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Environmental Audit Committee

Evidence on heat resilience and sustainable cooling by Historic England

About Historic England

1. Historic England is the Government's statutory adviser on all matters relating to the historic environment in England. We are a non-departmental public body established under the National Heritage Act 1983 and sponsored by the Department for Culture, Media and Sport (DCMS). We champion and protect England's historic places, providing expert advice to local planning authorities, developers, owners and communities to help ensure our historic environment is properly understood, enjoyed and cared for.

Summary

2.

- England's historic buildings, landscapes and urban green spaces can play a significant positive role in heat resilience and offer low carbon solutions. The planning framework could do more to maximise these opportunities.
- There is currently a skills shortage to deliver retrofit solutions in historic buildings to respond to the impacts of climate change.
- A joined-up approach is needed across government on policies, initiatives and funding to ensure that all aspects of climate change, mitigation and adaptation are holistically considered.

How can sustainable cooling solutions and adaptation strategies be implemented in such a way as to minimise overheating, reduce energy consumption and prevent overloading of the electricity grid during peak demand?

3. Historic parks, cemeteries and churchyards, squares and gardens, allotments and watercourses (canals and rivers) are the fundamental building blocks of green/blue infrastructure and are starting point for comprehensive urban greening. Complemented by urban domestic gardens, particularly larger historic urban 'villa' gardens, new green urban interventions need to work alongside these existing assets to maximise their cooling potential. More prominence for the protection and maintenance of historic green spaces could provide sustainable low/zero energy solutions.

4. Many historic towns and city centres have a higher building footprint density than more recent developments, and lower street-level temperatures due to low-rise narrow streets. Many lessons can be taken from the past on methods of cooling a building via passive measures, such as awnings and canopies to prevent solar gain in buildings.[1] Where reintroduced, passive measures in the construction of new buildings and retrofit of existing buildings helps to cool internal environments, saving energy and carbon[2]. To further cool environments the UK can learn from other countries and introduce more urban green areas.[3] [4]

[1] The Building Conservation Directory 2021 - Awnings and Canopies (historicengland.org.uk)
[2] Summertime overheating in UK homes: is there a safe haven? (journal-buildingscities.org)
[3] Toward park design optimization to mitigate the urban heat Island: Assessment of the cooling effect in five U.S. cities (sciencedirect.com)
[4] Urban green space cooling effect in cities: Heliyon (cell.com)

5. Passive measures such as natural ventilation or hybrid ventilation systems can contribute to reducing the cooling requirement of buildings, but in some cases are not sufficient and will need additional active cooling measures. Any increase in electrical loads from those measures can be reduced by ensuring that the required cooling is significantly reduced by passive measures first before using active ones.

6. A key observation from Historic England's research into overheating and historic buildings[5] found that each building's overheating profile is unique and influenced by a range of factors. It is important to propose mitigation measures that are most effective towards addressing building-specific overheating drivers. Modelling these individually is beneficial for decision-making at a building management level.

7. Approximately 83% of the UK population lives in towns and cities (ONS)[6]. City temperatures are typically 4°C hotter than surrounding countryside; London is up to 10°C hotter[7]. Temperature is greater in larger cities. This provides some advantage in winter but is increasingly problematic with increasing peak summer temperatures with urban areas more at risk of summertime overheating as they are affected by the heat island effect and the growth in urbanisation. More heat emissions in the urban areas and less heat loss at night, especially on calm clear nights, creates a greater challenge to providing comfortable internal environments[8].

8. In cities, only about 10 percent of energy from the Sun is reflected. This figure is lower in high-rise cities where radiation is often reflected down to street level. Research from the University of Basel, Switzerland, has shown that on a hot summer's day when air temperature was 25°C, streets reached temperatures of 37°C and roofs 45°C. The temperature of trees remained at 25°C and waterbodies were just 18°C.[9] Research in Manchester shows that built-up areas, such as city centres with vegetation cover of less than 30 percent, were up to 13°C hotter than urban green spaces[10].

9. Green urban design is more than simply planting trees. The benefits of open water bodies (particularly 'daylighting' previously culverted watercourses), grassland and varying height layers of tree canopy accommodate changing sun paths, prevailing winds and convection patterns, as well as the needs and demands of people. More research is needed into urban green/blue design to ensure maximum cooling and shading effectiveness at local and regional levels.

10. The role of domestic gardens should not be overlooked. Domestic gardens contain approximately 25 percent of the total UK non-forest and woodland trees. They can contribute as much as 86 percent of the urban tree stock[11].

