

PowerEx Live Conference

London, 12 December 2024

***Can we be healthier, save energy
and cut carbon without radically
reconstructing our buildings?***

Bill Bordass

www.usablebuildings.co.uk

OUTLINE


1. Where are we now?
 2. Stepping back
 3. From efficiency to sufficiency
 4. Glimpses of ongoing work
-

1.


WHERE ARE WE NOW?




Massive opportunity to cut energy infrastructure demands from new buildings and deep retrofits



The UK Passive House Organisation



- Home
- About Passivhaus
- Our Members
- Projects
- Awards & Competitions
- Campaigns & Policy



Passivhaus Classic + renewables
NET zero

Notional Building Regs zero carbon
NOT zero

Passivhaus: the route to zero carbon?

[Get started](#) [Membership](#) [Mailing List](#) [Projects](#)

We are in a climate emergency. Buildings are a significant culprit of carbon emissions – accountable for 35% of total global energy consumption. Passivhaus is a leading international design standard, delivering high standards of comfort and health AND slashing energy use from buildings. Thousands of buildings have been certified to this standard worldwide.

The Passivhaus Trust (PHT) is an independent industry leading organisation that promotes the adoption of Passivhaus in the UK. PHT is part of the global Passivhaus movement and the official UK affiliate of the International Passive House Association (iPHA).

Where does this get the existing building stock?

Some widespread policy options today

1. Deep Retrofit

Great if you have the chance, *but these are rare*

They also entail a lot of upfront carbon – *potential own goal*

2. Substantial Renovation

Tends to be the most common policy,

BUT the best UK and EU policymakers can see is increasing rates from perhaps 1% to 2% p.a.

3. Technical and supply-side measures

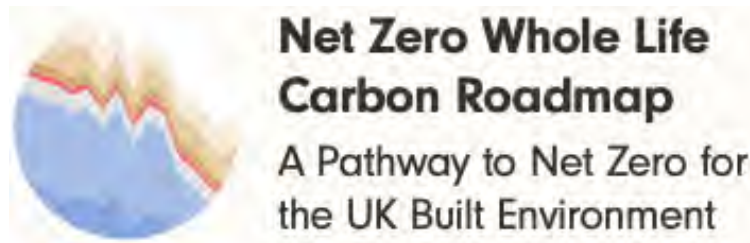
e.g. Heat pumps and Heat networks

BUT all come with supply chain problems, technical risks, and often high upfront costs, or stings in the tail.

The Fabric First approach:

BUT is this the holy grail for existing buildings?

“The opportunity for widespread behaviour change has been considered, with a cautious approach to expectations that occupants will be able to reduce thermostats without improvements to building fabric.”

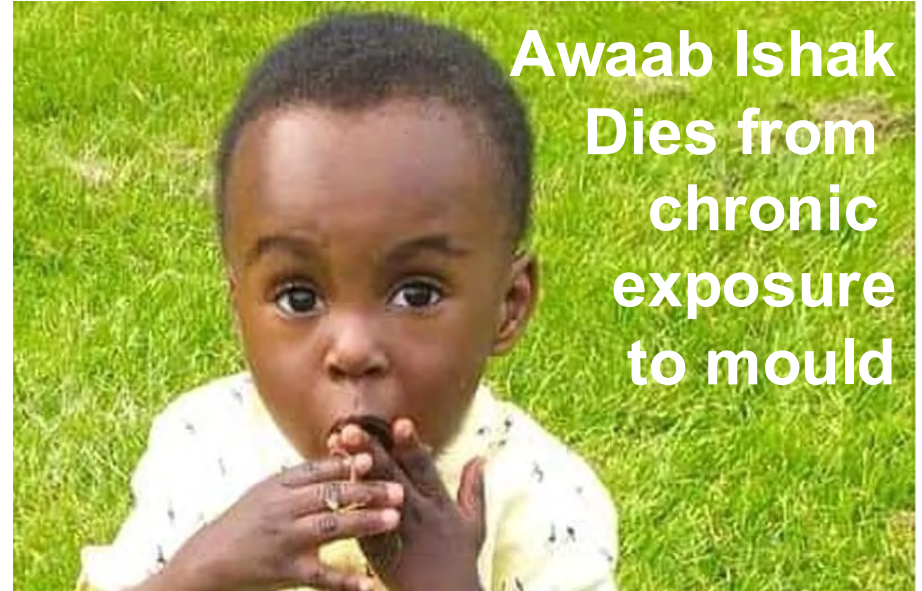


We've not been very good at things

Problems ignored can fester until there is a catastrophe



Risks to health, wellbeing and
productivity from overheating in
buildings
July 2022



Residents sickened by botched Welsh housing estate insulation scheme that made homes mouldy and cold



Rhys Williams ITV News

Wales Reporter

Friday 2 December 2022 at 4:56pm



"We've never lived like this before, the house used to be perfect before ..."



