounts to an estimated over 22,000 student-days of lost learning. Furthermore 47 of 60 (78 per cent) schools reported that overheating has had a significant impact on students' learning, productivity or behaviour, or has interrupted normal school activity in another way and 26 schools (43 per cent) experience severe overheating that occurs 'multiple times' or 'continuously' throughout the summer term. Most importantly for this study, 15 out of the 60 surveyed schools reported closing for at least part of the school day during the 2022 heatwaves (Figure 6).

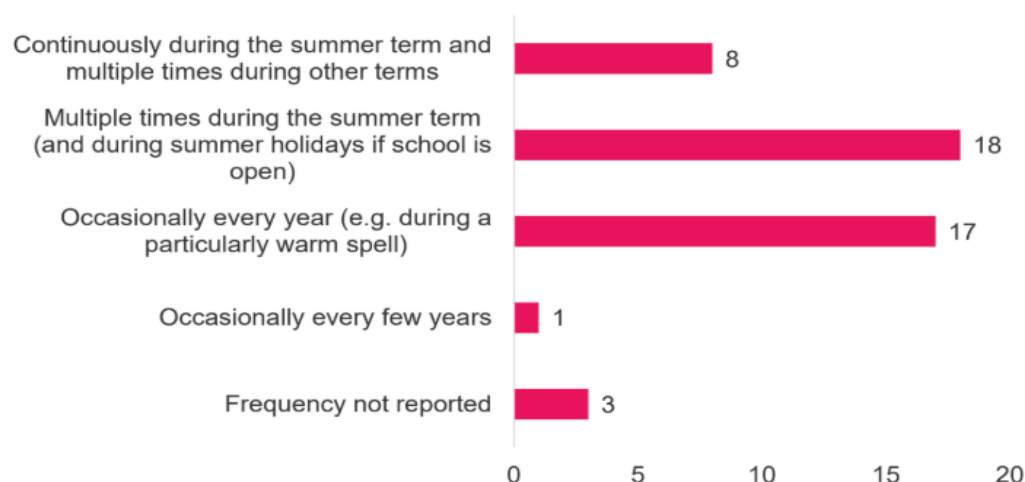


Figure 6: Reported frequency of overheating in schools that have experienced interrupted learning and school operations due to overheating. n=47. Source: Greater London Authority, 2023.

According to the third UK Climate Change Risk Assessment 3 (Watkiss, Cimato and Hunt, 2021), calculating educational disruption costs involves three primary components:

- reported school closures,
- pupil days lost, and
- parental workdays lost.

The scale of such impacts is exemplified by the June 2007 floods in Yorkshire and Humber, which affected 467 educational institutions and resulted in 170,000 pupils losing a total of 400,000 school days. The Environment Agency (2010) estimated the financial cost of these lost school days at £9.8m, using an average expenditure of £24.50 per pupil per day (2007 prices) and not including damage to property, derived from the adjusted Age Weighted Pupil Unit⁵ (AWPU). The study assumed a value of £3,000, applying the principle that 70 per cent of educational funding is pupil-

⁵ The AWPU is a standard unit of funding given annually to an individual school pupil at different ages. For more information see [Department for Education \(2017\). The national funding formula for schools and high needs](#). It is a key component of funding for schools, but applies to all pupils, regardless of deprivation or educational need, with additional allocations for such needs.

led, distributed across an assumed 190 school days per academic year (Education and Skills Agency, 2021).

The economic impact extended beyond direct educational costs to encompass lost parental productivity, with Hull alone experiencing an estimated £2.4m in lost parental workdays attributable to flood-related school closures. This calculation was based on average wage rates, adjusted to exclude national insurance contributions, for parents required to take time off work due to childcare responsibilities. An alternative valuation approach, utilising the National Audit Office's (2005) methodology for quantifying lost benefits associated with unauthorised absences, would yield a substantially higher estimate of £275 per pupil per day. Applied to the Yorkshire and Humber context, this methodology would generate a total cost of approximately £110m, a figure considered unrealistically inflated for practical policy applications.

The aggregate cost of educational disruption, encompassing both lost pupil days and associated parental workdays, was conservatively estimated at £11.4m. However, this figure likely represents an underestimate of the true economic impact, as it may not fully capture all indirect costs and long-term educational consequences associated with the flooding event.

This study used AWPU losses to calculate the costs from the 2022 heatwave episodes. The study started by estimating the total number of student-days lost. Due to the lack of observed data on how many schools in London are affected by overheating, the study uses a ratio derived from the GLA's survey of the 60 schools from the Climate Resilient Schools Programme (Greater London Authority, 2023). According to the survey, 47 schools reported significant overheating during the 2022 heatwaves. However, only 25 per cent (15 out of 60) schools closed, resulting in 33 days in total and an estimated figure of more than 22,000 student-days lost in that period.

These numbers imply that the average school closed for 2.2 days during that period, with some schools closing completely for several days and others finishing early during days of extreme heat. Using the data from the Department of Education for the GLA, we calculate that 787 schools are likely to have closed across all London boroughs (25 per cent of 3,149 schools). Assuming 2.2 days of closure for each school results in a total 1,732 school days lost.

To estimate the total costs for the Greater London area, the study used data on the total number of schools and pupils at the borough level as shown in Table 14 (Department for Education, 2023). Using the pupil-per-school ratio based on statistics from all boroughs in the 2021/22 school year, the average number of pupils per school was close to 470 (the mean and median values are close).

Table 14: GLA Schools and Pupils across London Boroughs 2021-22. Source: Department for Education, 2023

Statistic	Schools	Pupils	Pupils/School
Mean	95.4	44,179.9	467.6
Median	95	44603	476.2
Min	6	2,867	318.8
Max	170	69,742	694.6

Statistic	Schools	Pupils	Pupils/School
Standard Deviation	28.1	13,930.2	91.9
Total	3,149	1,457,938	-

Combining this value with the estimates for school days lost, this yields a total of approximately 814,040 (1732 x 470) student-days. Applying the Environment Agency average expenditure per pupil-day of £37.30 (adjusted from the original value of £24.50 to 2024 prices) we estimate the total costs at almost £30m (£30,364,000).

