OVERHEATING RISK MAPPING
LEAFLET

OVERHEATING IN HOMES

Overheating has not, historically, been something the UK housing sector has needed to grapple with, but it is a growing problem. Potentially up to 20% of the housing stock in England is already affected and the issue is likely to become more prevalent in future.

"As temperatures rise due to climate change there is an increased risk of overheating in buildings."
ENVIRONMENTAL AUDIT COMMITTEE

WHAT IS OVERHEATING?

Overheating is the term used to describe situations where the temperature inside a person's home becomes uncomfortably or excessively warm.

Overheating happens most often during warm weather. But external temperatures are only one factor causing overheating. The design of the building is also important.

Also, some members of the population are more vulnerable to overheating, for example older people and those with underlying health conditions.

MAPPING THE RISK

Maps, which display the relative risk of overheating in buildings by location, can be an extremely useful resource for policy makers when planning for heat waves and developing climate change adaptation strategies. They can help local authorities to target limited resources towards areas of greatest need.

Developers and those with housing management responsibilities could also make use of risk maps to help them understand whether they are building in a potentially high risk area, and/or whether residents are more or less likely to experience overheating.

PURPOSE OF THIS LEAFLET

This leaflet introduces current research and risk mapping methods, including outcomes presented at a city or regional level, and a national level. It is based on work carried out by the Zero Carbon Hub over the past two years as part of a large-scale project on 'Overheating in Homes', and specifically draws on the detailed evidence review, 'Overheating Risk Mapping', prepared by AECOM.

THE ZERO CARBON HUB'S OVERHEATING PROJECT

At the request of Government, the Zero Carbon Hub formed the project 'Tackling Overheating in Homes' in 2014 to gather evidence and information on the current and possible future extent and impact of overheating in homes. We also looked at the degree to which the housing sector is already gearing up to tackle the issue and what further action could be required to manage the risk of future overheating.

Our 'Overheating in Homes – the Big Picture' baseline evidence report, published in June 2015, presents our findings from:

- Over 400 research papers and reports;
- 6 thematic Evidence Reviews;
- A survey of 75 Housing Providers (representing 207,728 homes) in partnership with Sustainable Homes;
- 33 in-depth interviews with Housing Providers and other industry experts; and
- Workshops and one-to-one meetings.

All our Overheating publications are available online at **www.zerocarbonhub.org**

The term Housing Provider covers all organisations who build, manage, rent or retrofit domestic properties, for example developers and private and social landlords.

EVIDENCE REVIEWS

As part of the Overheating in Homes project, a series of Evidence Reviews were commissioned from experts on key themes related to overheating.

DEFINING OVERHEATING
by CIBSE, ARCC, UCL, and the LSHTM

ASSESSING OVERHEATING RISK
by Inkling LLP, CIBSE, UCL and ARCC

IMPACTS OF OVERHEATING
by AECOM

OVERHEATING RISK MAPPING
by AECOM

DRIVERS OF CHANGE – OVERHEATING IN HOMES
by the ZCH and AECOM

SOLUTIONS TO OVERHEATING IN HOMES
by BRE

LEAFLETS FOR HOUSING ASSOCIATIONS AND LOCAL AUTHORITIES

MONITORING OVERHEATING – HOUSING ASSOCIATION CASE STUDIES

LOCAL AUTHORITIES – TACKLING OVERHEATING IN HOMES

CO-OCCURRENCE OF RISK FACTORS, HAZARDS AND VULNERABILITIES

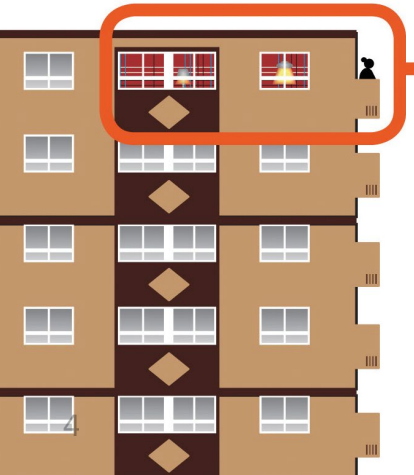
In order to fully understand the risk of overheating for any building or individual, it is important to understand where people live and the individual's circumstances, as well as building types and designs.

