OVERHEATING IN HOMES

DRIVERS OF CHANGE

ZERO CARBON HUB

Overheating in homes

This leaflet provides an update on our 'Tackling Overheating in Homes' project and summarises national-level statistics and trends that could affect the extent and severity of overheating in the future.

There is growing evidence of overheating occurring more frequently in homes, both new and existing, and especially in smaller, single-aspect dwellings where cross ventilation is more difficult for occupants to achieve.

Exposure to excess heat in homes over prolonged periods can have serious consequences for the health of the people living there. In extreme cases, there can be a risk to life for vulnerable groups, such as the elderly or sick, who are also more likely to be occupying their homes during the day when the heat is most intense. For this reason in particular, homes are our focus.

With external temperatures set to increase and more hot spells and heat waves anticipated, there is a concern that overheating in homes will become more commonplace in the future.

The Zero Carbon Hub's working definition of overheating

The phenomenon of a person experiencing excessive or prolonged high temperatures within their home, resulting from internal and/or external heat gains, which leads to adverse effects on their comfort, health or productivity.

THE ZERO CARBON HUB'S OVERHEATING PROJECT

The Zero Carbon Hub has been coordinating research into the issue of overheating and providing guidance for industry over a number of years.

Working with government, industry and academic partners, our ambition now is to translate what is known about the issue of overheating in homes into recommendations on the types of framework and actions which could be needed to systematically address the issue for the long term. The project is called 'Tackling Overheating in Homes'.

Our preliminary report will be published in June 2015, prior to the Committee on Climate Change's report to Parliament on the country's progress on the National Adaptation Programme. Our final recommendations are due by early 2016.

EVIDENCE REVIEWS

A comprehensive evidence gathering exercise is underway. This has included the Zero Carbon Hub commissioning a series of Evidence Reviews from experts on key themes.

The following Reviews have been published:

- **DEFINING OVERHEATING**
  by the Chartered Institute of Building Services Engineers (CIBSE), ARCC, University College London (UCL), and the London School of Hygiene and Tropical Medicine
- **ASSESSING OVERHEATING RISK**
  by Inkling LLP, CIBSE, UCL and ARCC
- **IMPACTS OF OVERHEATING**
  by AECOM
- **OVERHEATING RISK MAPPING**
  by AECOM

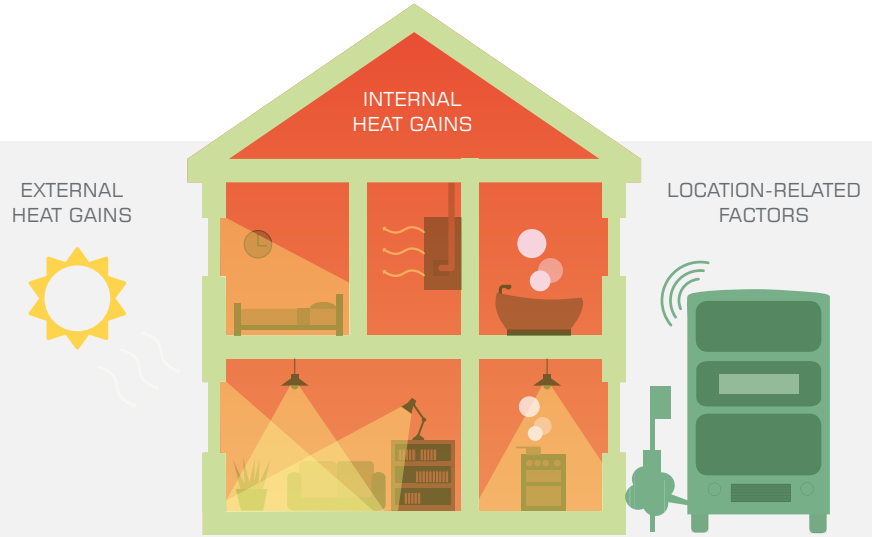
A fifth Evidence Review will set out the range of technical and behavioural measures and solutions available to address overheating in new and existing homes. This will be published in June 2015.

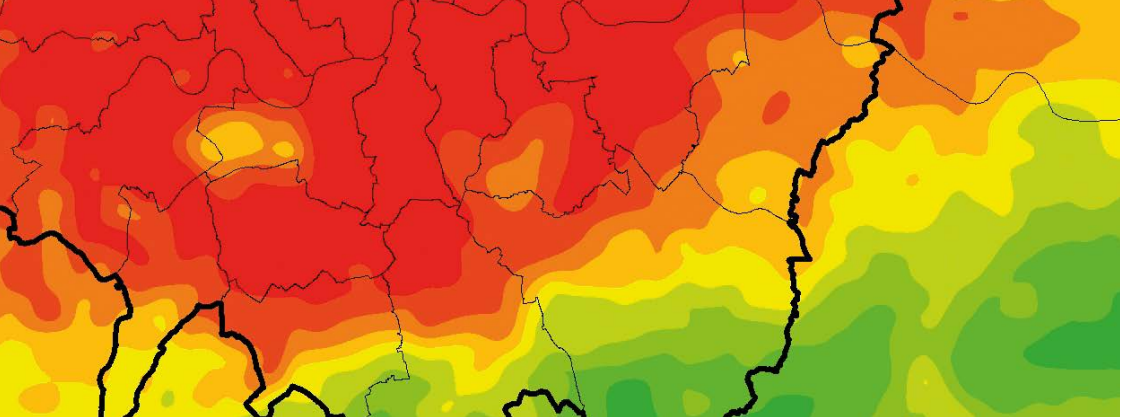
WHY COULD OVERHEATING BECOME MORE PREVALENT?