The study then estimated the total cost associated with the additional parental workdays lost. The study adopts the ratio between school days and parental workdays lost used by the Environment Agency in the 2007 flooding event in Yorkshire and Humberside. As discussed above, the economic cost of parental workdays lost is estimated by the average daily wage with the number of working days that parents were required to take off work in order to care for children affected by school closures. The flooding event in Yorkshire and Humberside resulted in an estimated parental workdays loss of approximately £2.4m. According to data from the UK Office for National Statistics (ONS) Annual Survey of Hours and Earnings for 2007, the average daily wage across the affected regions -including North Yorkshire, West Yorkshire, East Yorkshire, and Lincolnshire- was estimated at £81.75 per day. Based on these wage levels, the total parental workdays lost during the event were estimated at approximately 29,358 days. This occurred alongside an estimated 400,000 pupil-days lost due to school disruption.

In our analysis, the total number of student-days lost in the GLA was estimated at 814,040 days. Assuming a similar ratio to that used in the Yorkshire and Humberside flooding case, the corresponding number of parental workdays lost in the GLA is approximately 59,746 parental working lost days. To estimate the associated economic cost, ONS wage data for 2022 were used. The average daily wage in the London area was estimated at £157.20 per day. Multiplying this wage level to the estimated parental workdays lost resulted in a total estimated cost of approximately £9.39m, bringing the total cost to £39.8m.

Table 15: Lost school days and costs for London's 2022 heatwave. £. 2024 prices.

School closed	Lost school days	Cost of lost school days			Parental workdays		Total
		Student-days of lost learning	Cost per pupil day	Total costs of lost school days	Total parental workdays lost	Total cost of lost parental workdays	Total Costs from School Closures
787	1,732	814,040	£37.30	£30,364,000	59,746	£9,392,000	£39,756,000

It is important to treat such results as provisional, as they do not reflect the sum total of funding lost. However, since the Climate Resilient Schools Programme selected schools with a bigger focus on flood risk than overheating, it is possible that the results underestimate the actual risk.

Acknowledging that the percentage of closed schools is derived from a survey of 60 establishments, we augmented the analysis by looking at the 95 per cent confidence interval for the proportion of closed schools across London boroughs⁶. The true population proportion lies between 14 per cent and 36 per cent with 95 per cent confidence. Applying the same average number for closing days and pupils per school we calculate a range of lost pupil-days between 457,258 and 1,170,775 due to extreme heat. This, in turn, implies a total cost between £17,056,000 and £43,667,000.

3.5 Transport

Transport infrastructure underpins London's economy. The transport system is exposed to a wide range of climate-related risks. These include risks from extreme precipitation, temperature, storms and sea level rise and tidal flooding. Such risks will affect assets, operations and services and are expected to rise over time with climate change (Transport for London, 2024).

Risk severity profile per climate hazard for today, 2050 and 2080

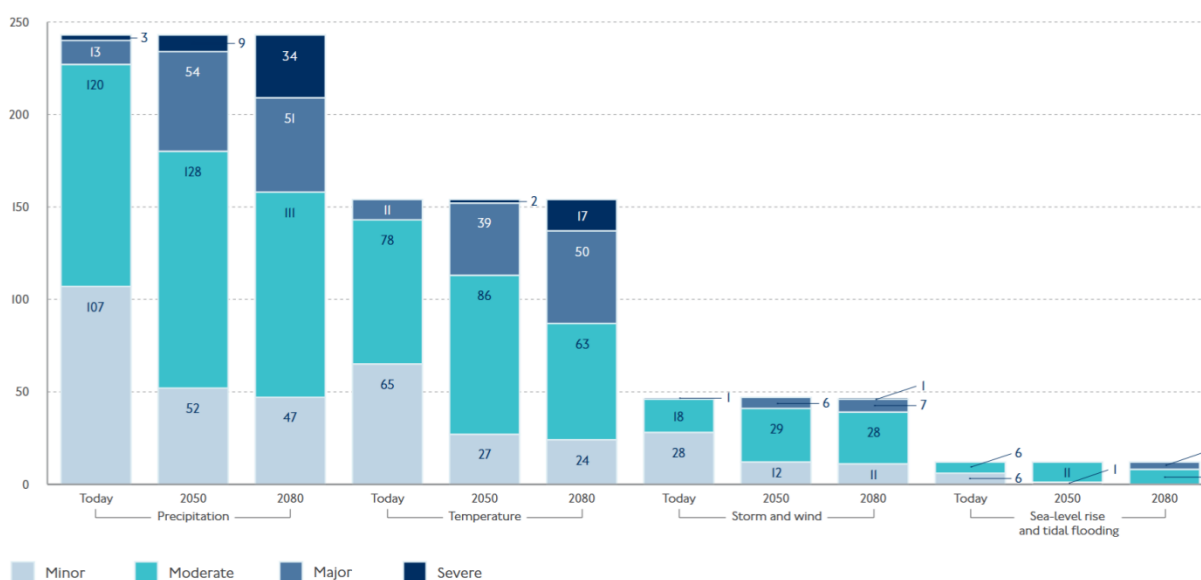


Figure 7: Risk severity profile per climate hazard for today, 2050, and 2080. RCP6.0, 90th Percentile Source: TfL, 2024.

The heatwaves in London caused widespread disruption on the transport network, with some services having to close and others being delayed. TfL also identified a range of impacts (TfL, 2023). The organisation had to put speed restrictions in place across their Tube and rail services. The organisation also had to suspend work on construction projects, while trackside fires and fires near Tube services caused disruption and damage. There was a major DC power failure at Dagenham East, and points, signalling and track circuits also failed. A number of customers and colleagues also fell ill from the heat.

⁶ Our sensitivity analysis is based on adjusting for the number of schools closed - in terms of the share of the total number of schools. The number of pupils and days of closure are held constant at their sample average.

These events all come with significant costs. However, it can be very challenging to estimate the specific costs associated with disruption to multiple modes of transport, particularly because of the cross-boundary issues of transport and the issues of reporting and logging journey times.

One exception is TfL. As the regional transport authority for London, TfL is responsible for buses, the underground network and the docklands light railway. This makes it more straightforward to attribute disruption to within the greater London boundary.