The 'Reducing Urban Heat Risk' report, published by Arup in 2014, used three categories of risk: location within London, building characteristics, and people characteristics (Table 1). A combination of the three categories can be used to create an overall risk profile and, using a qualitative approach, to define high, medium and low risk scenarios.

Table 1. **Factors considered in two of the three ARUP risk index categories**

Building Characteristics	People Characteristics
Age of construction	Age
Materials	Health
Orientation	Mobility
Layout	Sex
Height	Socio-economic status
Storeys	Culture
Deep plan	Languages spoken
Single or dual aspect	Awareness and experience of hot weather
Balcony	Perception of heat risk
Garden	Level of social connection
Glazed areas	Adaptive capacity issues
Insulation	
Thermal mass	
Shading level	
Ventilation	

Figure 1. **High overheating risk example taken from larger Arup infographic**



High risk example

Ms X is 68 years old with limited mobility and a respiratory condition. Her days are spent mostly at home with occasional visitors. Her top floor flat is in a tower block with poorly insulated walls, south facing windows and balcony and no external shading. She lives within a UHI, close to a main road with no green or blue space in the area.

"Reducing Urban Heat Risk: A study on urban heat risk mapping and visualisation," ARUP, GLA, LCCP, Climate UK, Environment Agency, UCL, London Borough of Islington, Jul. 2014.

SPATIAL MAPPING

By categorizing and mapping different hazards and vulnerabilities to overheating risk, it is possible to identify the locations, dwellings and residents more at risk of overheating.

MAPPING THE URBAN HEAT ISLAND

One factor contributing to overheating risk in buildings is the external temperature – both air and surface.

Observed temperatures in built-up urban areas can be significantly higher than in the surrounding countryside, by up to 9°C in the centre of London and 8°C in Manchester. This so-called 'Urban Heat Island' (UHI) effect is greatest on calm nights with clear skies.

Researchers at the University of Birmingham studying heat health risk in the city used Land Surface Temperature data (LST), recorded from satellites at high-resolution (1 km^2) during the heatwave night of 18th July 2006 to represent the spatial variation in the Urban Heat Island (UHI).

LOWER SUPER OUTPUT AREA

Lower Super Output Areas or LSOAs are fixed geographical areas (of varying physical size), defined by the Office for National Statistics, which can be used for spatial statistical analysis. Each LSOA has a minimum population of 1,000 and an average population of 1,500.

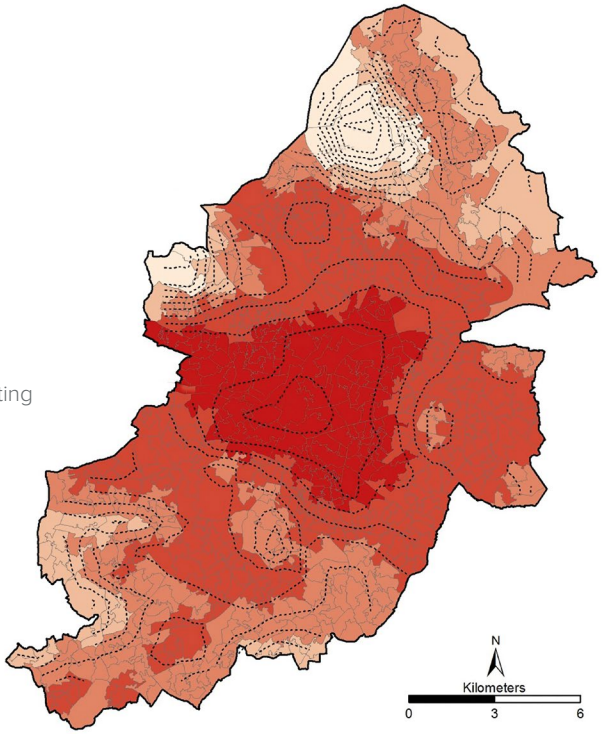


Figure 2. **Level of the Urban Heat Island in Birmingham under heatwave conditions and categorised by Lower Super Output Area – night time 18th July 2006**

C. J. Tomlinson, L. Chapman, J. E. Thornes, and C. J. Baker, "Including the urban heat island in spatial heat health risk assessment strategies: a case study for Birmingham, UK," International Journal of Health Geographics, vol. 10, no. 1, pp. 42–55, Jan. 2011.

