

Healthy and resilient buildings

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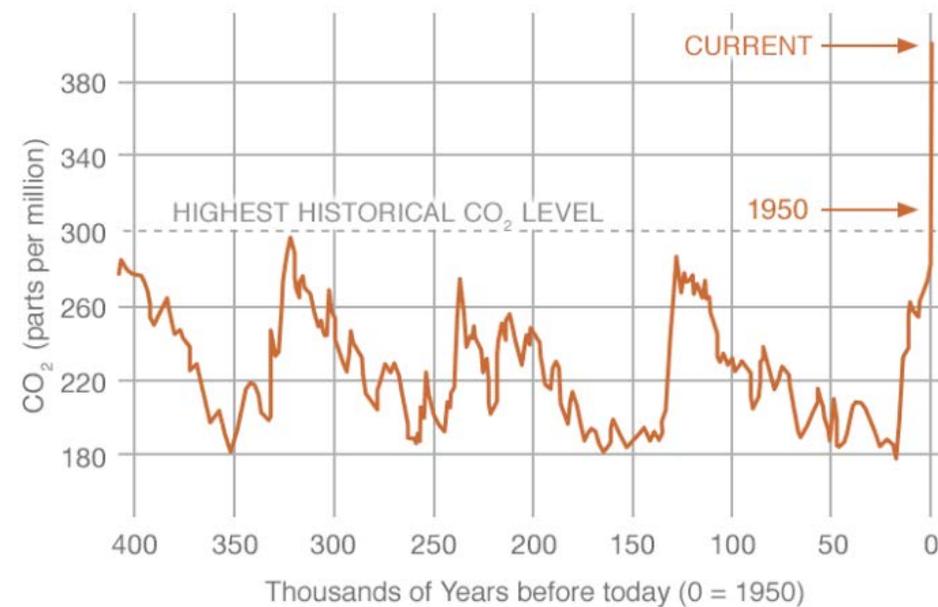
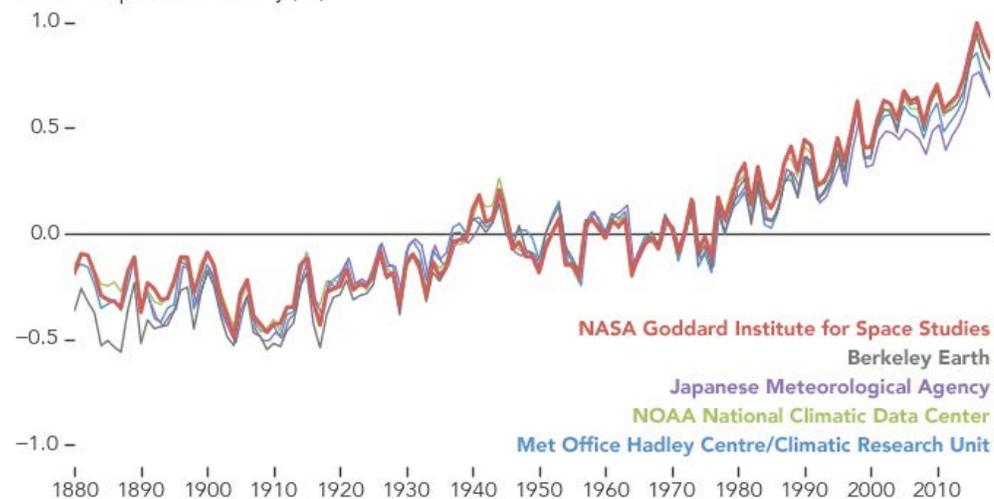
Committee member UK Indoor Environments Group