Whilst no systematic processes are currently in place for estimating costs to TfL from historic events, (England, K. – Personal communication), the TfL adaptation reporting power report (TfL, 2024) identifies that the July heatwave resulted in a loss of £8.4m in expected revenues. This was based on a comparison with the previous daily averages of the three weeks prior to the heatwave period (England, K – personal communication). Similar analysis was not undertaken for the other heatwave periods as travel advisory notices were not issued, making it challenging to estimate the impact on revenues.

Whilst a helpful figure, these costs will be a significant under-estimate, since they focus solely on foregone revenue. There will also be wider direct costs from impacts on staff, and damages. However, transport also contributes to wider productivity of the economy. Whilst such damages are beyond the scope of study here, they are likely to be an order of magnitude higher than those captured here.

3.6 Emergency services (fire and ambulance)

Heat can result in a range of different impacts, including the increased prevalence and impacts of wildfires (Belcher et al., 2021), as well as increasing morbidity and mortality (Romanello et al, 2024). Therefore, another key cost arising from the 2022 heatwaves for London was the increased demand and associated emergency service responses.

Fire Services

The Fire Services play a key role in heatwaves including tackling wildfires, rescuing people from lifts. On 19 July 2022, London Fire Brigade (LFB) declared a major incident because of events across London, including numerous grassfires and wildfires exacerbated by the weather conditions. During the event, LFB responded to a wide range of calls. On 19 and 20 July 2022 alone, London Fire Brigade took 2,496 calls to control, and mobilised over 1,198 assets, to 106 fires (London Fire Brigade, 2023).

LFB provides detailed data on the number of incidents attended through its incident records (London Datastore, 2025). This suggests that over the three heatwave periods in June, July and August, there were 9,181 incidents. Most of the events (4,194, 45 per cent) were to dwellings, followed by outdoor fires (1,830, 20 per cent) and non-residential (1,585, 17 per cent). These are shown in Figure 8 below.

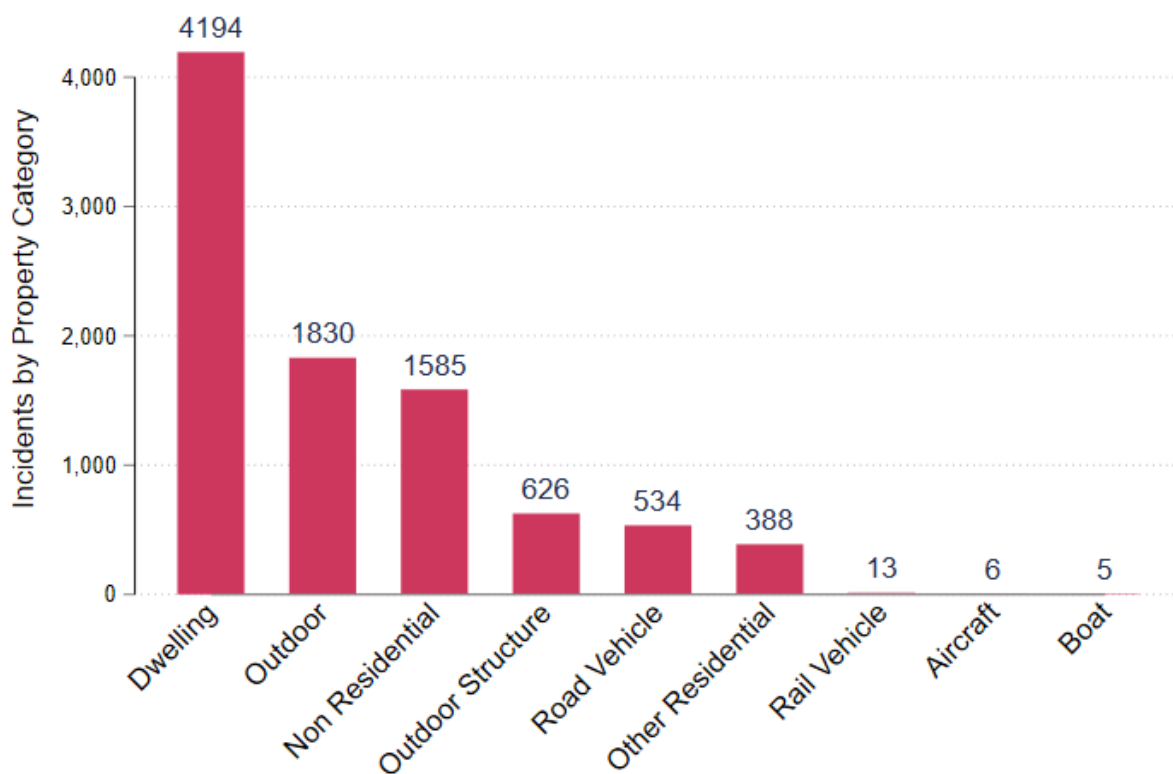


Figure 8: Incidents by property category. Source: London Datastore, 2025.

Within this, 3,665 calls related to false alarms, whilst 2,487 calls were related to fires, and 3,029 were related to special services (Figure 9).