[5] Overheating and Historic Buildings (historicengland.org.uk)
[6] Trend Deck 2021: Urbanisation (www.gov.uk)
[7] Urban Heat Islands (rmets.org)
[8] Justine M. Hall, John F. Handley, A. Roland Ennos, The potential of tree planting to climate-proof high density residential areas in Manchester, UK, Landscape and Urban Planning, Volume 104, Issues 3–4, 2012, Pages 410-417.
[9] Sebastian Leuzinger, Roland Vogt, Christian Körner, Tree surface temperature in an urban environment, Agricultural and Forest Meteorology, Volume 150, Issue 1, 2010, Pages 56-62
[10] Justine M. Hall, John F. Handley, A. Roland Ennos, The potential of tree planting to climate-proof high density residential areas in Manchester, UK, Landscape and Urban Planning, Volume 104, Issues 3–4, 2012, Pages 410-417.
[11] Gardening Matters: Urban Gardens, Royal Horticultural Society, 2011

To what extent do the Government's Climate Change Risk Assessment and National Adaptation Programme (as well as other related strategies such as the Net Zero Strategy and Heat and Buildings Strategy) identify and address the risks from extreme heat?

11. The Government's Climate Change Risk Assessment acknowledges overheating and impacts on work productivity, with further reference to research into human health and mortality and the development of Part O for new buildings in the Building Regulations. It does not, however, consider that a maximum temperature to work in is required, or that further work to our regulations is needed for existing buildings.

12. NAP3 again focuses mainly on overheating in new buildings and not in existing buildings. Non-domestic buildings will continue to rely on mechanical systems using a lot of energy and will be sealed up, potentially causing air quality issues whilst using mechanical ventilation. At present only the Department for Education have stated they will opt for nature-based solutions. We would encourage more public bodies to adopt nature-based solutions, including in the context of Greening Government Commitments.

13. The reliance in NAP3 on tackling overheating via regulation overlooks that regulation only applies where changes are being undertaken, otherwise there is no requirement to meet the newest regulation standards.

14. The Net Zero Strategy has minimal recommendations in relation to overheating, apart from where cooling benefits will occur through afforestation and greening of our environment to capture carbon or prevent flooding. The Net Zero Strategy fails to recognise overheating as a leading hazard.

Does the current planning framework do enough to encourage heat resilience measures such as cooling shelters, water bodies, green infrastructure and shading to be integrated into urban planning?

15. In the same way libraries, churches and museums can act as warm havens for people unable to afford to heat their homes, they can also play an important role in acting as cooling hubs in summer months. Buildings of traditional construction, such as churches and cathedrals tend to be 'heavyweight'[12] buildings, with a high thermal mass meaning the fabric of the building will warm up more slowly during the day, keeping the internal temperature low without the need for mechanical cooling. They could also provide refuge for people required to work outside during the day who require respite to avoid heat stress. It is essential these buildings are protected, well maintained, and recognised in national and local heat resilience plans and policies.

16. There are opportunities for historic landscapes to support a heat resilient future. Historic urban planning delivered networks of green spaces that continue to provide environmental benefits, including heat resilience, in our towns and cities today. One such example is the network of green spaces provided for public benefit in Nottingham by an Inclosure Act of 1845, which are a vital part of the city's green infrastructure[13]. The heat resilience and cooling benefits of parks need to be understood and considered in the round alongside their societal, wellbeing, cultural and heritage significance. Where robust management plans are in place, there is room in our urban parks and

[12] CIBSE Guide A Environmental Design May 2019, CIBSE London

[13] Greater Nottingham Partnership, Greater Nottingham Blue-Green Infrastructure Strategy, January 2022, Page 50.

greenspaces for more traditional horticulture and spaces for nature that will together support climate change resilience and nature recovery.

17. Using the legacy of historic landscapes to inform new development often means working more closely with the grain of nature. For example, working with natural drainage patterns, settlement orientation and landcover (trees, grassland, heath, etc.) can contribute to nature-based solutions that will help make new developments more sustainable.

18. The current planning framework could do more to support and guide urban greening as a key element in green infrastructure networks. Many proposals for urban greening (for example, 'wilding' of parks, management of watercourses) sit outside the scope of the planning system. Subdivision of large gardens also remains difficult to resist under the current planning framework. Green infrastructure needs to be integral to local plans and new developments, guided by the Green Infrastructure Framework.