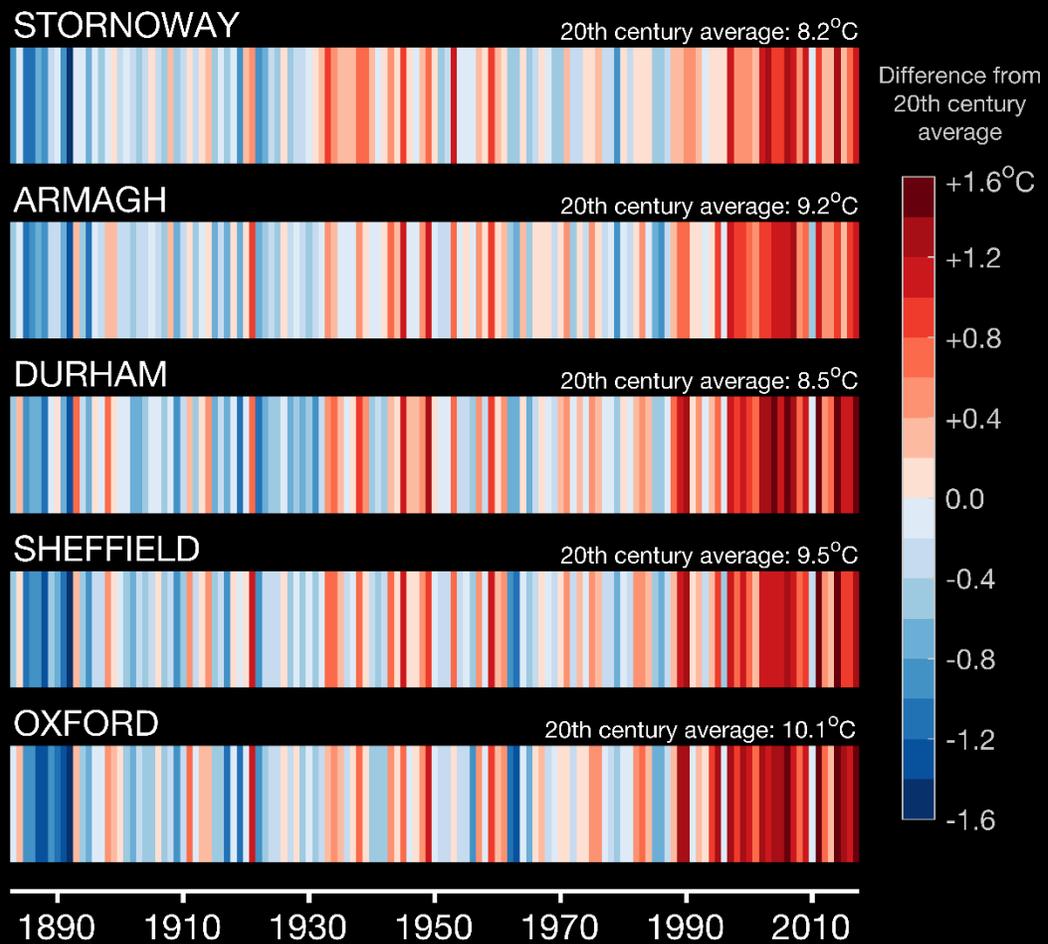


A World of Agreement: Temperatures are Rising

Global Temperature Anomaly (°C)