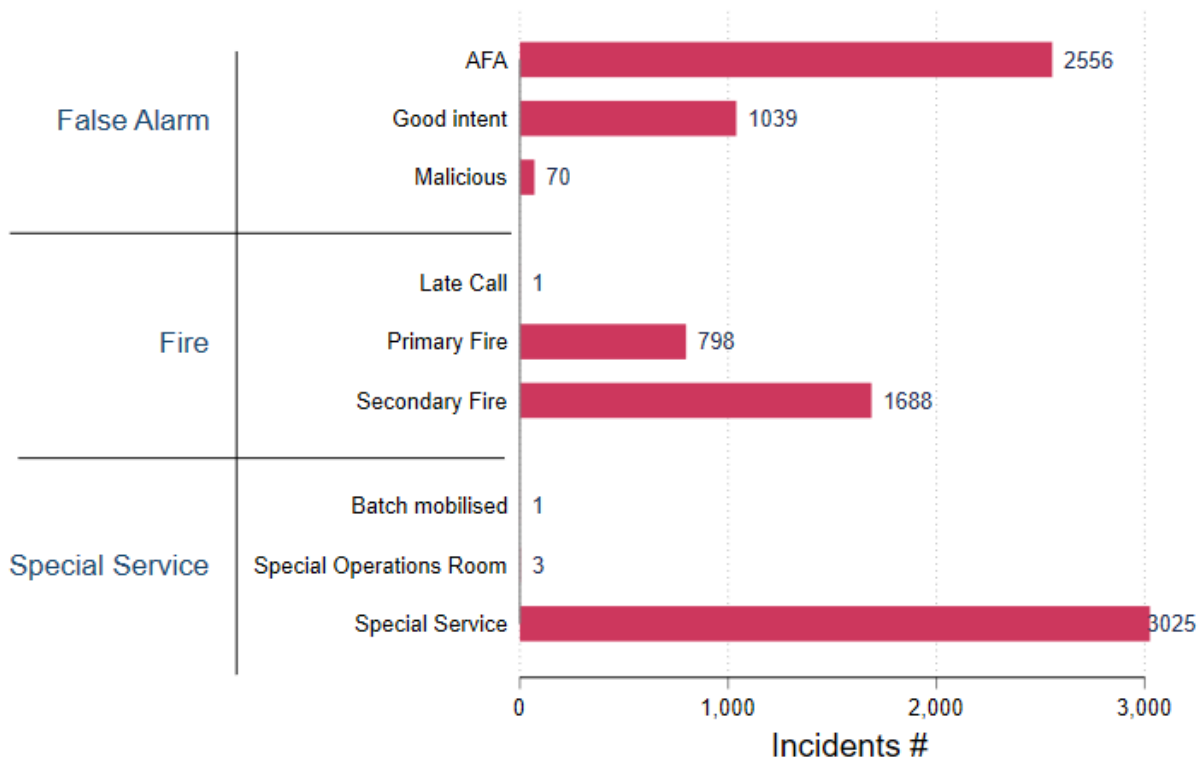


Figure 9: Breakdown of incidents over the three heatwave periods by group and stop code description. Note: AFA means Automated False Alarm. Source: London Datastore, 2025.

Whilst the emergency services do not typically collect data on the costs of individual callouts, it is possible to generate indicative estimates. The data also includes a notional cost (£) for the callout, which consists of the time spent, multiplied by the notional annual cost of a pump, which equates to £6 per minute. This figure was assumed to be in today's prices. Applying this value to the data can be used to generate indicative costs for the total costs to the fire service. These are shown in Table 16 below.

Table 16: Total costs to London Fire Brigade from call outs. Source: Authors, based on London Datastore (2025).

Event	Number of incidents	Total cost
15 - 17 June	1,239	£586,733
10 - 19 July	4,317	£3,060,111
8 - 15 August	3,625	£1,955,686
Total	9,181	£5,602,530

Over the three events, the total cost was £5.6m, with a higher total cost in July as opposed to June and August. The data is likely to be an overestimate for several reasons. First, the number represents the total costs of all incidents, but in reality, a certain proportion of costs would have been incurred regardless of a heatwave. Furthermore, due to the modest resources available for

this study, the data was not cleansed and includes all incident categories and associated responses. This includes malicious false alarms. Further work may wish to focus on refining this data for further accuracy. However, it also does not include the wider costs of coordination of the response to the major incident.

Ambulance service call outs

Ambulance services were also stretched during the heatwaves, dealing with health impacts that are worsened by heat, such as Chronic Obstructive Pulmonary Disease (COPD), and additional health conditions such as heat stress and heatstroke which increase morbidity and mortality. Quantifying this impact on the service is difficult as the London Ambulance service does not publish detailed incident response records.

However, partial data is available for the impacts on 18 and 19 July, which indicated that the service took 13,400 emergency service (999) calls over those two days (London Ambulance Service, 2022). The release also cites that an average would be 5,500 calls a day. Given this, the study sought to value the additional calls as a proxy for the additional demand created by the heatwaves. Unlike the LFB, there are no nominal figures of the cost associated with the callout of an ambulance. Data from the NHS Confederation Ambulance Service Network (2010) indicates that the average cost of an ambulance call out is £200. This was updated to 2024 prices (£324) and then applied to the costs to give the indicative estimates shown in Table 17 below.

Table 17: Heatwave related emergency calls for ambulances from 18-19 July. Source: Authors, based on London Ambulance Service, 2022.

Day	Total calls	Total costs	Of which, Heatwave-related calls	Heat-wave additional costs
18 July	6,600	£1,468,000	1,100	£245,000
19 July	6,800	£1,512,000	1,300	£534,000
Total	13,400	£2,980,000	2,400	£779,000

Table 17 shows that the indicative costs resulting from the additional heatwave demand to the ambulance service were in the order of £779,000. Assuming a broadly similar level of increased demand across the entire period, the additional costs for the entirety of the heatwave periods would rise to £8.2m. However, this number is subject to significant uncertainty since a 999 call does not automatically guarantee an ambulance will be sent (London Ambulance Service, 2022). Some studies suggest around 40 per cent of 999 calls are unlikely to need an emergency response (Snooks et al., 1998, Snooks et al., 2002), but it is unclear how applicable this number is in the context of heatwaves.

Total costs

Based on the data above, it is possible to generate a partial cost of the emergency services cost response. This suggests that the total emergency services cost was in the order of £13.8m (Table 18).

Table 18: Total emergency services costs (fire and ambulance) for 2022 heatwave period. Source. Authors.

Item	Cost
Fire	£5,603,000
Ambulance (assumed whole period)	£8,180,000
Total	£13,782,000

However, as explained in the two sections above, the costs are likely to be an underestimate, since the assessments do not include wider health service costs associated with treatment of heat-related impacts. Similarly, it is possible there will also be increased costs from demand on the Metropolitan police, since higher temperatures can also lead to increased hostility and violent crime (by around 3-6 per cent) before dropping off at extremely high temperatures, though this varies significantly based on local context (Suelkee et al., 2025).

