CARDIFF
SCHOOL of ART & DESIGN

Cardiff Metropolitan University | Prifysgol Metropolitan Caerdydd

Considering summertime relative humidity in older properties

Factsheet for asset managers and retrofit coordinators.

Introduction

This factsheet aims to provide you with a better understanding of the impacts summertime relative humidity will have on older, traditional properties and provides advice on approaches to tackling them.

Typically, these properties are over 100 years old. Traditional construction is building construction consisting of solid brick, earth or stone external walls, or pre-1919 timber-framed external walls with any infill (BSI, 2023).

We will outline the climate risks posed to our buildings by our changing climate and make suggestions on appropriate adaptations at behavioural, maintenance and refurbishment levels. We will also point you in the direction of advice on how to deal with condensation, damp and mould growth, moisture in building fabric and more general air quality issues.

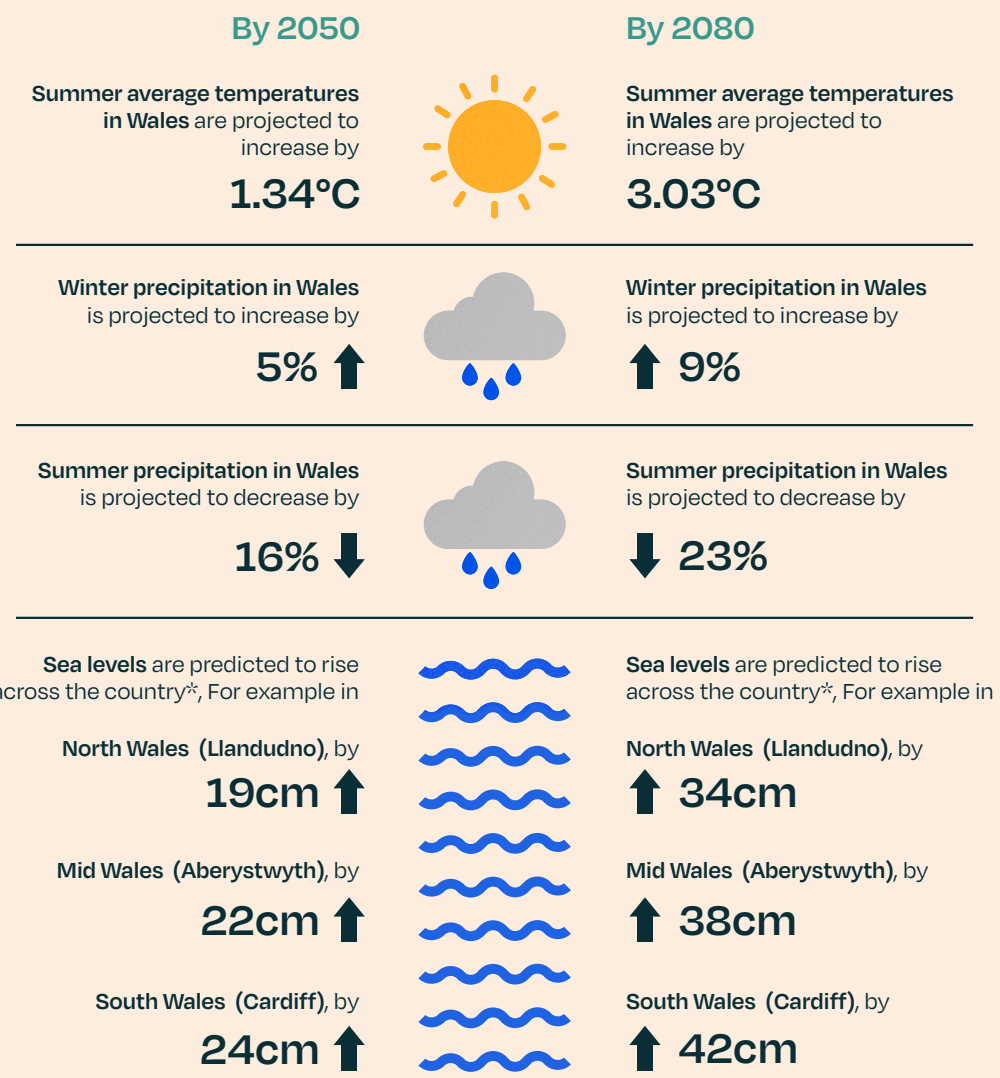
Climate change and Climate vulnerabilities

The urgency and likely impact of climate change has been thoroughly assessed by scientists, the results of which are now widely published and regularly reported in the mainstream media.