MAPPING LAND SURFACE AND AIR TEMPERATURE FOR LONDON

Arup compared the All London Green Grid, which shows green spaces in Greater London, with a satellite image of Greater London Land Surface Temperature (LST) in June 2011 (Figure 3). This showed that green/blue spaces help to cool land surface temperatures.

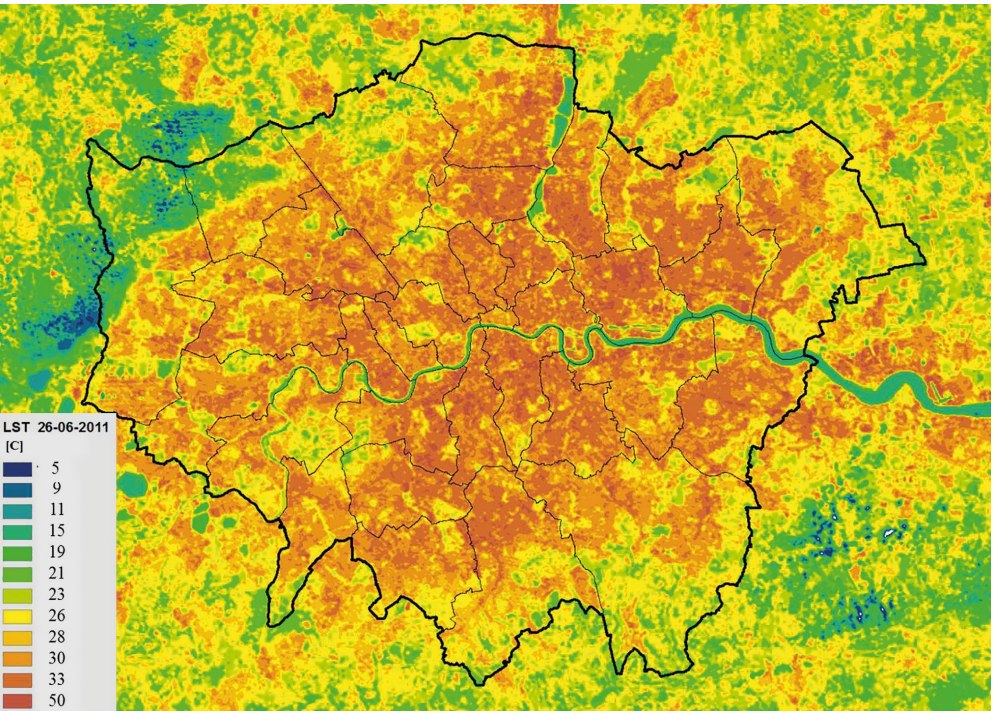


Figure 3. **Greater London measured Land Surface Temperatures (°C) – day time 26th June 2011 (ARUP 2014)**

ARUP, "Reducing Urban Heat Risk: A study on urban heat risk mapping and visualisation," ARUP, GLA, LCCP, Climate UK, Environment Agency, UCL, London Borough of Islington, Jul. 2014.