3.7 Wildfires

The increasing prevalence and severity of wildfires, exacerbated by a changing climate globally, pose a pressing challenge with far-reaching consequences for ecosystems and human communities (Alamanos et al., 2024). Heatwaves and wildfires are tightly interconnected, with extensive academic and observational evidence demonstrating a robust causal relationship across multiple regions (Ruffault et al., 2020; Rossiello & Szema, 2019). Heatwaves, characterised by prolonged periods of unusually high temperatures, significantly elevate wildfire risk by rapidly drying out vegetation and soils, turning landscapes into highly combustible fuel beds. When this occurs, even a small ignition source, whether from lightning or human activity can spark fires that spread far more quickly and intensely than under normal conditions.

In the case of London during the summer of 2022, there is strong evidence supporting the argument that the heatwave was the main driver of wildfires, primarily attributed to vapor pressure deficit (VPD), which explains up to 61 per cent of the variation in the number of wildfires (John and Rein, 2025). Higher temperatures, extended dry periods, and increased wind speed all contribute to a greater chance of wildfires, while precipitation and lower wind speeds reduce this risk. These events highlight how extreme heat and drought conditions, which are amplified by climate change, can increase the likelihood of fire weather. Studies have shown that significant wildfires can be attributed to components of fire weather such as temperature, with increased temperatures likely leading to higher burnt areas (Thompson et al., 2025, John and Rein, 2025).

Although wildfires are traditionally associated with the natural environment, they also have severe implications for human welfare, buildings, infrastructure, and businesses, and in some cases can cause fatalities, making them highly relevant to urban areas (Belcher et al., 2021). In January 2025, Los Angeles wildfires resulted in at least 31 confirmed direct deaths, while studies suggest the broader health impacts, including respiratory and cardiovascular complications, may have contributed to as many as 440 indirect fatalities (McKoy, 2025). Wildfires exert a serious negative impact on socioeconomic stability, resulting from the damaged public and private properties and the disruption of vital ecosystem functions from the natural world (Koundouri, 2023).

Nevertheless, during the June–August 2022 wildfires in London, significant damage occurred, but there were no direct fatalities reported. Wildfires create a wide range of societal costs. There are

costs associated with attendance and suppression, but they can also result in the emission of carbon dioxide as well as small particulate matter, both of which have impacts on human health, productivity, wellbeing and the environment.

The LFB attended 161 wildfires between June and August in 2022 (London Fire Brigade, 2025). However, these statistics do not specify which of those fell within the 2022 heatwave periods, nor the area of burn, typically needed for valuing impacts. Similarly, whilst the LFB incident logs document calls to attend wildfires, they do not capture the information needed to value the impacts. However, some information is available for the summary costs of the 2022 wildfires, based upon the Major Incident Review conducted by the LFB (London Fire Brigade, 2023).

The derived data focus on the period from July 16-19 and August 11-14 and provide a timeline of events documenting significant grassland wildfires, including their size and location. The review revealed a total of 45 fires covering a total area of 195 hectares.

Whilst no specific figures were provided for suppression costs, it is possible to derive some nominal figures. Newly released data from the LFB not only provide the annual number of incidents, but also the response cost (London Assembly, 2025b). Using these data, we are able to derive an average cost of incident of £6,456. Applied to the 45 events this provides notional suppression costs of £295,000. However, these may overlap to some degree with the fire callout costs already estimated.

It is also possible to derive monetary values for emissions associated with the burn. Having established the burnt area, the study estimated the CO₂ and PM_{2.5} emissions. CO₂ emissions were valued in the same way as for energy.

- **Carbon dioxide equivalent (CO₂e) emissions** – Quantified using emissions factors for each land type (total CO₂e/ha/year) and valued using the most recent central series of carbon prices from HM Government (BEIS, 2021) and the Intergovernmental Panel on Climate Change (IPCC)⁷.
- **PM_{2.5} air pollution** – Quantified using the ratio of 0.045 tPM_{2.5} per tCO₂e and valued using the Department for Environment, Food, and Rural Affairs' (DEFRA) latest valuation of PM_{2.5} pollution in high population density areas.

CO₂ emissions from grassland fires depend on a multitude of factors, including the specific grass species present, their planting density and the moisture content present at the time of the fire. The emissions of tCO₂e and tPM_{2.5} associated with the wildfires from the 2022 heatwaves are outlined in Table 19.

Table 19: CO₂ and PM_{2.5} emissions of the wildfires of the 2022 heatwaves. Source: Authors, based on EEA (2023).

Hectares (Ha)	tCO ₂ e	tPM _{2.5}
195	1,158	52

The estimated costs of emissions vary with the incidence of wildfires but also the prevailing values attached to emissions. To assign monetary values to wildfire emissions, we use governmental

⁷ Details can be found in the IPCC Emissions Factor Database (EFDB).

prices (BEIS, 2021) under three scenarios (high, central, and low), along with PM_{2.5} prices provided by DEFRA (2023) shown in Table 20. Specifically, DESNZ estimates the costs of carbon through carbon prices, while DEFRA provides damage costs for PM_{2.5}. For carbon, the central estimated cost per tonne for 2024 prices was £276, while for PM_{2.5}, the central estimate was £19,670 (Table 20). Table 21 shows the central estimate for the total cost of emissions to be more than £1.3m with a plausible range between approximately £500,000 and £3m.

Table 20: Carbon prices used for valuation. Source: Authors, based on BEIS, 2021 and DEFRA, 2023.

Price	tCO ₂ e	PM _{2.5}
High scenario	£415	£54,000
Central scenario	£276	£19,670
Low scenario	£138	£7,775

Table 21: Costs of emissions from summer 2022 wildfires for CO₂e and PM_{2.5}. Source: Authors, based on EEA, 2023, DEFRA, 2023 and BEIS, 2021.

Scenario	CO ₂ e	PM _{2.5}	Total
High	£480,570	£2,808,000	£3,288,570
Central	£319,608	£1,022,840	£1,342,448
Low	£159,804	£404,300	£564,104

Combining these with the suppression costs gives a total cost of £1,638,000, with air quality impacts constituting the largest impact (Table 22).

Table 22: Total wildfire costs from the 2022 heatwaves. Rounded to nearest '000.d Central scenario. Source: Authors.