Current international decarbonisation efforts are unlikely to hold global warming to 1.5˚c (UN, 2022). Consequently, we need to plan for warmer, wetter weather, and more extreme weather patterns, including high winds, storm surges and intense precipitation.

Rainwater damage is more likely to occur due to climate change (see Hayles, 2022), and changed precipitation patterns are impacting building envelope moisture dynamics. This will impact indoor environmental quality and occupant health, particularly if it leads to condensation, damp, and mould growth (Hayles et al, 2022).

Figure 1: Climate Change predictions by 2050 and 2080 taken from the UK Climate Projections (UKCP18) dataset.[1]



1 – UK Climate Projections (UKCP18), Met Office https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index

The impacts of increasing relative humidity are already being reported in some properties. We therefore need to prepare for these changing weather patterns and adapt our homes accordingly. In recent years there has been a focus on decarbonisation efforts aimed at improving the energy efficiency of our homes whilst reducing our reliance on fossil fuels. Many of these energy efficiency approaches have changed the interrelationship between heat and moisture, adding to the risk of moisture build up.

Traditional buildings take up moisture from their surroundings and then release it according to environmental conditions. Dwellings constructed using traditional methods also tend to have greater thermal inertia than modern homes, so they heat up and cool down more slowly. This ability to 'buffer' moisture and heat helps to even-out variations in humidity and temperature. This also means you are less likely to experience overheating in a traditional building during warmer weather.

The interrelationship between heat and moisture in buildings is complex. In a well-maintained building that is adequately heated and ventilated, the daily and seasonal cycles of wetting and drying, heating and cooling, balance out. However, that balance may be adversely affected when changes are made to building fabric, heating or ventilation e.g., to increase energy efficiency. Invariably, this can lead to problems of moisture accumulation as well as overheating and fabric damage (Cadw, 2022). As a direct consequence, occupants may experience ill health due to poorer indoor air quality through exposure to condensation, mould and damp.