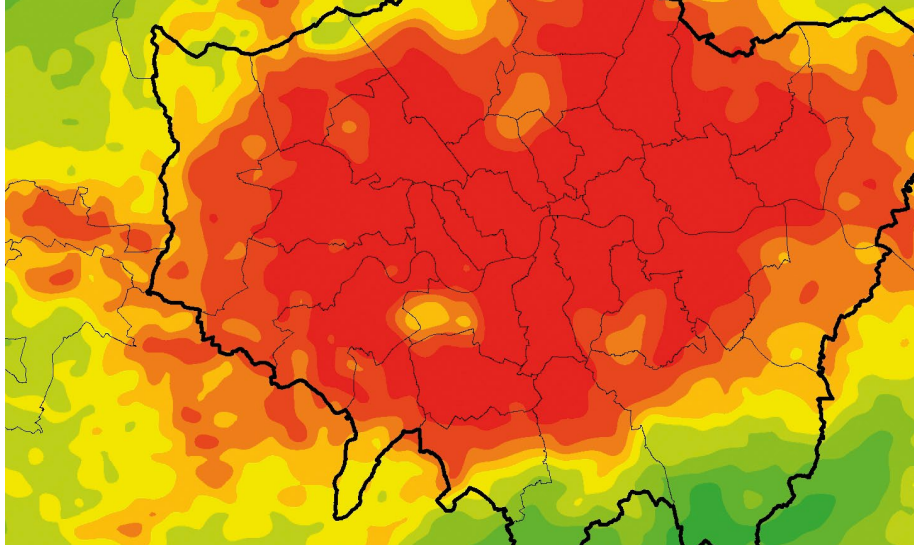
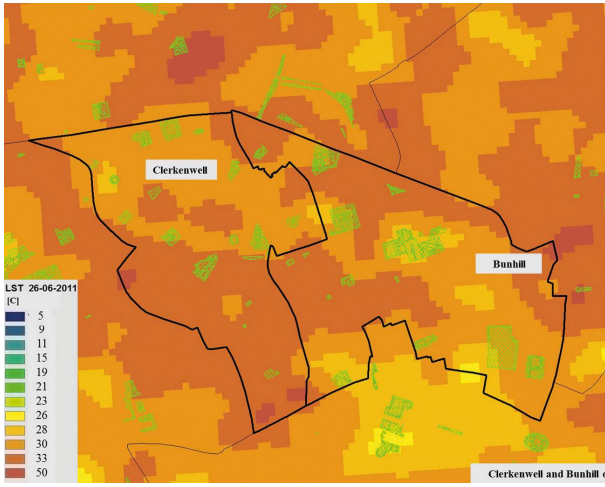


Figure 4. **Greater London modelled average air temperature for May-July 2006 (ARUP 2014)**

Combining green space and land surface temperature maps of London, with other maps such as modelled air temperature (Figure 4), allows higher risk 'hot spot' areas to be identified and flagged.

Figure 5. **Clerkenwell and Bunhill measured Land Surface Temperatures – day time 26th June 2011 and green spaces map overlay (ARUP 2014)**



These maps show the noticeable temperature differences that the Urban Heat Island causes between rural and urban areas. During the August 2003 heatwave, the night time air temperature in central London was 9°C higher than in the surrounding areas.

OVERLAYING TEMPERATURE AND GREEN SPACE MAPS AT LOCAL WARD LEVEL

Arup mapped two specific pilot areas within the central London Borough of Islington: the wards of Bunhill and Clerkenwell. Both locations have low green space density and high LST, indicating potentially greater heat risk. Overlaying maps of LST and green spaces (Figure 5) shows that whilst larger green spaces appear to influence the LST, smaller spaces have a more limited effect.

