



DRIVERS OF CHANGE 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.

WHY COULD OVERHEATING BECOME MORE PREVALENT?

Overheating is being driven in part by increased urban living at high density, changes in building design, increased use of electrical appliances and electronics in the home and an ageing population who are more vulnerable to the effects of excess heat. With a changing climate it is becoming even more important to design buildings to be more resilient to heat.

Some of these drivers are beyond the full control of individual housing providers and consumers, but should be factored into decision-making and overheating risk assessments to ensure future homes are sufficiently resilient.

PURPOSE OF THIS LEAFLET

This leaflet, draws on the Thematic Evidence Reviews, commissioned by the Zero Carbon Hub as part of a large-scale project on 'Overheating in Homes', and sets out some of the patterns, statistics and projections relevant to the future extent of overheating. All projections carry a level of uncertainty and are sensitive to their underlying assumptions. As a result, any conclusions about future overheating based on these will also be uncertain.

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

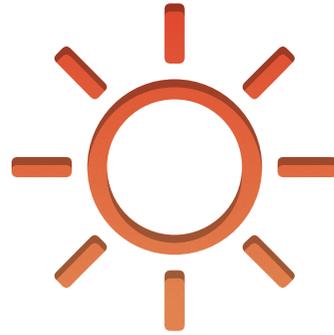
by BRE

LEAFLETS FOR HOUSING ASSOCIATIONS AND LOCAL AUTHORITIES

MONITORING OVERHEATING – HOUSING ASSOCIATION CASE STUDIES

LOCAL AUTHORITIES – TACKLING OVERHEATING IN HOMES

WEATHER AND CLIMATE



INCREASING AVERAGE TEMPERATURES AND HOTTER SUMMERS

As the climate changes, more extreme weather events are predicted in the UK, as well as average summers becoming hotter and drier. We can also expect longer and more frequent heat waves, higher average peak temperatures, higher UV radiation levels and elevated ozone levels.

CLIMATE TRENDS

- Although average temperatures at a national level can vary significantly from year to year, average annual temperatures have increased across all regions of the UK over the past hundred years. Eight of the UK's top-ten warmest years have happened since 2002 (Met Office).
- 2014 was the warmest year on record in the UK, with an average (mean) temperature of 9.9°C (Met Office).
- Between 1961 and 2006, the average number of Cooling Degree Days, a measure of how much energy is required for cooling, has increased throughout the UK and by almost a third in London (UKCP09).

CLIMATE CHANGE PROJECTIONS FOR THE UK

- The UK Climate Projections 2009 (UKCP09) suggest that both seasonal mean and daily mean temperatures in summer and winter are likely to increase by 2050 under all emissions scenarios.
- During the period 1961 to 1990, the summer mean daily maximum temperature in London was 21.3°C. By the middle of the 21st century, it is projected to be between 22.5°C and 28.1°C.
- Similar temperature rises are expected throughout the UK. In Cardiff, for example, the summer mean daily maximum temperature for the period 1961 to 1990 was 19.8°C. By the 2050s, this value is projected to increase by between 1.1°C and 6.8°C.

The range of values used for London and Cardiff run from the low emissions 10-percentile to the high emissions 90-percentile of the UKCP09 projections.



QUANTIFYING THE EFFECT OF CLIMATE CHANGE ON OVERHEATING

The link between climate change in the UK and the risk of overheating in residential properties is not straightforward and has been investigated by many researchers.

One recent study relating to London used data from multiple models to calculate the potential percentage of residents at risk of thermal discomfort for both 2030s and 2050s climate projections and for different dwelling types: detached, semi-detached and terraced houses, and flats.

It found that, in its high emission, median result scenario, by the 2030s, 59% to 76% of residents living in flats in the Greater London area could be affected by thermal discomfort, as defined in CIBSE Guide A (2006). Small shifts in the temperature thresholds used were found to create significant benefits for residents.

HEAT WAVES

- In Europe, the most severe heat-related impacts in living memory occurred during the heat wave of August 2003. There were almost 15,000 excess deaths in France, and over 2,000 excess deaths in England and Wales.
- The latest Met Office research suggests that by the 2040s a summer as hot as 2003, when summer temperatures exceeded the 1961–90 mean by 2.3°C, is expected to be very common; potentially every other year.

HUMIDITY LEVELS

At high temperatures the body loses heat by sweating. This process is much more effective in hot, dry climates than in hot and humid climates. Currently relative humidity is higher in the UK than elsewhere in Europe, but it has been decreasing and is projected to decrease further. Therefore, in terms of the big picture, relative humidity should become less relevant as a driver of overheating in the future, however more research is needed to further understand this phenomenon.

DEMOGRAPHIC CHANGES



OFFICE FOR NATIONAL STATISTICS POPULATION PROJECTIONS

The population of the UK is growing and is projected to increase to 73.3 million people by 2037, an increase of over 9 million people from 2012 levels.