Scenario	Amount
Suppression costs	£295,000
CO ₂ e	£320,000
PM _{2.5}	£1,023,000
Total	£1,638,000

The costs are likely to be an underestimate for several reasons. Firstly, the cost of attending wildfires will vary drastically depending on the size and duration of the burns. The use of an average figure will potentially mask some of the higher costs incurred during the heatwaves. Secondly, the partial nature of the wildfire data captured means it is possible a larger number of fires were attended. A future priority would be improving the capture of incident data to capture the size of wildfires to help improve the assessment of the impact of such events, as well as the economic costing.

3.8 Total costs

Based on the individual sections outlined above, we estimate the costs of the event to be in the order of £1.5bn. The biggest costs by a large magnitude relate to productivity impacts, followed by impacts on mortality and energy. The full breakdown of results is shown in Table 23.

Table 23: Total estimated economic costs of the London 2022 Heatwaves by type, with associated organisations impacts. Numbers rounded to nearest £'000 Source: Authors.

Category	Cost	Who typically incurs associated fiscal/ financial costs?
Productivity	£1,320,000,000	Businesses, households, public sector
Health (Mortality - VOLY)	£52,833,000	Public sector (NHS, Emergency Services)
Energy Consumption	£40,221,000	Businesses, households
Education	£39,756,000	Households
Health (Morbidity)	£36,312,000	Public sector (NHS, Emergency Services)
Emergency Services	£13,782,000	Public sector (London Fire Brigade, Met Police, London Ambulance Service)
Transport (TfL)	£8,400,000	Public sector (TfL)
Wildfires	£1,638,000	Public sector (London Fire Brigade)
Total	£1,512,942,000	

4 Conclusions and recommendations

Extreme heat is already imposing a material economic burden on London. This report shows that London experienced significant economic, fiscal and financial impacts from the 2022 heatwaves, totalling £1.5bn and that these are borne by businesses, households and the public sector. However, there is considerable uncertainty in the analysis, and as such, the costs are likely to be an underestimate. Left unchecked, these costs are likely to escalate as climate change intensifies, adding to wider cost pressures, such as an aging population and increased life expectancy. Given climate projections suggest that heatwave events are likely to become more frequent and more severe, there is a strong economic rationale for investment in adaptation to reduce such impacts.

Developing a vision and plan for addressing heat risk would support efforts to reduce the impacts identified here. This should have a focus on implementing adaptation options in sectors which can deliver economic, fiscal and financial benefits today and into the future. These include the built environment, business and economy, health and care, infrastructure (energy and transport), emergency preparedness and response and nature as discussed in this report. This should also be supported by strong capacity building and community engagement for businesses and citizens to help them prepare. In addition, there are future research needs to further enhance the evidence base and targeting of adaptation. These include:

- Extending this preliminary work to consider monetary valuation of future climate risks across the full range of UKCCRA3/UKCCRA4 risks under a range of climate scenarios – this would allow adaptation planning to inform a greater understanding of the relative magnitude of such risks to inform targeting of resources and efforts.
- Continuing work like the London Climate Ready Partnership Climate COST forum to put in place more systematic methods and processes for capturing data from extreme weather events to allow the collection of a stronger evidence base for costing – this would allow the capture of physical impact data (e.g. impacts on energy demand, or NHS services) as well direct cost data which would then allow for more holistic analysis.

The documentation of the substantial economic and social costs of the 2022 heatwaves provide rigorous evidence to further support the economic case for Heat Ready London. Nonetheless, the study still suffers from limitations commonly associated with such empirical exercises. Assigning monetary values to human life can be quite challenging, while the models and methods used in this report do not capture "tail" events or the complex feedback loops in socio-economic systems, leading to a potential underestimation of true costs. To gain a robust understanding of total costs it is important to develop standardised data gathering on physical, social, and economic impacts of extreme events at the local and organisational level. Adopting spatially resolved, bottom-up approaches would help capture local socio-economic and climatic idiosyncrasies, especially in large metropolitan areas.

In addition to data collection improvements, the methodologies underpinning the cost estimations are constantly being refined to include monetised social impacts and indirect costs, incorporating behavioural and long-term effects. Better communication and coordination between relevant organisations and institutions can help to address the severe limitations in current cost reporting. Effective knowledge-sharing networks, such as those successfully established between organisations like the Met Office, local authorities, and first responders, can improve the quality of forecasting and early warnings. The methods and results from this report can act as a catalyst for stimulating cross-organisational cooperation to address data and framework limitations and unveil the true magnitude of the costs borne by cities and regions in the face of extreme climate events.



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Annex 1: Data characteristics of annual productivity loss

To estimate the annual productivity loss, the study undertook the following steps:

1. For each year in the 1998–2021 time series, the average daily productivity loss was calculated, by dividing the total annual productivity loss attributed to heatwaves by the number of heatwave days in that year.
2. Using the derived series of average daily losses, a historical average was computed (and associated distribution) of daily losses across the period. This historical average was then multiplied by 19, the number of heatwave days observed in 2022, to estimate the total productivity loss during the 2022 episode.

Table A1: Annual and daily productivity losses in London, with adaptation. 2000-2021⁸.

Criteria	Annual cost (£m)	Daily cost (£m)
Min	£46.5	£10
Max	£2,369	£291
Mean	£690	£68
Median	£234	£51
Q1	£103	£19.7
Q3	£1483	£86

Figures A1 and A2 present the annual losses in GVA for Construction, Financial and Insurance Activities and Professional, Scientific and Technical activities between 1998 and 2021. It is important to note the pronounced drop in productivity losses for office-related work when adaptation measures are put in place.

Figure A1: GVA losses in selected industries with Adaptation

⁸ For years with at least one documented hot day.