Although there are different ways of determining when a property is overheating, recent research, drawn on by the Committee on Climate Change's Adaptation Sub-Committee, estimates that up to 20% of homes in England may already be overheating, even in cool summers.

These homes are likely to 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 such site-specific risk factors, designers, housing providers and retrofitters can target practical overheating mitigation measures – such as shading or bespoke ventilation strategies – to the homes and people which most need them.





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 generally drier. We can also expect longer and more frequent heat waves and higher average peak temperatures.

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 2015).

2014 was the warmest year on record in the UK, with an average mean temperature of 9.9˚C (Met Office 2015).

Although the summer of 2014 was not as warm as 2013 or the heat wave years of 2006 and 2003, the UK mean temperature was 14.8˚C, which is 0.5˚C above the 1981 to 2010 summer average (Met Office 2015).

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 more than doubled in London (UKCP09).

The UK Climate Projections 2009 estimate 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 climate projections above are taken from CIBSE's Probabilistic Climate Profiles (ProCLIPS). ProCLIPS are representations of the UKCP09 climate projections. They are intended to assist building designers in familiarising themselves with the likely future climate. The ranges used are from the low emissions 10-percentile to the high emissions 90-percentile.

In addition to these site-specific factors, other patterns, trends and drivers at the regional and national level are expected to lead to more cases of overheating in the future. Such drivers, including the ageing population and climate change, are normally beyond the full control of individual housing providers and consumers. However, they need to be factored into decision-making and overheating risk assessments to ensure future homes are sufficiently resilient.

This leaflet, drawing on each of the Evidence Reviews, sets out some of the patterns, statistics and projections relevant to the future extent of overheating at a national level. References have been provided at the end so readers can explore the assumptions behind the information in more detail.

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. They do, however, provide a useful starting point for business and policy planning.

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.

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 straight-forward and has been investigated by many researchers. One study relating to London was reported by Jenkins et al in 2014, drawing on Mavrogianni et al 2012.

Data from multiple models was used 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.

One of the project's findings was that, in their 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. Temperatures reached 38.5˚C in Kent on 10 August. More than 2,000 excess deaths were attributed to the heat wave in England and Wales (Kovats et al 2006).

The latest 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 in the UK; potentially every other year (Christidis et al 2014).

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 (UKCP09). 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

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 (ONS 2013).

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 (ONS 2014).

The population over 75 is projected to nearly double in the next 30 years, to around 13% of the UK population in 2037 (ONS 2013).

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 around 12% of households in 1961 (ONS 2015).

Of the 7.6 million people in UK households who lived alone in 2014, nearly 4 million were over 65 (Age UK 2015).

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 (ONS 2014).

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 (Defra 2013).

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 (GLA 2006, Levermore et al 2011).

The concentration of the population in urban areas can put pressure on land resources, requiring the re-use of brownfield sites for building, often at high densities. There are many reasons why high density housing in cities is more prone to overheating, for example, dwelling sizes may be smaller, potentially amplifying 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

Many high density new developments have a central corridor with single-aspect apartments on either side. This practice has advantages in maximising the number of dwellings which can be built per unit area. However, recent research suggests 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 2014, approximately 30% of the newly completed residential units in England were flats, compared to 20% in 2000 and approximately 50% in 2008 (DCLG 2015).

In London the proportion of apartments is much higher than the rest of England, at 83% in 2012 (DCLG 2013).

Fewer new flats are being built in Wales compared to England; less than 15% of the total new housing stock in 2014 (Welsh Government 2014).

As the population ages, more care homes and retirement properties are also 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.

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 energy through the building fabric. Millions of existing buildings have also been retrofitted with insulation and other energy efficiency measures.

Such measures are extremely beneficial in winter – helping to keep homes warm and to save energy - but could have unforeseen and unintended consequences in summer if not managed. For example, insulation keeps homes warm in winter and helps keep them cooler in summer, but effects such as solar gain can cause an increase in internal temperatures which are potentially difficult to dissipate.

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.

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

Air conditioning systems designed to cool buildings are not currently used widely in the domestic sector. Regulation tends to encourage the use of good design and passive measures first to keep homes cool, relying on air conditioning systems only when absolutely necessary.

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 (DECC 2013).

A study by Peacock et al (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. This would have knock on consequences for energy use in the home with potential to increase carbon emissions.

FUTURE OVERHEATING

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

Without adaptation measures, it seems likely that the number of people experiencing overheating in their homes would increase and that issues could arise for longer periods of the year than at present. We might also expect the impact of overheating cases to worsen as the proportion of the population who are vulnerable to the effects of heat exposure grows.

One of the challenges industry and government Ministers 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's project will support this process by analysing a range of possible strategic responses which are considered both proportionate and feasible to deliver.

For more information about the Zero Carbon Hub's 'Tackling Overheating in Homes' project go to our website: www.zerocarbonhub.org

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The Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering zero carbon homes in England from 2016. The Hub reports directly to the 2016 Taskforce.

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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