MAPPING PEOPLE AND BUILDING RISK FACTORS

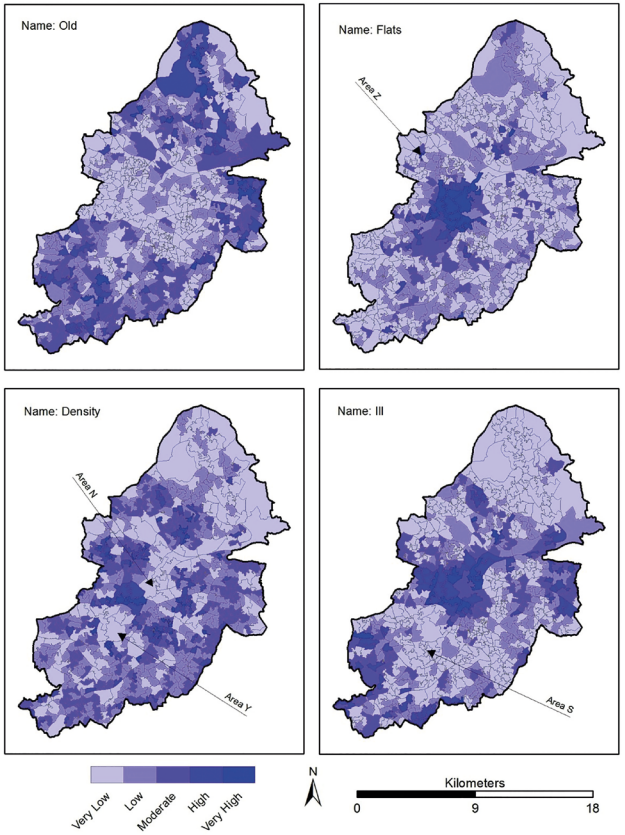


Figure 6.
Birmingham risk factor layers at LSOA level. Population age is labelled 'Old'; dwelling type – 'Flats'; household density – 'Density'; Population health – 'Ill'

Tomlinson et al. 2011, as before

The Birmingham study considered five risk factors, each rated from very low to very high.

People factors	Environmental factors
Population age	Household density
Population health	Dwelling type
	Urban Heat Island

Census data and Geographic Information System (GIS) can be used to locate the demographic, lifestyle and economic status of populations.

The people factors and the environmental factors related to individual homes, (household density and dwelling type), were also mapped at LSOA level (Figure 6)

COMBINING RISK FACTORS TO MAP HEAT RISK

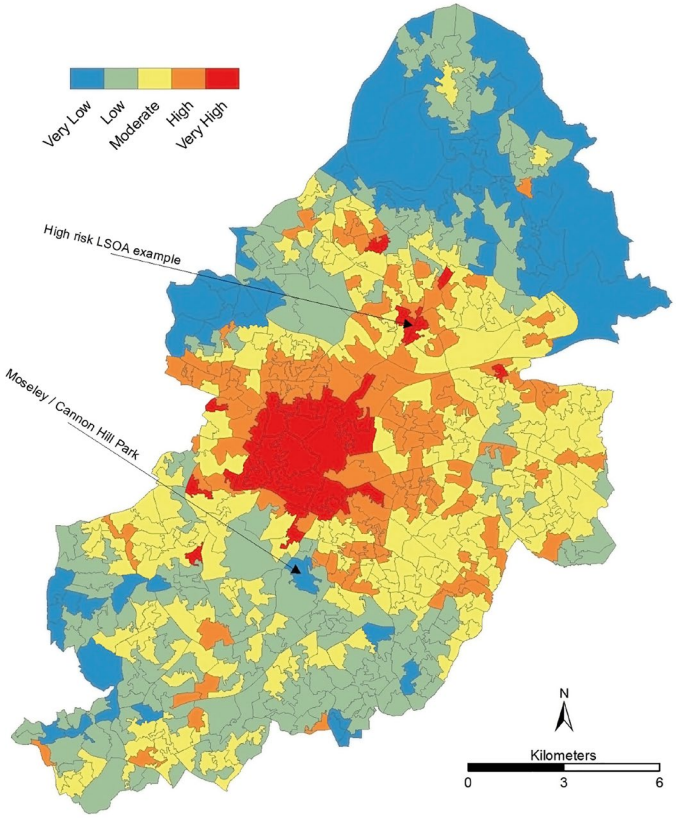


Figure 7. **Birmingham - combined heat risk based on household information and UHI temperature variations.**