19. Blue/green infrastructure is evidenced as being effective internationally. More than 100 years of urban green planning can be seen in the work of the Hamburg Green Network[14]. The Singapore Green Plan has illustrated how greening of a dense urban environment can be successfully achieved[15].The health resilience of Singapore during the Covid-19 pandemic has been attributed in part to the 'greening' of the city environment.

What can be done to protect the UK's existing public and private sector housing stock from the impacts of extreme heat while ensuring that homes are sufficiently warm in the winter months?

20. Maintenance is essential for energy efficiency, carbon reduction and reduction of fuel poverty and should be incentivised. It can save between 30-50% of carbon emissions, and up to 40% savings in energy consumption16. This is a significant saving when we consider the English Housing Survey 17 'estimated that 13% of homes in the social rented sector failed to meet the decent homes standard in 2020, compared to 21% in the private rented sector and 16% in the owner-occupied sector'. It is accepted that insulation materials will stop performing thermally when wet, so the importance of continuous maintenance is a factor. Lower income households need to be supported with heating and cooling their homes, to prevent deterioration of the building and health risks to the occupants. We encourage government to explore fiscal measures to incentivise the repair and maintenance of building fabric in addition to encouraging uptake of energy efficiency improvements (e.g. heat pumps).

21. It is essential to recognise the performance differences of traditional and modern construction. Traditional buildings with solid walls generally perform better in summer months, evidenced by the Energy Follow Up Survey[18]. Appropriate retrofit can reduce heat loss in winter and heat gain in summer by identifying where the biggest losses and gains occur. Where retrofit measures do not

[14] Green Network Hamburg (hamburg.com)
[15] Singapore Green Plan 2030 (greenplan.gov.sg)
[16] Maintenance and benign changes as a sustainable strategy for the refurbishment of historic suburban dwellings (kingston.ac.uk)
[17] English Housing Survey 2021 to 2022: headline report (www.gov.uk)
[18] Energy Follow Up Survey: thermal comfort, damp and ventilation (publishing.service.gov.uk)

consider the building's construction type, are installed poorly and not maintained, they result in decay of the property and health issues to the occupants[19].

22. Maintenance and retrofit of historic buildings require a sufficiently skilled workforce. There is already an evidenced[20] skills gap and shortage, and demand will grow dramatically over the next few years. Retrofit of our 6.2 million pre-1919 traditionally built residential buildings could lead to an additional £35 billion of output annually, but delivering this requires significant growth, investment and reform.

23. The report estimates there are currently 100,000 people working with historic buildings in occupations relevant to retrofit (and this is already falling short of need with 11% of employers reporting a skills gap regarding retrofit to historic buildings, with 6% also reporting skills shortages) and this needs to grow by 105,000 per year (81,000 to work on residential buildings, and 24,000 commercial).

24. These new entrants will need training, as do those already working in the sector. Research from 2013 evidenced that 75% of contractors have not completed any training for pre-1919 building work in the past 4-5 years. Given the speed at which our knowledge is growing, regular training is required to avoid unintended consequences of adaptation. However, the current training offered in both retrofit and mainstream construction does not routinely adequately recognise the distinction between traditional and modern construction or educate learners in the different approaches required. A widescale review of training available for the construction sector is required to ensure knowledge of retrofit of both modern and traditional buildings is appropriately covered and widely available, alongside clear incentives to drive up-take.

25. The scale of this challenge highlights the need for a long-term national strategy that sets out how it will bring together skills and training, funding and incentives, and standards and advice to tackle the requirements for the country's building stock, including its historic buildings. This is pivotal in providing the industry, investors and training providers with the confidence they need to up-skill and scale up the workforce.

26. A joined-up approach is needed across government on policies, initiatives and funding to ensure that all aspects of climate change, mitigation and adaptation are holistically considered. The current focus on retrofit does not consider the risk of overheating; for example, all publicly funded projects are required to comply with PAS2035 (a UK framework for applying energy retrofit measures to existing buildings including implementation best practices), but this does not provide options for adaptation to climate change.

What role might reversible heat pumps (which can act as both heating and cooling systems) and other emerging technological solutions, such as the development of smart materials, play in meeting future cooling demands?