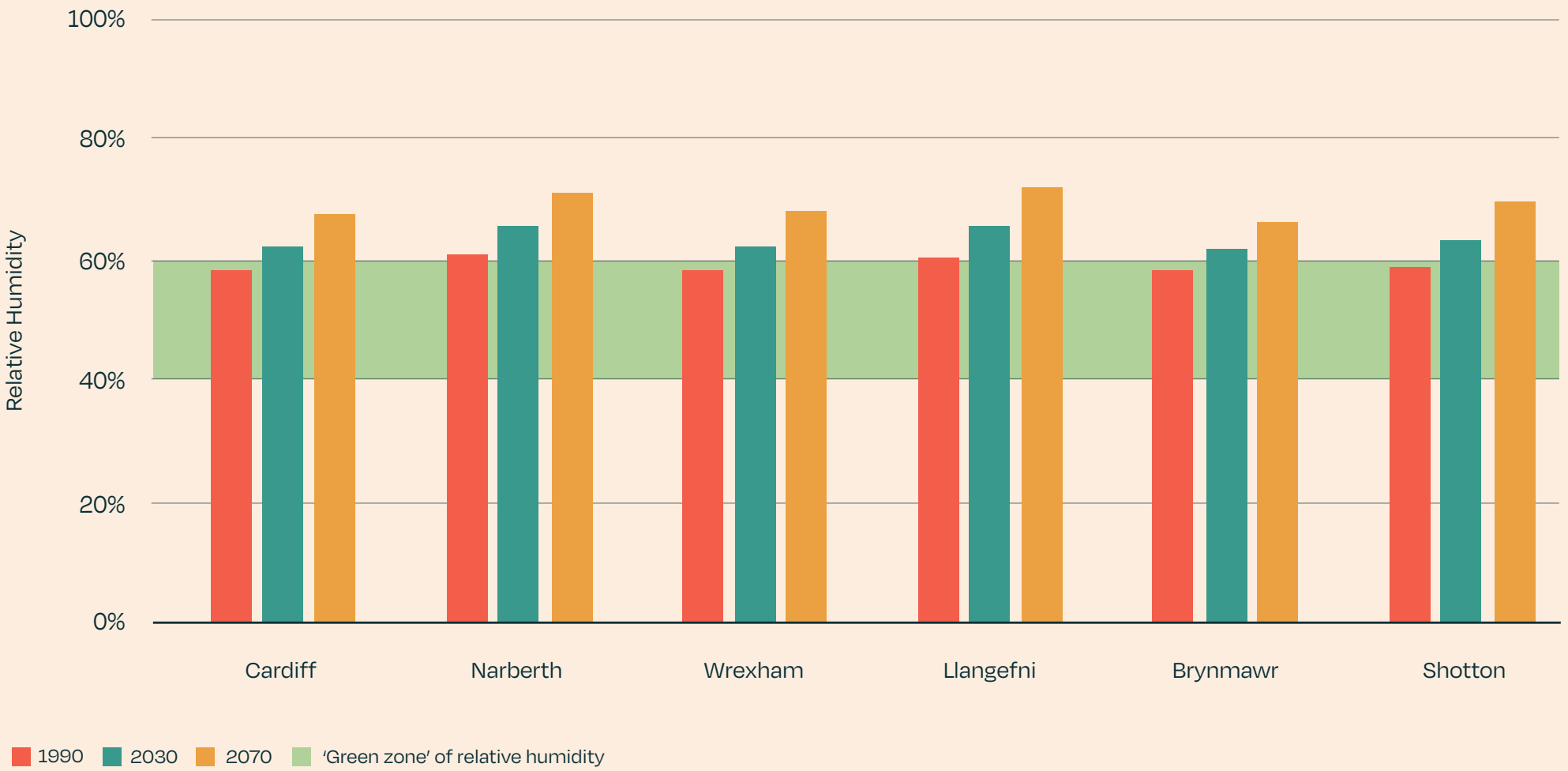
Inadequate ventilation

Reduced ventilation (should indoor air not be regularly exchanged / extracted) not only results in the build-up of moisture that can lead to damp and mould growth, but it also leads to a build-up of indoor contaminants or pollutants, which both contribute to poorer indoor environmental quality and subsequently reduced health and wellbeing. We need to be aware of the unintended consequences of interventions aimed at increasing energy efficiency that may lead to reduced ventilation and consequently increased moisture retention in buildings **see full report** as well as the impact of increased moisture due to changes in our climate.

Current and future risks

Climate vulnerability modelling has demonstrated that it is now more important than ever to consider how we adapt our buildings to address the challenges caused by a changing climate. Understanding present and future climate stressors will help inform climate mitigation and adaptation approaches and how to tackle these concurrently. There is an optimal range of between 40-60% summertime relative humidity for human health and comfort. Anything beyond 60% is deemed too moist.

Figure 2: Indoor daily maximum relative humidity averaged over the study period for six locations throughout Wales for baseline, 2030 and 2070



Summertime relative humidity in older properties in Wales is projected to exceed this healthy target daily in the region of 50-60% of the time between 2021-2040; rising to over 75% of the time during 2061-2080 see **report**.

As warm air can carry more moisture than cold air, the relative humidity level will be higher in a building that has the capacity to stay cooler in the summer months.

Results therefore demonstrate there is the potential for poorer indoor environmental quality in our older housing stock during the summer due to this increase in relative humidity. All geographical locations in Wales will experience this increase.