People are also living longer. For example, life expectancy at birth in the UK has increased from 70.8 years for males born in 1980-1982, to 78.9 for those born in 2011-2012.

The population over 75 is projected to nearly double in the next 30 years, to around 13% of the UK population in 2037.

VULNERABLE PEOPLE

The elderly population are at increased risk of heat related illness, especially if their health is already declining. They are usually less able to adapt to higher temperatures. They may also live alone and be socially isolated and so don't seek help quickly enough. The proportion of the population who are overweight or suffer from cardiovascular diseases is also increasing, and these groups too have a higher risk of suffering from heat-related illness.

Although people living in hot countries are accustomed to higher temperatures, it is not clear how quickly people in the UK will acclimatise. Particularly those who are most vulnerable to the effects of excess heat.

OCCUPANCY PROFILES AND ONE-PERSON HOUSEHOLDS

- In 2014, 28% of the 26.7 million households in the UK contained only one person, compared to only 12% of households in 1961.
- Of the 7.6 million people in UK households who lived alone in 2014, nearly 4 million were over 65 (Age UK).

If the proportion of single-person households continues to grow, this could lead to more demand for small flats and homes, some of which are likely to be occupied by younger, healthy people who are out at work all day. However, not all residents will fall into this category. An increasing number of elderly people, and those who are more vulnerable to the effects of overheating, are also likely to be living in these potentially higher risk dwellings.

WORKING PATTERNS

- People may increasingly work from home in the future. According to recent estimates, around 14% people at work in the UK are home workers, a percentage that has been increasing at a 2.8% rate since records began in 1998.

Direct heat exposure during the day time for home workers is increasingly likely to have an impact on the work capacity for those segments of the population, and mean the management of day, as well as night time temperatures in homes, becomes very important.



URBANISATION

- In 2011, nearly 82% of the population in England and Wales lived in urban areas. Around 21% of the urban population were aged 60 or over.
- Many cities in the UK experience the Urban Heat Island effect where temperatures in the city-centre can be much higher than in surrounding rural areas, particularly at night. Differences of as much as 9°C have been recorded in London and 8°C in Manchester compared with local rural areas.

The concentration of the population in urban areas can put pressure on land resources, requiring the re-use of brownfield sites, often at high densities. There are many reasons why high density housing in cities is more prone to overheating, for example, small dwellings amplify the effect of internal heat gains and the external air is more likely to be warmer due to the Urban Heat Island effect.

CONSTRUCTION PRACTICES

ENERGY EFFICIENCY AND AIR-TIGHTNESS

In recent decades there has been a strong drive towards reducing heat loss in homes and winter heating costs by incorporating energy efficiency measures. As a result, new-build dwellings are highly insulated and airtight and lose much less heat through the building fabric. Some existing buildings have also been retrofitted with energy efficiency measures.

Such measures are extremely beneficial in winter – helping to keep homes warm and to save energy. It is important to note that insulation can also help to keep homes cooler in summer too by reducing solar gains through the fabric, although adequate ventilation is essential.

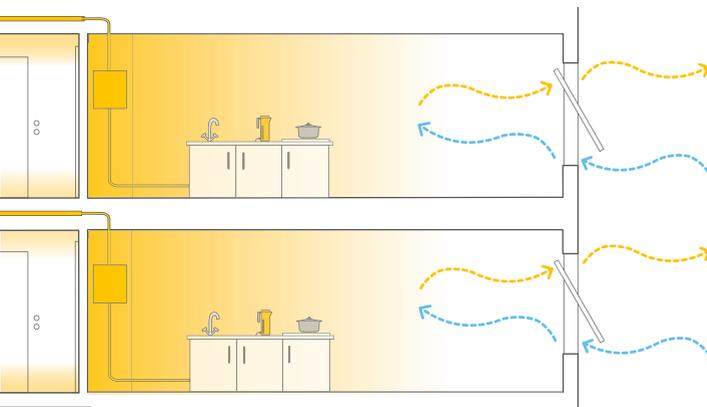
FLATS AND APARTMENTS

- In 2013, 33% of the newly completed residential units in England were flats compared to 20% in 2000.
- In London the proportion of apartments is much higher than the rest of England, at 85% in 2013. Almost 25% of new dwellings built in the last 20 years were one-bedroom flats.
- Fewer new flats are being built in Wales compared to England; less than 17% of the total new housing stock in 2013.

Many high density new developments have a central corridor with ‘single-aspect’ apartments on either side. This maximises the number of dwellings which can be built per unit area. However, recent research suggests that such flats have a higher risk of overheating than other house types.

One reason is that it can be harder to achieve adequate ventilation in a single-aspect apartment than in an apartment or house with opening windows on two or more sides.

In some cases with communal heating and hot water systems, heat from the hot water circulation pipes has also led to overheating. CIBSE and the Association for Decentralised Energy published new guidance in June 2015 to help to prevent this happening in future.



It is harder to achieve adequate ventilation in a single-aspect apartment.