27. Heat pumps offer an efficient, low carbon means of space heating and hot water for many traditional buildings and are a well-developed technology. There are many successful examples of monobloc (air to water) heat pumps being installed in existing buildings, reusing existing traditional heat emitters, or installing new underfloor heating or fan convectors. For reversible heat pumps, direct expansion systems (air to air) would be required. These transfer heat and

[19] Planning responsible retrofit of traditional buildings (historicengland.org.uk) Page 12
[20] Heritage and Carbon: Addressing the skills gap (grosvenor.com)

cooling into the building using refrigerant, rather than water[21]. This makes traditional heat emitters that use water redundant. No direct expansion systems are currently available that utilise low environmental impact refrigerants[22].

28. In urban areas, however, where achieving comfortable internal environments will be challenging, using a reversible heat pump will negate the need for two separate systems, one for winter heating and the other for summer cooling. Indoor units always incorporate a fan and therefore make noise when heating or cooling, which can make them less desirable for residential applications. Care would need to be taken to ensure overall energy consumption did not inadvertently increase by operating in cooling mode in summer.

29. There are three types of direct exchange system, the most efficient and flexible system comes with the highest initial capital cost. Traditional variable refrigerant systems have high refrigerant charges which can leak over the life of a system.

Does the Government's Future Homes Standard adequately consider overheating in homes? If not, what additional elements should it include?

30. The Future Homes Standard only considers overheating in new buildings constructed from 2025. It does not address buildings constructed before 2025 which means the vast majority of the housing stock falls outside existing regulations and standards. Following the 2021 consultation, positive change occurred with the introduction of Part O, the amendments to Part F and L of the Building Regulations, and the revision of SAP 10. Part O and SAP10 are only relevant to new buildings and further review of Part F and L is required to support existing buildings, particularly those of traditional construction.

31. The Approved Documents do not recognise many measures of passive ventilation, for example, cross ventilation or correct orientation of buildings. Cross ventilation in existing buildings has been reduced or removed in many cases when internal partitions, doors or windows have been altered. Both passive and mechanical ventilation should be included in recommendations in Approved Document A, F, L and O, to ensure that work to existing buildings or construction of new buildings does not have to rely solely on mechanical ventilation.

Does the UK need a dedicated Heat Resilience Strategy? What lessons can be learned from other nations when it comes to national strategies for heat resilience?

32. Delivering heat resilience requires action spanning multiple government departments and policy areas. Furthermore, existing and emerging polices designed to deliver Net Zero must be considered alongside policies to improve resilience to ensure measures to reduce carbon are not impacted at later stages due to the impacts of climate change, and to ensure they don't exacerbate the impacts of climate change, for example the overuse of internal wall insulation.

33. Where historic buildings may require retrofit to improve their resilience, similar challenges may be faced to those experienced when retrofitting for energy efficiency including:

- A need for clear planning policy and regulation to inform decision-making.
- Greater skills, training and capacity in local planning authorities.

[21] Heat Pumps in Historic Buildings (historicengland.org.uk) Page 4
[22] Heat Pumps in Historic Buildings (historicengland.org.uk) Page 7

- Improved guidance and information for homeowners, including information on approved products to avoid maladaptation and costly (financial and in carbon emissions) remedial works.
- Greater skills, training and capacity in the construction industry to enable appropriate retrofit of historic buildings and to bring costs down. Historic building retrofit requires 205,000 workers every year from now until 2050 to meet Net Zero – over double the number of current workers with the necessary skills[23].
- Funding/fiscal measures designed to work with the regulatory framework for the historic environment to ensure the historic buildings stock is not scoped out of funding schemes and changes to fiscal policy.

34. The challenges above relate to adapting historic buildings for energy efficiency, but they are relevant to retrofit in general, and the challenges are likely to be broader when factoring in the role of green infrastructure. A dedicated Heat Resilience Strategy provides opportunity to coordinate cross-departmental action.

35. The strategy would need to look at how we define a heat wave, at the moment it is 3 days >25C which would be exceeded on a regular basis. It also needs to consider where data is collected as weather data used by building designers is from weather stations at airports. These are generally in semi-rural to rural areas. London's station is Heathrow Airport and Manchester's is in Cheshire, which are not urban areas so do not take into account the heat island effect. During the 2022 heat wave, Geoffrey Levermore at The University of Manchester demonstrated that the maximum daytime temperature in central Manchester did not significantly exceed that recorded at the weather station; however, the urban night-time temperatures significantly exceeded it.[24]

[23] Heritage and Carbon: Addressing the skills gap (grosvenor.com)
[24] Heat waves and the urban infrastructure (cibse.org)