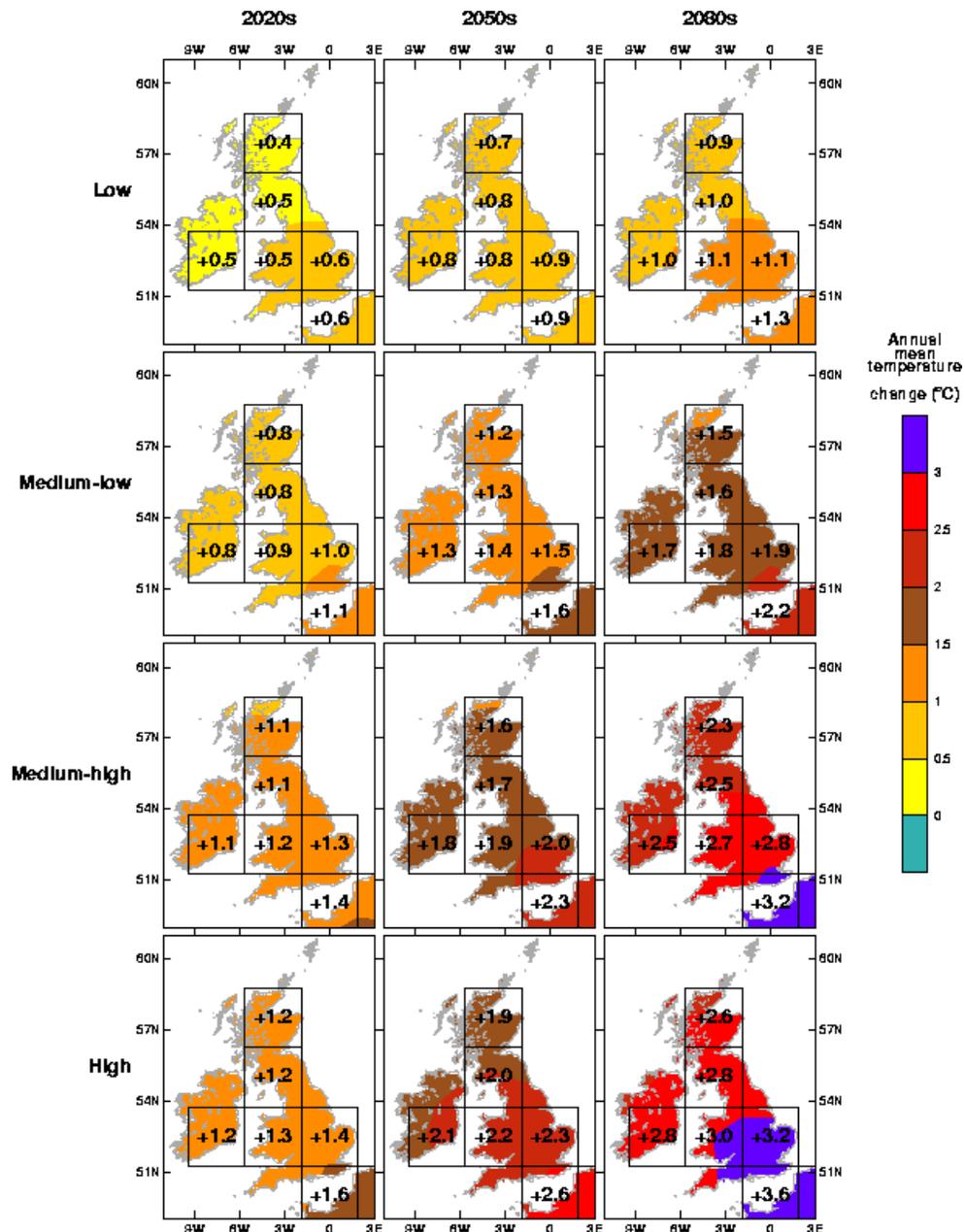


UK warming stripes (1883-2017)



Change in mean annual temperature (°C) with respect to the 1961-90 mean for thirty year periods centred on the 2020s, 2050s and 2080s for the UKCIP98 scenarios (Hulme and Jenkins, 1998).

The UKCIP98 scenarios were prepared for the UK Climate Impacts Programme. The four scenarios (low, medium-low, medium-high and high emissions) span a range of future global warming rates from 0.1° to 0.3° C per decade.
Source: Climate Research Unit. University of East Anglia