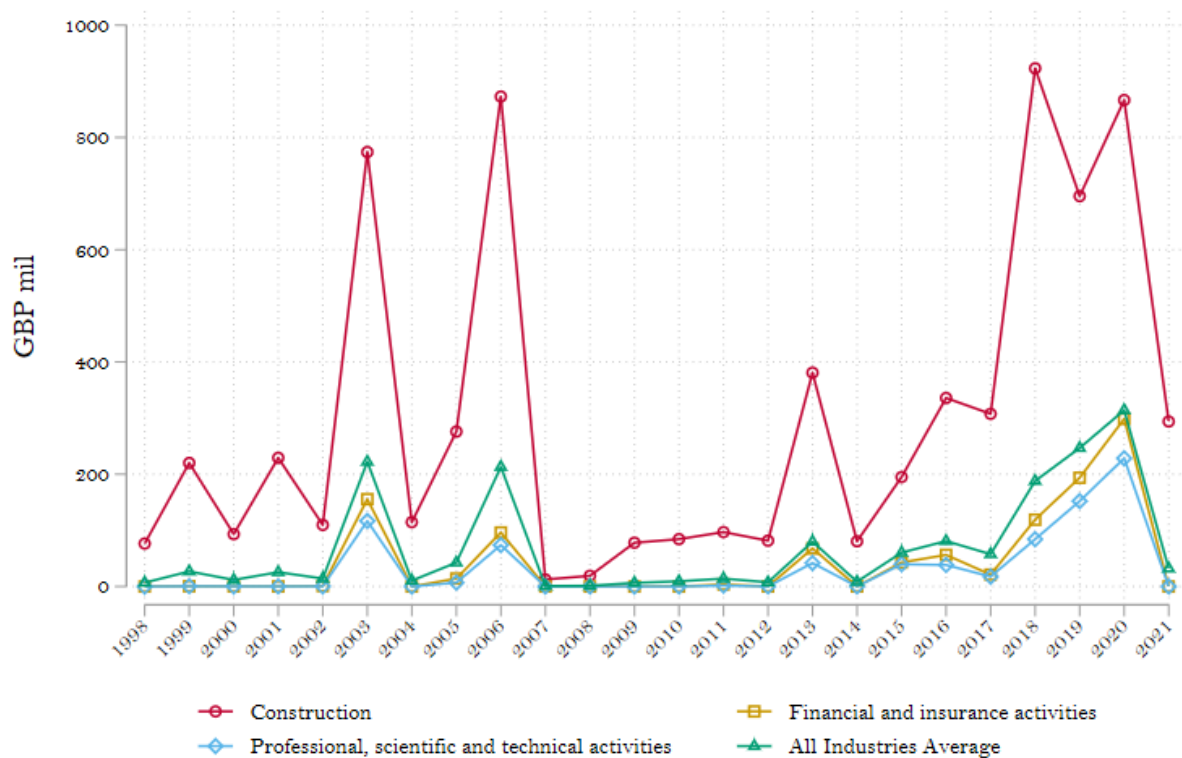


Figure A2: GVA losses in selected industries without Adaptation

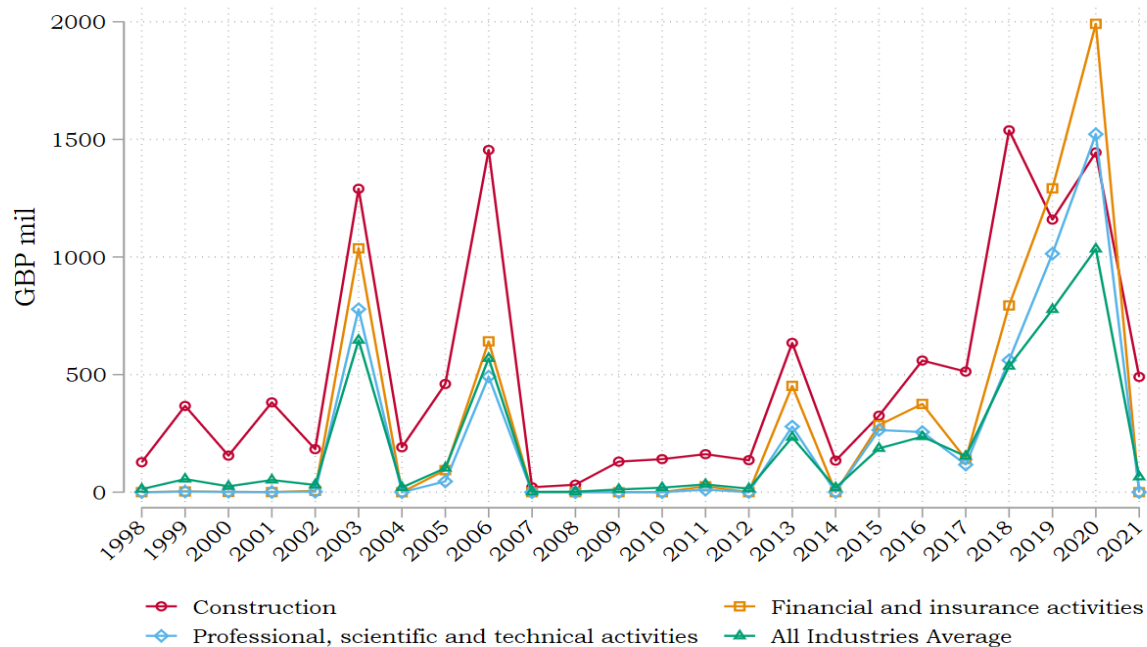


Figure A3 and Table A2 present the relative figures when no adaptation is assumed.