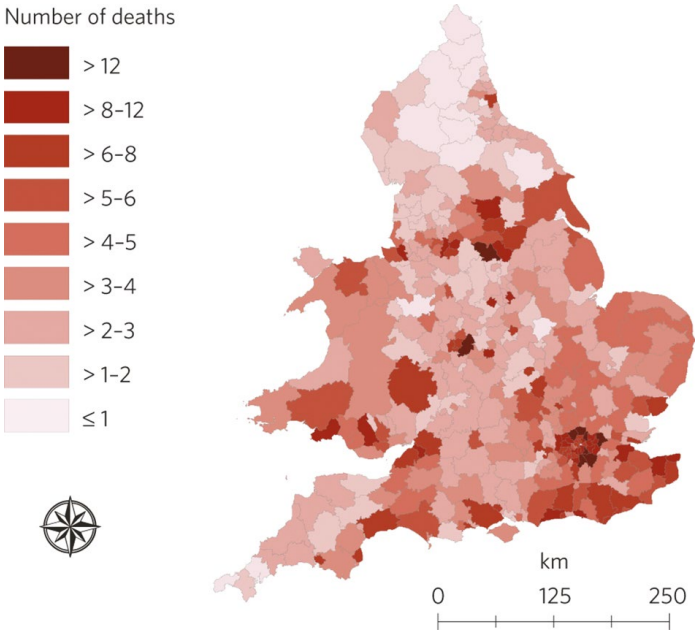
Tomlinson et al. 2011, as before

APPLYING LOCAL KNOWLEDGE

The London Borough of Islington is putting risk mapping to use in its Seasonal Health Interventions Network (SHINE) programme. Under SHINE, heatwaves trigger extra vigilance from their staff, particularly towards vulnerable clients.

The maps of these additional risk factors for people and dwelling type were combined with the mapped Urban Heat Island (Figure 2) to produce an overall heat risk map for Birmingham (Figure 7). This shows areas of "very high" heat risk to be mostly concentrated in the city centre. This is where the highest temperatures are experienced as well as the highest number of ill people, flats and household density.

REGIONAL TEMPERATURE AND MORTALITY MAPPING



Researchers at Imperial College, London looked at how the relationship between cardiorespiratory deaths and temperature varies on a regional basis. They found that a 2°C rise in external summer temperatures could lead to approximately 1,500 additional deaths in England and Wales, about one half of which would occur in 95 districts. Figure 8 maps the distribution of these deaths over 376 local authority regions. It is important to note that this study only covers cardiorespiratory deaths due to heat and not other causes.

Figure 8. **The number of additional cardiorespiratory deaths in the districts of England and Wales that would be expected during five summer months if temperatures were warmer by 2°C.**

Bennett et al, "Vulnerability to the mortality effects of warm temperature in the districts of England and Wales," Nature Clim. Change, vol. 4, Apr. 2014.

CLIMATE JUST MAPPING TOOL

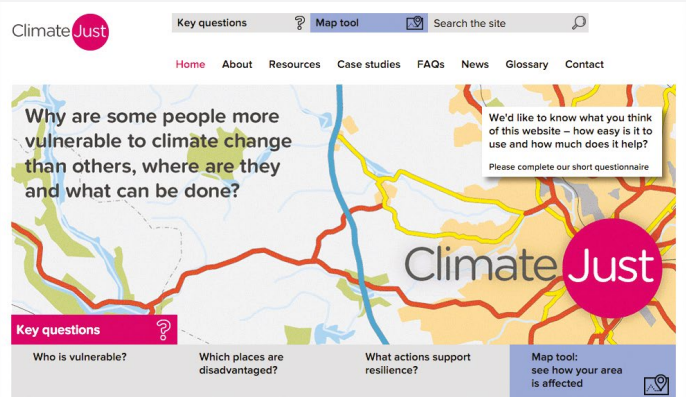
The Climate Just website www.climatejust.org.uk is a recently launched information resource and mapping tool, jointly funded by the Joseph Rowntree Foundation and the Environment Agency Midlands Region and hosted and managed by Climate UK. It is based on content developed by the University of Manchester, with additional contributions from JBA Consulting and the Centre for Sustainable Energy.

It is designed to help with the delivery of equitable responses to climate change at the local level. Its main focus is on supporting responses to the impacts of extreme events, such as flooding and heatwaves, as part of wider climate change adaptation. It also addresses equity issues in relation to climate mitigation and includes analysis of fuel poverty and carbon emissions.

Among other resources, the Climate Just website includes a mapping tool, containing new map data for England, showing where extreme events like floods and heat waves are likely to have the biggest impacts as a result of the characteristics of people and communities.

The Climate Just map tool includes projected summer temperatures in the future climate of the 2050s.

The website is especially targeted at people working on climate change and/or with vulnerable communities such as local authorities and their partners in social care, health, housing and the voluntary and community sectors.



Since our formation in 2008, the Zero Carbon Hub continues to work with Government and industry to identify risks, remove barriers to innovation and help demonstrate that energy efficient, healthy new homes can be delivered by the mainstream house building industry.

Get in touch to find out how we can assist you

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