Buildings and Energy Performance. The big picture

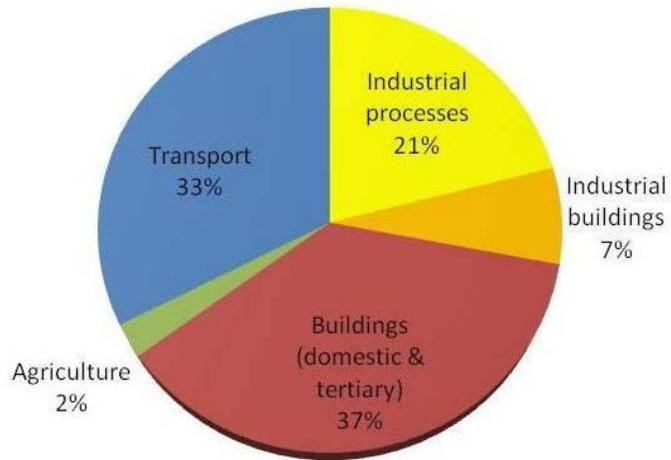
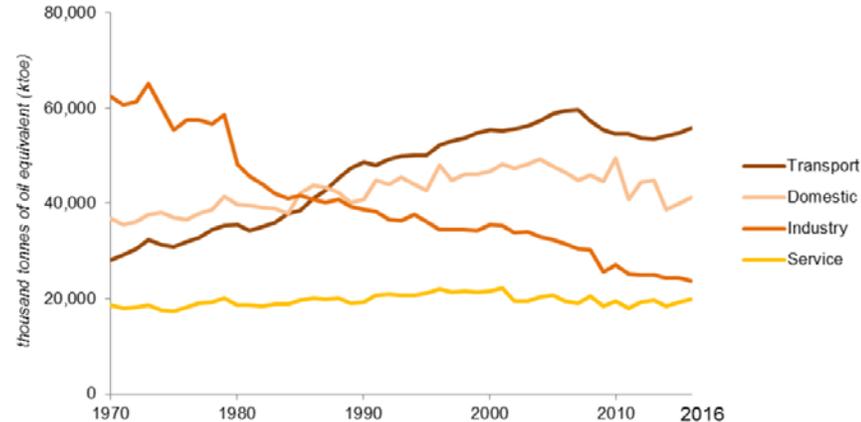
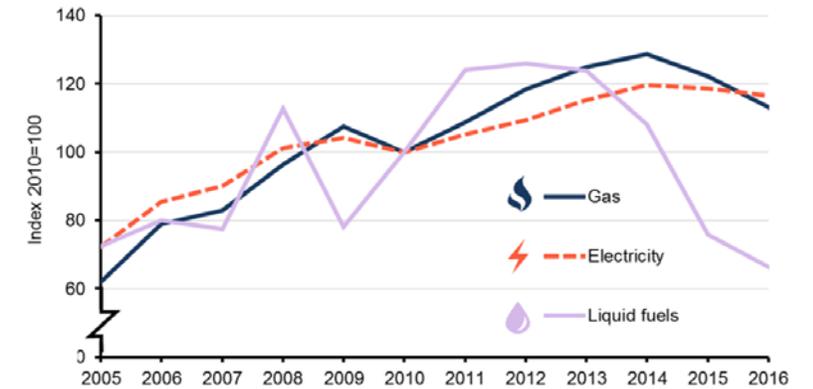


Chart 1.04: Final Energy Consumption by Sector



Source; BEIS ECUK Table 1.01

Chart 3.03: Consumer Price Index for gas and electricity



Source; BEIS Domestic energy price indices, QEP 2.1.1 and 2.1.2

Buildings in use account for 38% of UK total CO2 emissions.

Replacement of building stock is very low 1-2% per year. 85% of the buildings that exist today will still be here in 2050.

The UK has the oldest housing stock in Europe with 55% of its dwellings dating from before 1960.

Significant proportion of existing buildings were constructed when there was no strong energy efficiency component within the building regulations.

Act now to mitigate risk; climate change. Existing building stock needs to be addressed.

Indoor Environmental Quality Emphasis on Energy Conservation and Higher Expectations

Increased thermal insulation and air tightness are causing unintended consequences (low thermal comfort and IAQ, as well as overheating).

Although we are constantly made aware of the dangers of outdoor pollution, indoor air quality (IAQ) is a subject which is less frequently talked about. We spend up to 90% of our time indoors.

Inadequate ventilation coupled with poor quality building materials, such as PVC and paints, are causing negative impacts on occupant health.

Poor Air Quality



Low comfort

Unnecessary
Air Conditioning

Medical
Conditions

Distress
Incapacity
Death

Overheating



Public Health
Problem

Cost to society

Anthropogenic pollutants

- Sources**
 - Combustion**
 - Unvented gas/kerosene heaters
 - Biomass (wood/coal) for heating/cooking
 - Tobacco smoke
 - Wood (fireplaces), gas ranges – pilot lights
 - New furniture, solvents, painting, adhesives, insulation, cleaning products, materials for offices
 - Building materials, water
 - Allergens**
 - Dust, beds, carpets
 - Pets, birds, insects, rodents
 - Dampness
 - Plants
 - Viruses, bacteria

- Pollutants**
 - CO, CO₂, NO₃, PAHs
 - CO, CO₂, PM, PAHs
 - CO, CO₂, PM, VOCs, PAHs
 - VOCs
 - VOCs, formaldehyde
 - Radon
 - Acarides (HDM)
 - Moulds
 - Pollens
 - Biological contaminants