Figure A3: Historic annual and daily GVA losses without Adaptation

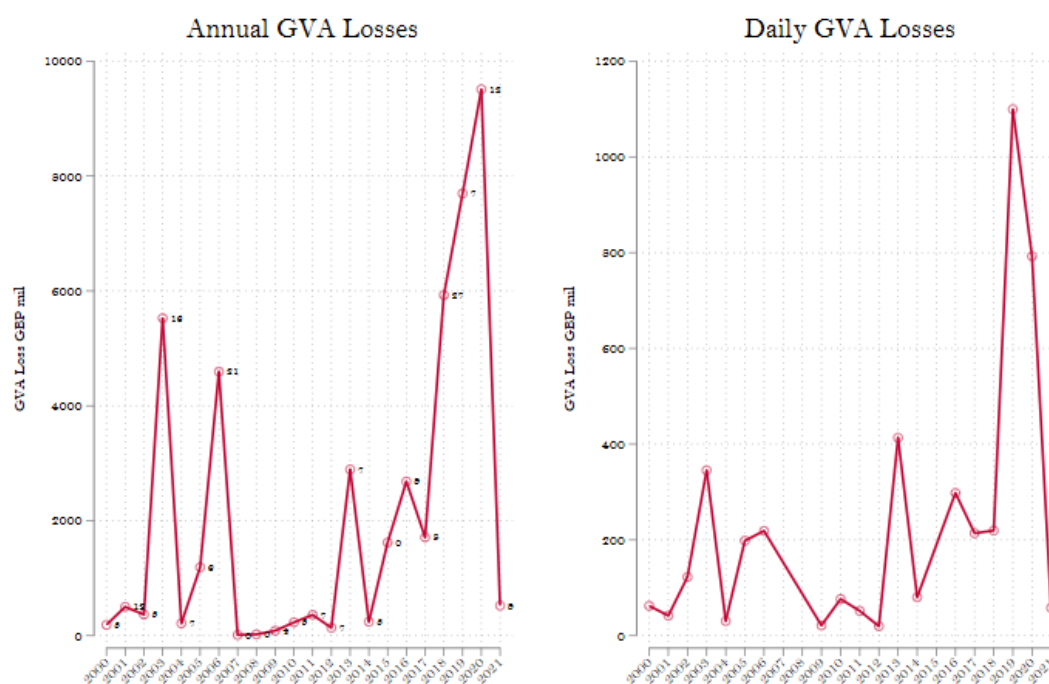


Table A2: Estimated GVA losses for the 2022 Heatwaves under the no adaptation scenario

Criteria	Losses
Average Daily Cost (2000-21)	£4,360
Median Daily Cost (2000-21)	£2,330
Range (Min-Max)	£373- £20,900
Interquartile Range	£981- £5,660

Annex 2: Wildfires calculations

European Environment Agency guidance (2023) recommends that carbon emissions from wildfires can be approximated as:

$$M(C) = 0.45 \times A \times B \times \alpha \times \beta$$

M(C): mass of carbon (kg);

0.45: average fraction of carbon in fuel wood;

A: area burnt in m² (1 ha = 10,000 m²);

B: average total biomass of fuel material per unit area in kg/m²;

α: fraction of average above-ground biomass, relative to the total average biomass B;

β: burning efficiency (fraction burnt) of the above-ground biomass.

The values for B, α, and β vary depending on the biome, such as Boreal forest, Temperate forest, Mediterranean forest, Scrubland, and Grassland (Steppe). This study assumed grassland as a wildfire type, since it has the lowest content of total biomass.

Default parameter values for B, α and β are given in the guidance as 2, 0.36 and 0.5 respectively for grasslands. Hence multiplying the area burnt by 0.36 gives an estimate of the total emissions.

The guidance also includes methods for calculating PM_{2.5} states that PM_{2.5} emissions can be estimated as proportional to the mass of biomass burnt, with a value of 9g/kg suggested.

Table A3: Significant grassland fires attended. Source: London Fire Brigade, 2022.

Incident number	Date	Fire damage (Ha)	Type of fire	Ward
1	16.07.2022	6	Grassland, woodland and crops	
2	17.07.2022	2	Grassland, woodland and crops	
3	18.07.2022	0,09	Grassland, woodland and crops	
4	18.07.2022	3	Other outdoors (including land)	
5	18.07.2022	0,02	Grassland, pasture, grazing etc	
6	18.07.2022	2	Grassland, woodland and crops	
7	18.07.2022	6	Grassland, pasture, grazing etc	Hayes
8	18.07.2022	4	Grassland, woodland and crops	
9	19.07.2022	1	Grassland, woodland and crops	
10	19.07.2022	3	Grassland, woodland and crops	
11	19.07.2022	15	Grassland, woodland and crops	F39 Hornchurch
12	19.07.2022	4	Grassland, woodland and crops	A40 Hendon
13	19.07.2022	1	Grassland, woodland and crops	H28 Woodside
14	19.07.2022	1	Grassland, woodland and crops	H26 Addington
15	19.07.2022	40	Grassland, woodland and crops	F40 Wennington
16	19.07.2022	8	Grassland, woodland and crops	F41 Dagenham
17	19.07.2022	40	Grassland, woodland and crops	G23 Hillingdon
18	19.07.2022	1.2	Grassland, woodland and crops	A34 Edmonton
19	19.07.2022	3,2	Grassland, woodland and crops	F35 Woodford
20	19.07.2022	5	Grassland, woodland and crops	E27 Erith
21	19.07.2022	2	Grassland, woodland and crops	H43 Twickenham
22	19.07.2022	1,6	Grassland, woodland and crops	
23	19.07.2022	3	Grassland, woodland and crops	F41 Dagenham
24	11.08.2022	1,5	Grassland, woodland and crops	

Incident number	Date	Fire damage (Ha)	Type of fire	Ward
25	11.08.2022	2,5	Grassland, woodland and crops	
26	11.08.2022	1,5	Grassland, woodland and crops	
27	11.08.2022	1,5	Grassland, woodland and crops	
28	11.08.2022	2	Grassland, woodland and crops	
29	11.08.2022	1	Grassland, woodland and crops	
30	12.08.2022	2	Grassland, woodland and crops	
31	12.08.2022	2,5	Other outdoors (including land)	
32	12.08.2022	4	Grassland, woodland and crops	
33	12.08.2022	1	Grassland, woodland and crops	
34	12.08.2022	4	Grassland, woodland and crops	
35	13.08.2022	27	Grassland, woodland and crops	
36	13.08.2022	2	Grassland, woodland and crops	
37	13.08.2022	0,2	Grassland, woodland and crops	
38	13.08.2022	2	Grassland, woodland and crops	
39	13.08.2022	0,008	Grassland, woodland and crops	
40	13.08.2022	0,05	Grassland, woodland and crops	
41	13.08.2022	0,1	Grassland, woodland and crops	
42	14.08.2022	0,005	Grassland, woodland and crops	
43	14.08.2022	0,25	Grassland, woodland and crops	
44	14.08.2022	1	Grassland, woodland and crops	
45	14.08.2022	3	Grassland, woodland and crops	
Total hectares		195		