So, what do we do about it? The results show that ventilation strategies to improve the extraction of moisture-laden air, whilst diluting the concentration of pollutants that are present indoors, are necessary now and in the future to avoid increased incidences of condensation, damp, and mould growth, as well as adverse impacts from other allergens, particles and pollutants.

Strategies range from changes in our behaviours, to increasing our use of both passive and active ventilation systems to reliably exchange air.

Figure 3: The Schofield-/Sterling Chart

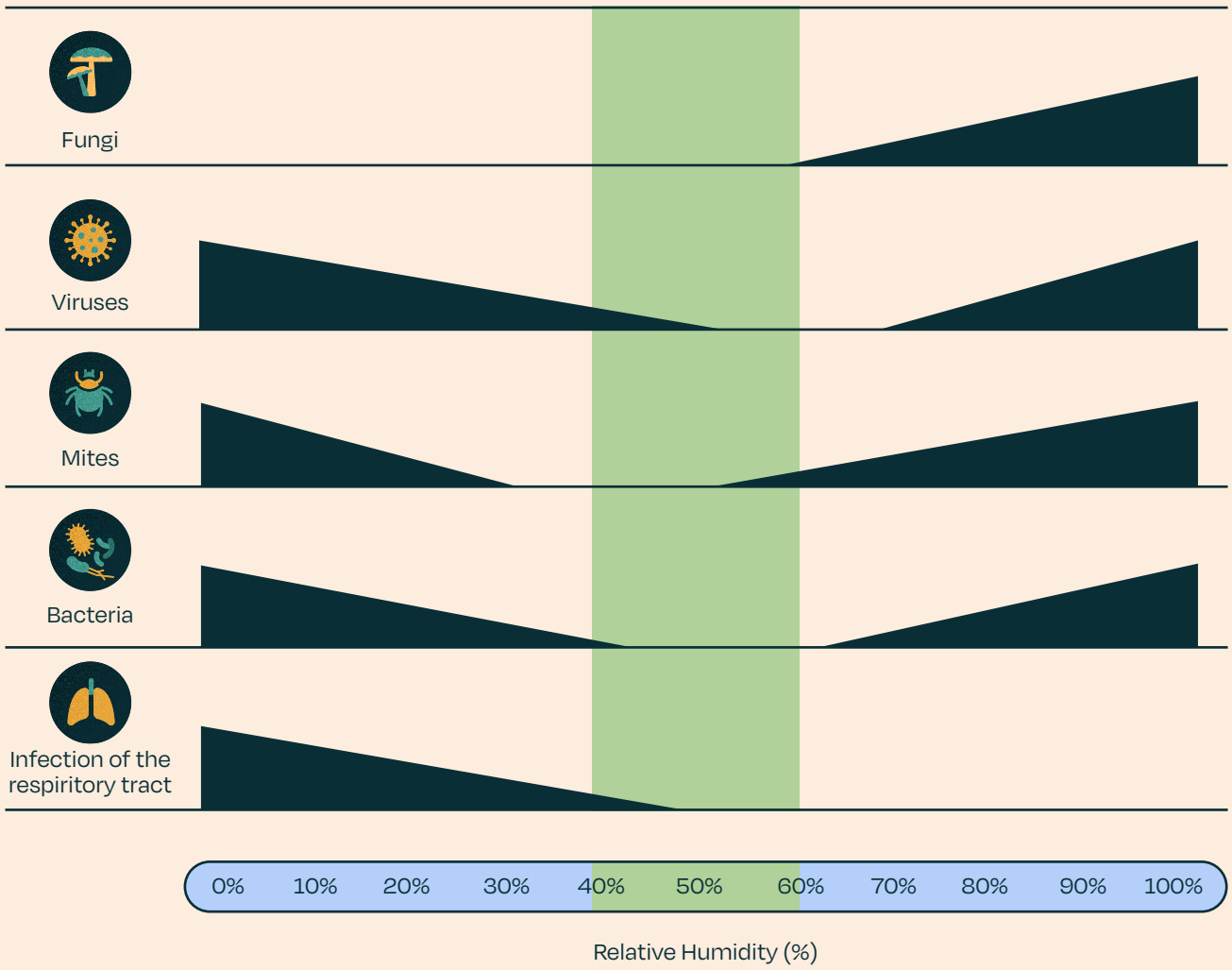
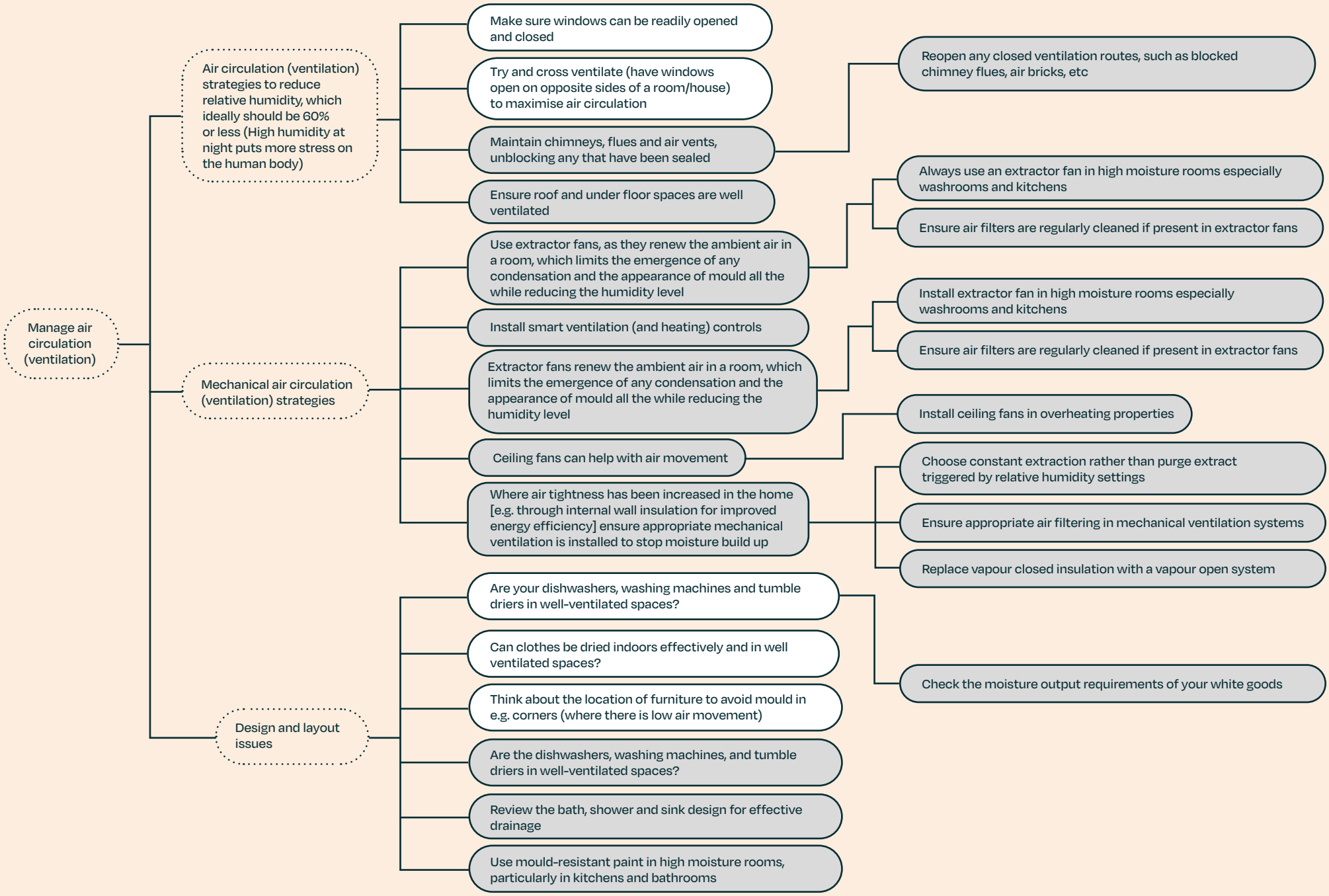