"It's always freezing in here now and you can't do anything to decorate as it's ruined within a matter of weeks."



2.

STEPPING BACK



Should we be resolving our problems,
or re-examining our premises?

*“We can't solve problems
by using the same kind of thinking
we used when we created them”*

Attributed to A EINSTEIN

*“We are suffering from an attempt
to know our way into the future
instead of live our way”*

W SHARPE

Every little helps: *use multiplier effects to save energy and carbon quickly*

ENGAGE PEOPLE to start with, **AND** for example ...

BE LEAN - Halve the demand

Review standards, reduce losses, avoid waste.

times

BE MEAN - Double the efficiency

Buy efficient equipment, use it effectively, minimise system losses, tune it up.

times

BE GREEN - Halve the carbon in the supplies

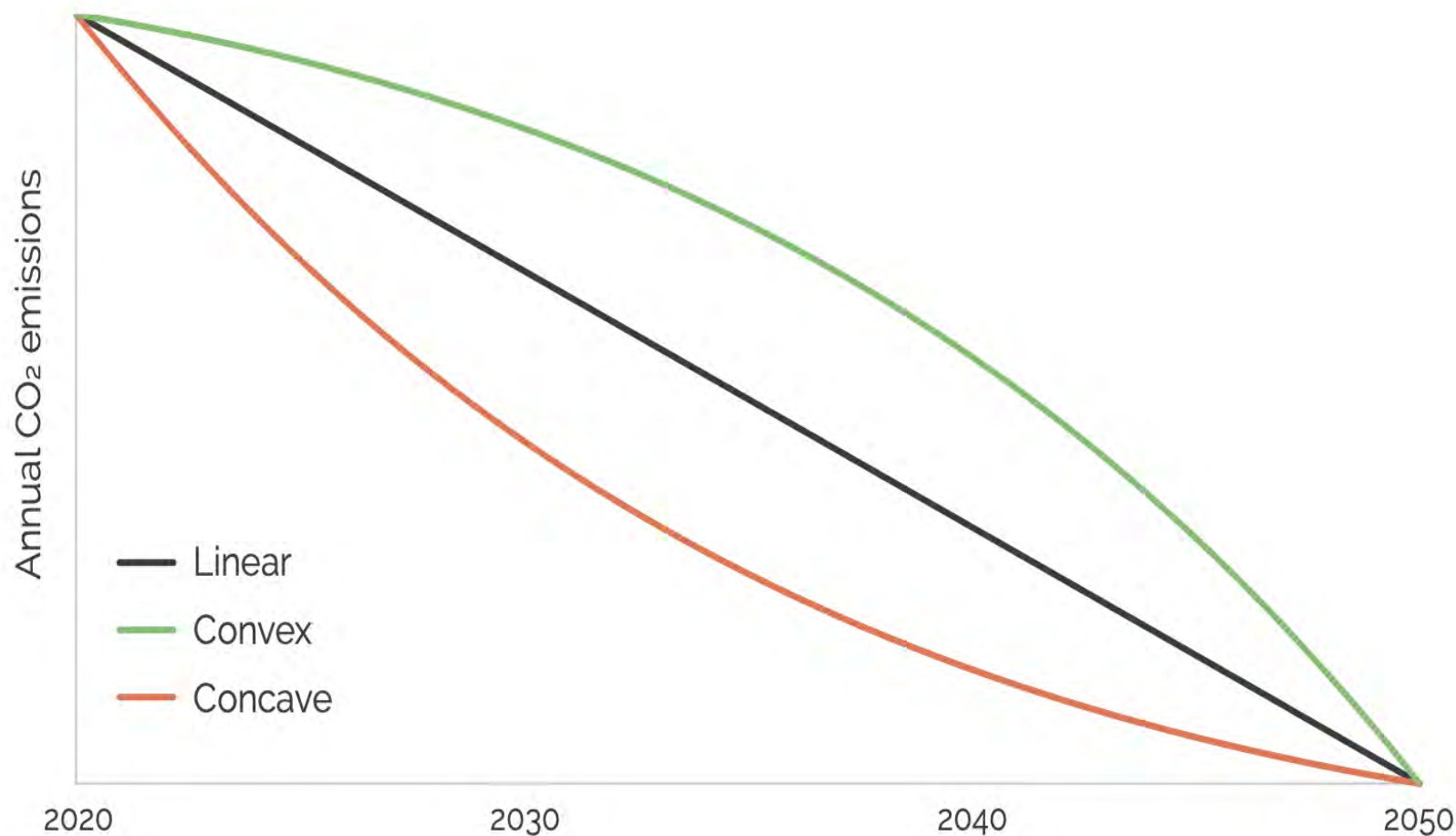
With on-and off-site measures

equals

You're down to one-eighth of the CO₂

Possible Decarbonisation Trajectories

A quick start minimises cumulative emissions



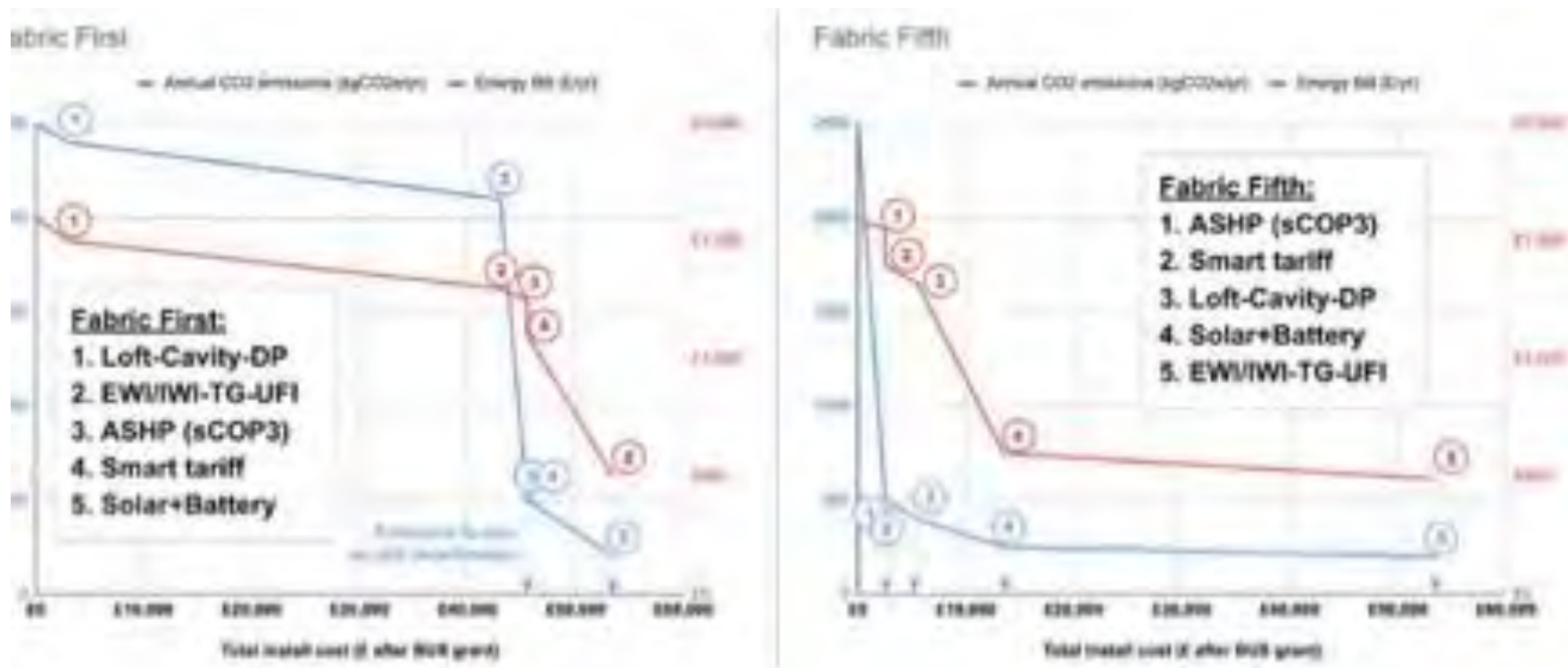
What about Fabric Fifth?

as advocated by Nigel Banks at Octopus

1. ASHPs ASAP
[ASHP = Air Source Heat Pump]
2. Get Smart: Meters and Controls
3. Measure and get comfy
4. Solar and Storage
5. Fabric Fifth

What about Fabric Fifth?

as advocated by Nigel Banks at Octopus



“... prioritises high impact, low cost measures. It isn't about not doing fabric measures but is about trying to make sure we decarbonise our homes and lower bills as quickly and cost effectively as possible...”