Pollutants

- Combustion products and ETS (CO, CO₂, NO, SO₂, PM, wood/coal smoke)
- VOCs (alkanes, formaldehyde, esters, ketones)
- Biological organisms (fungal spores, bacteria, viruses)
- Allergens (pollens, moulds, mites, cockroaches, insect, dander, feathers)
- Radon

Health effects

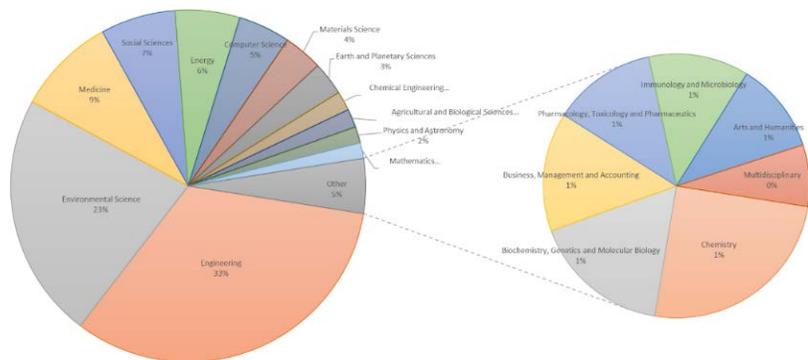
- Respiratory symptoms
- Lung function reduction
- Bronchial hyperresponsiveness
- Asthma
- COPD
- Upper/lower respiratory tract irritation
- Asthma
- Respiratory infections
- Sensitisation (specific/total IgE)
- Respiratory allergic diseases
- Hypersensitivity pneumonitis
- Chronic cough
- Lung cancer

Indoor Air Quality. Practice gap

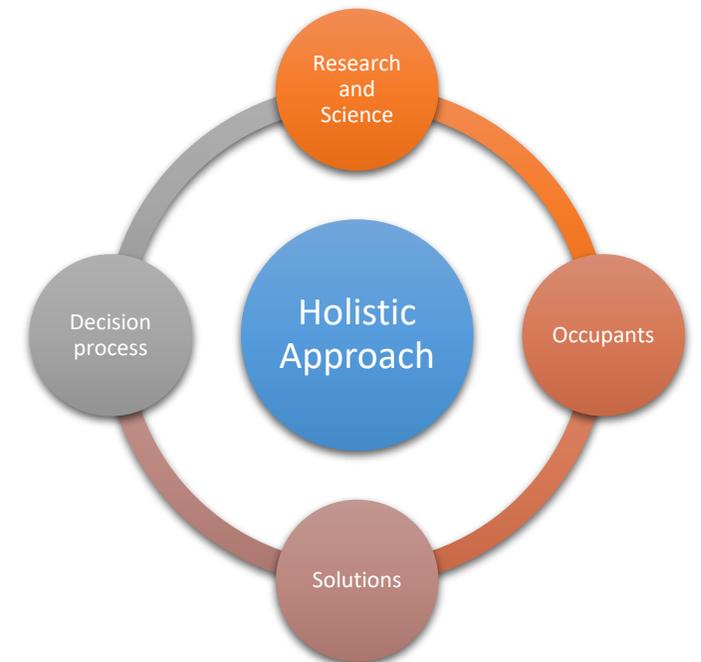
IAQ being produced as a result of other problems (e.g. energy conservation).

IAQ in buildings, complex problem (studied by 28 subject areas). Breaking down the IAQ problem into its parts gets bogged down in detail and by different perspectives.