Figure 4: Drying strategies for a more comfortable indoor environment



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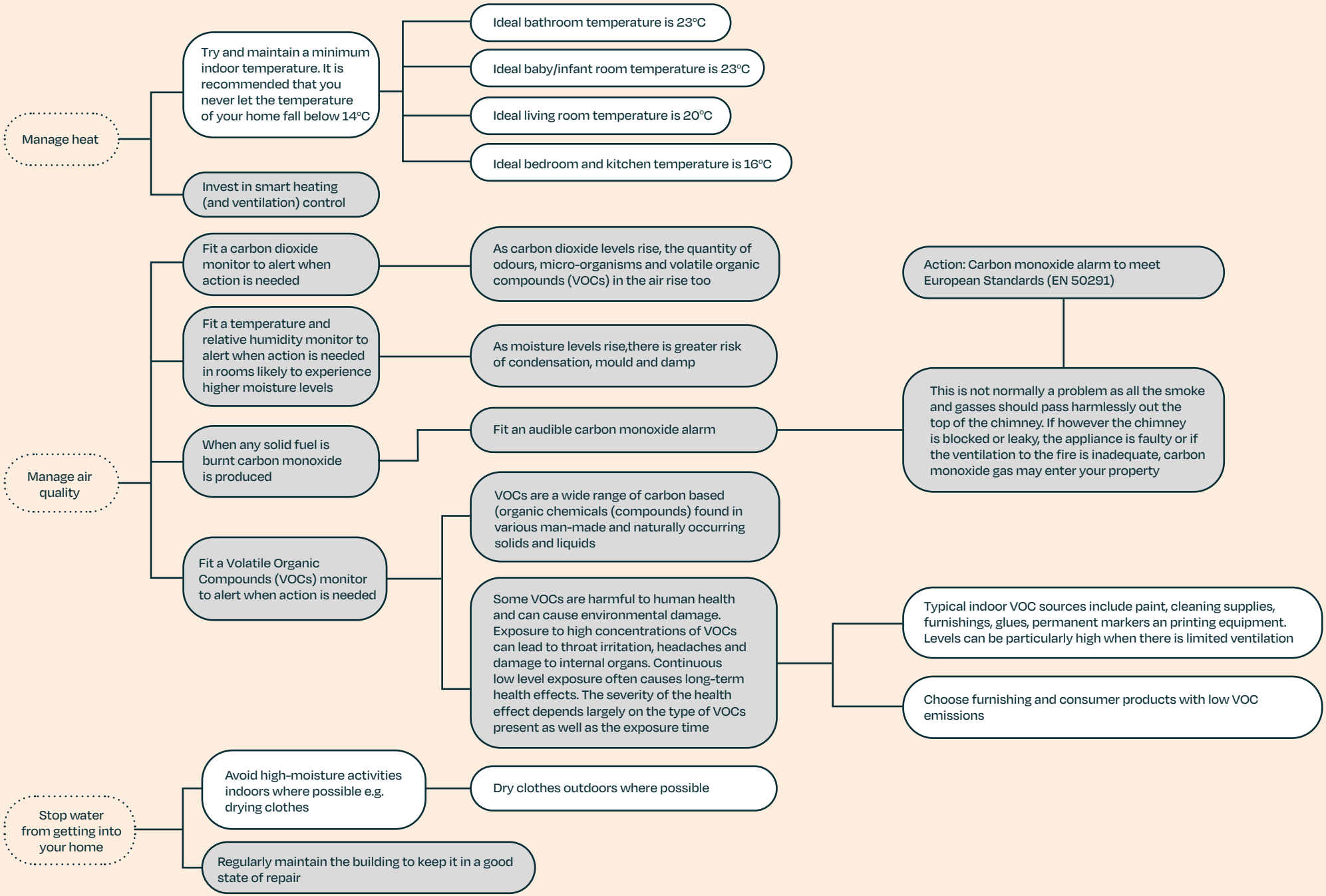