What about Fabric Fifth?

as advocated by Nigel Banks at Octopus

1. ASHPs ASAP *BUT mightn't they be too big, inefficient, noisy, and overtax the Grid? Best cut some demand first.*
 2. Get Smart: Meters & Controls *BUT not everybody will be able to cope. Smart meters can also be unreliable.*
 3. Measure & get comfy. *As presented, includes some fabric measures, e.g. low cost insulation+draughtproofing.*
 4. Solar & Storage: Big savings from shifting energy use, *BUT it is no panacea.*
 5. Fabric Fifth, or embodied carbon may be too high. *BUT fabric maintenance does need to come first, while costings often only consider upgrades, not remedials.*
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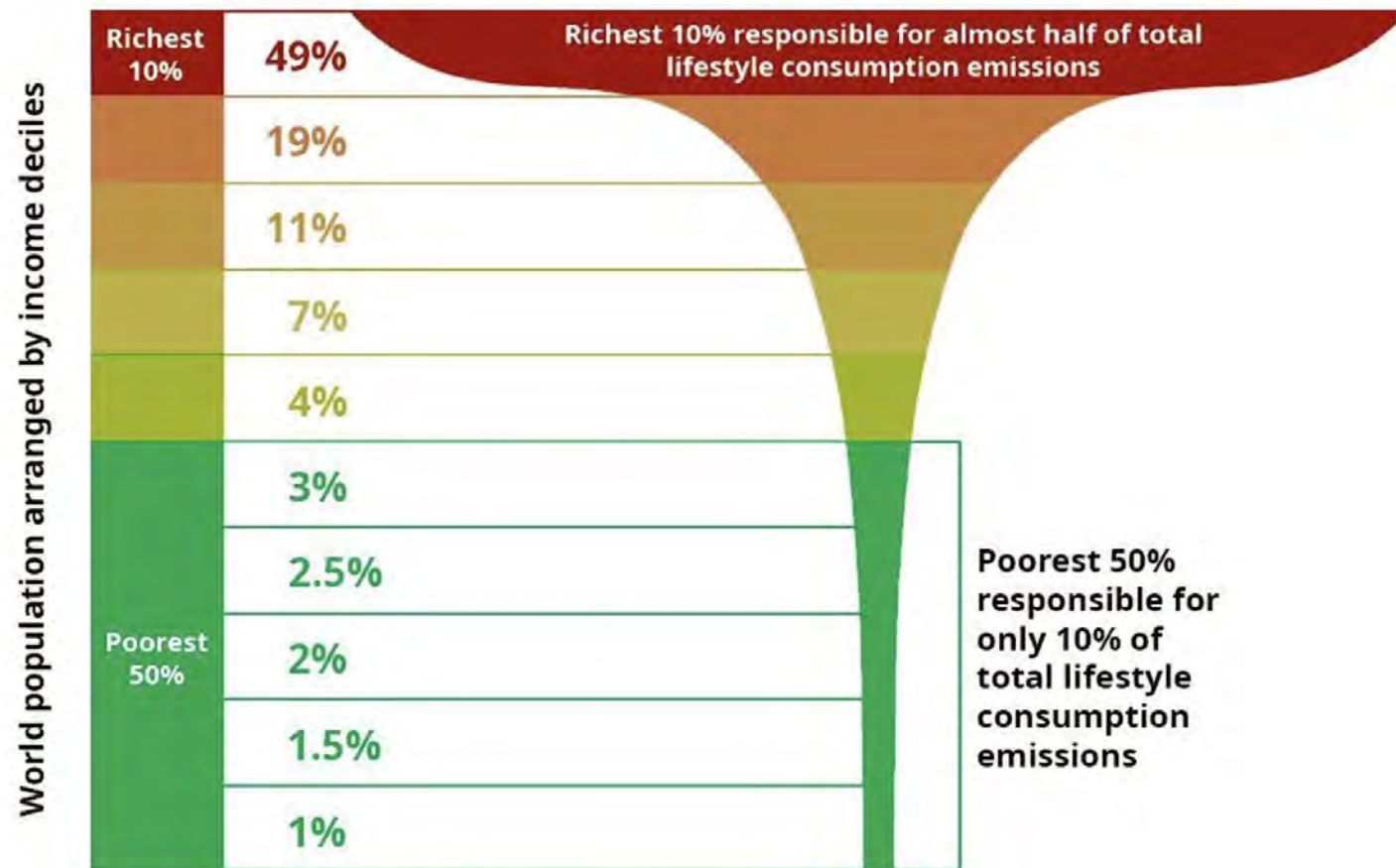
3.