(Figure adapted from Understanding Overheating – Where to Start, NHBC NF44)

WINDOWS AND VENTILATION



Traditionally, our homes have relied on passive approaches to keep the occupants cool, including opening windows and ‘background ventilation’.

However, overheating research projects are finding that occupants frequently report a reluctance to leave their windows open due to concerns about noise, pollution and security, particularly in urban areas.

In addition, many new dwellings have large windows or patio doors. Although these allow lots of natural daylight in on bright days, the sun coming through these large areas of glass can quickly make the rooms inside too hot if counter measures such as clever positioning, shading, or treated glass are not used.

A recent study by DECC found that air conditioning units in homes are very rare - they were used by less than 3% of the households surveyed, but approximately 43% of households used portable fans to keep people cooler.

Another study in 2010 raised the possibility that the number of homes with air conditioning could reach 18% in London by 2030 if householders follow the same patterns as consumers in the United States in response to rising temperatures.

MECHANICAL VENTILATION

An alternative way of providing fresh air now used in many newer homes is by mechanical ventilation systems. However, such systems are generally designed to provide good indoor air quality, and not to cool the property down.

AIR CONDITIONING

Air conditioning systems designed to cool buildings are not used widely in the domestic sector.

Stakeholders interviewed by the ZCH tended to support approaches which encourage good building design and the use of passive measures first. A good example is the ‘Cooling Hierarchy’ adopted by the Greater London Authority (GLA) in their planning guidance.

Increased uptake of air conditioning would have knock-on consequences for energy use in the home, increasing carbon emissions. Fuel poor households may also have problems paying for the extra energy.

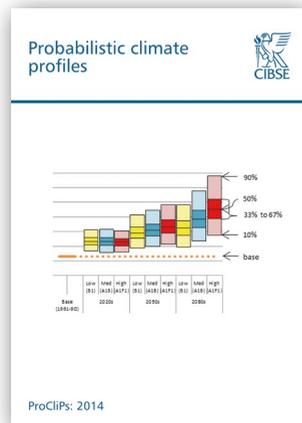
In addition, the waste heat from AC systems is nearly always ejected into the outside air. This has the potential to intensify the Urban Heat Island.

DESIGNING FOR FUTURE RESILIENCE

Some homes have specific combinations of risk factors which make them more prone to overheating. For example, they may have windows intended to provide ventilation and to purge hot air, but which open onto noisy main roads and so are rarely used by the occupants.

By understanding these risk factors and the range of solutions available to combat them, designers, housing providers and retrofitters can reduce the risk of overheating. See for example the Zero Carbon Hub's evidence review on 'Solutions to Overheating'.

However, it is also important to consider the other drivers outlined in this leaflet, in order to maximize future resilience.



HOMES WITH VULNERABLE OCCUPANTS

As the population ages, more care homes and retirement properties are being constructed. The occupants of these types of accommodation are particularly vulnerable and good building design will be critical to avoid increasing the chances of overheating occurring.

The Heatwave Plan for England (2015) recommends that cool rooms, maintained at temperatures below 26°C, should be provided in hospitals, care/nursing homes and other residential environments occupied by vulnerable individuals.

CLIMATE CHANGE

CIBSE have published a set of ProCLiPs (Probabilistic Climate Profiles), a visual representation of the UKCP09 projections, to help communicate climate risk and uncertainty to designers and clients, and to enable them to choose future weather data for design analysis.

FUTURE OVERHEATING

Although it is very difficult to quantify the possible levels of overheating in homes over the long term, if the trends outlined continue and are realised as expected, this paints a concerning picture for future health and comfort.

Without mitigation measures it seems very likely that the number of people experiencing overheating in their homes will increase and that these problems could occur for longer periods of the year than at present. We might also expect the severity of the impacts of overheating to worsen as the proportion of the population who are vulnerable to the effects of prolonged heat exposure grows.

One of the challenges industry and government decision-makers face is to decide how to proceed on the basis of evidence of current overheating, whilst also acknowledging the complexity and uncertainty around future levels.

The Zero Carbon Hub is supporting this process.

The Zero Carbon Hub will shortly produce a proposal for an agreed definition of overheating in new homes, based on recommendations and advice drawn together from the evidence gathering phase of the Overheating project, and also views put forward by a working group of 40 experts.

The Zero Carbon Hub is also engaging directly with housing providers and health professionals to help them improve their whole approach to managing the risk of overheating – within their organisation's internal processes, within their physical stock, and with their tenants and customers.

Although the number of people experiencing the effects of overheating in the UK is currently small compared to the problem of cold, leaky homes, it is vital that efforts by the construction and energy efficiency sectors in the coming years focus on making future homes safe and comfortable for the occupants during the summer, as well as the winter.



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

 0845 888 7620

 info@zerocarbonhub.org

 Zero Carbon Hub, Layden House,
76-86 Turnmill Street, London EC1M 5LG

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