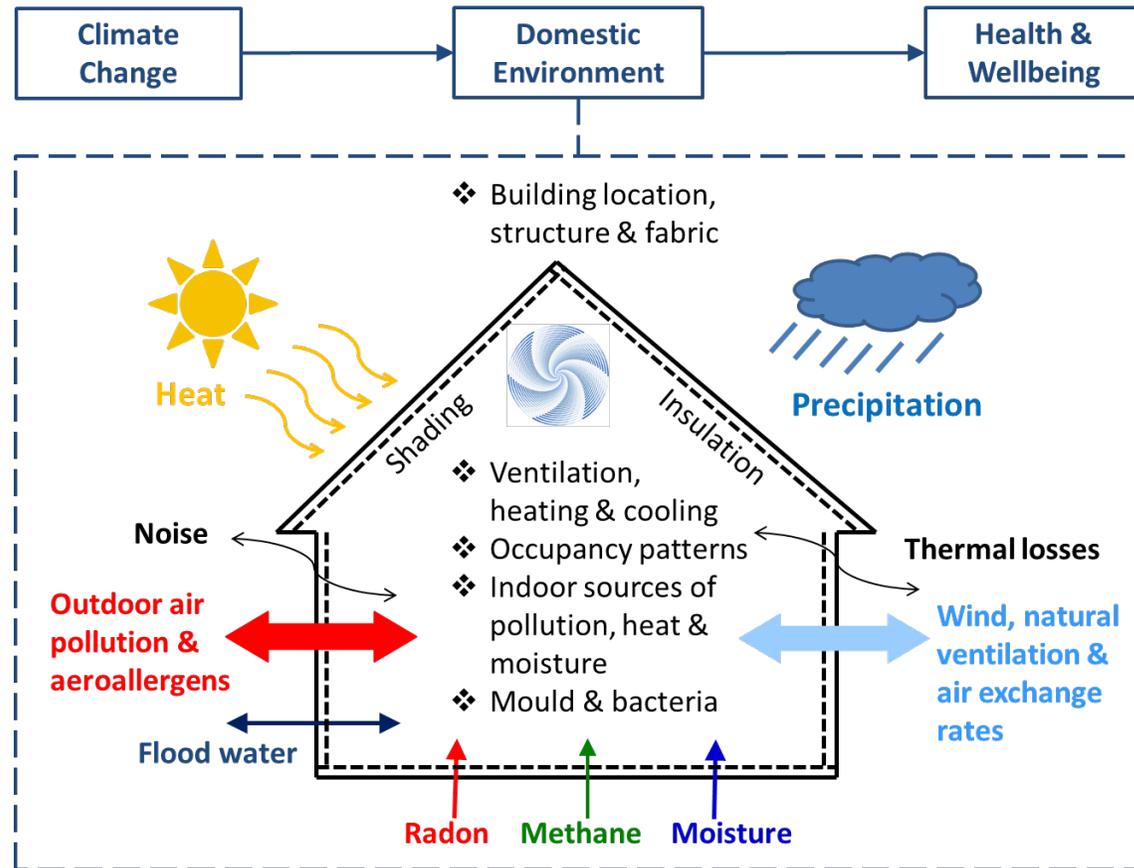
Need of a more holistic view to address the complexity of the interactions occurring in indoor environments, and to better understand barriers, challenges and bottle necks for effective implementation.



Bibliometric study. Using “indoor air quality” and “buildings” as search words gives 8,305 research outputs divided into 28 subject areas, showing the multifaceted and unbounded nature of IAQ.



Indoor Air Quality. Holistic view



Vardoulakis, S., Dimitroulopoulou, C., Thomes, J., Lai, K. M., Taylor, J., Myers, I., ... & Davies, M. (2015). Impact of climate change on the domestic indoor environment and associated health risks in the UK. *Environment International*, 85, 299-313.



IAQ improvement and overheating mitigation in new build residential

- Need to close the gap between research and practice.
- Need to create resilient houses and adapt designs to new occupant needs derived from Covid19 (more time spent at home, working from home, etc)
- The research involves working with major home builder partners to conduct trials to monitor and record indoor air quality in unoccupied and occupied dwellings across the UK, gathering user's feedback on thermal comfort and wellbeing and evaluating the data obtained to propose solutions that can cost effectively improve the IAQ and thermal comfort in new developments.
- Major home builders involved (Barratt Homes, Redrow, Taylor Wimpey), housing associations (e.g. Midland Heart) and industry advisors (e.g. Envirovent, AES Sustainability Consultants, Istock, Glen Dimplex).
- A key element of the Research is to gain a better understanding of occupants behaviour and home building process, including the things that influence how decisions are made, so we can deliver performance, without causing unintended consequences and in a cost-effective way.

MANY THANKS FOR YOUR ATTENTION

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