Organisations

- BRE https://bregroup.com
- Cadw https://cadw.gov.wales
- Historic England Historic England - Championing England's heritage | Historic England
- Historic Environment Scotland Historic Environment Scotland | Àrainneachd Eachdraidheil Alba
- National Trust https://www.nationaltrust.org.uk/
- The sustainable traditional buildings alliance STBA – UK Centre of Excellence for traditional buildings (stbauk.org)
- UK Centre for Moisture in Buildings UKCMB home - UK Centre for Moisture in Buildings

Advice and guidance for older building maintenance and care

- BSI. PAS 2035:2023 Retrofitting dwellings for improved energy efficiency – Specification and guidance. British Standards Institution
- BSI. PAS 2030:2023 Specification for the installation of energy efficiency measures (EEM) in existing buildings. British Standards Institution
- BSI BS7913: 2013 Guide to the conservation of historic buildings. British Standards Institution
- BS EN16883: 2017 Conservation of cultural heritage - Guidelines for improving the energy performance of historic buildings. British Standards Institution
- BSI BS5250: 2021 Management of moisture in buildings. Code of Practice. British Standards Institution
- Cadw (2022). How to improve Energy Efficiency in Historic Buildings in Wales 43720 How to improve Energy Efficiency in Historic Buildings in Wales (gov.wales).
- Historic Environments Scotland (2021). Technical Paper 35: Moisture Measurement in the Historic Environment
- Investigation of moisture and its effects on traditional buildings. RICS (2022)

Further Reading on indoor environmental quality

- Arundel, A.V., Sterling, E. M.,Biggin, J. H. and Sterling, T. D. (1986). Indirect health effects of relative humidity in indoor environments. Environmental Health Perspectives, 351–361.
- EEA (2013), Indoor air quality. Denmark: European Environmental Agency. Indoor air quality — European Environment Agency (europa.eu)
- EPA (2010), Climate change, indoor air quality and health. Available online at: Climate Change, Indoor Environment and Health | Indoor Air Quality (INDOOR ENVIRONMENTAL QUALITY) | US EPA
- EPA (2021). Indoor air quality. Available online at: https://www.epa.gov/indoor-air-quality-indoor environmental quality/introduction-indoor-air-quality
- Kwok, W. T. (2016), Indoor air quality and its effects on humans—A review of challenges and developments in the last 30 years. Energy and Buildings (130) pp. 637–650.
- Royal College of Paediatrics and Child Health (2020), The inside story: Health effects of indoor air quality on children and young people, available online at: https://www.rcpch.ac.uk/sites/default/files/2020-01/the-inside-story-report_january-2020.pdf
- Spiru, P. and Simona, P.L. (2017). A review on interactions between energy performance of the buildings, outdoor air pollution and the indoor air quality, Energy Procedia, Volume 128, 2017, Pages 179-186, ISSN 1876-6102, https://doi.org/10.1016/j.egypro.2017.09.039
- Tham, K. W. (2016). Indoor air quality and its effects on humans—A review of challenges and developments in the last 30 years. Energy and Buildings, Vo.130, pp. 637–650.

Further reading on climate vulnerability modelling

- Hayles, C. S. (2022). How resilient are buildings in the UK and Wales to the challenges associated with a changing climate? Welsh Government. Available online at https://gov.wales/resilience-buildings-challenges-associated-climate-change-report
- Hayles, C. S., Huddleston, M., Chinowsky, P., & Helman, J. (2022) 'Summertime impacts of climate change on dwellings in Wales, UK. Building and Environment', https://doi.org/10.1016/j.buildenv.2022.109185

Additional reading

- UN (2022) The Closing window: Climate crisis calls for rapid transformation of societies. United Nations Environment Programme, ISBN: 978-92-807-3979-4

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