FROM EFFICIENCY TO SUFFICIENCY

*“What we’ve got used to,
we’re not necessarily entitled to.”*

“A constrained world cannot afford the rich ”
GEORGE MONBIOT

Percentage of CO₂ emissions by world population



Source: Oxfam

We've evolved to take things for granted



PEOPLE FIRST: *Comfort standards are socially and culturally determined*

But also driven by vested interests in promoting things

“People’s needs... have social histories of their own ... The [mistaken] distinction between technology ... and behaviour.

*“Sociology ... repeatedly demonstrates the extent to which **things ... ‘script’ what people do ...***

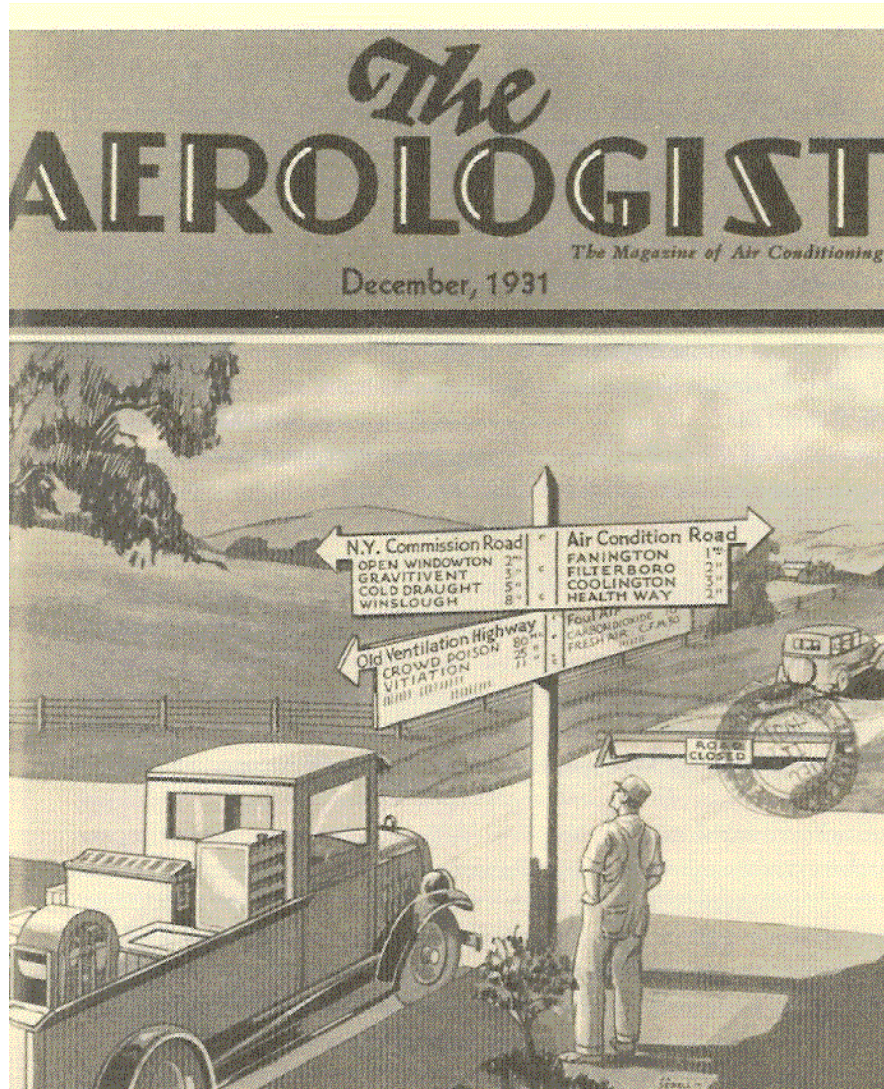
“[while] dominant paradigms remain ... [in the literature] there are fewer references to non-technical barriers and more to sociotechnical change, and ... practices not behaviours.”

“If current understandings of comfort underpin escalating levels of energy demand, why persist with them?”

ELIZABETH SHOVE, Sociologist, University of Lancaster

FRAMING COMFORT *in the 20th Century:*

Space conditioning was converted into a marketable commodity



"In 1922, the New York State Commission ... advocated natural ventilation ... The engineering community seriously opposed ...

... *"The Aeroalogist journal ... argued physicians were stepping outside their [professional] boundaries.*

"When natural climate was the ideal, mechanical systems were found wanting, but *when quantitative standards ...*

became the measure, natural climate was found wanting.

When no town could deliver an ideal climate, all towns became potential markets."

AND AFTER WORLD WAR 2:

Climate-responsive features of buildings (verandahs, shutters, shade roofs etc.) were simplified or eliminated, in order to make air conditioning more affordable.

Quotation from 1916

by the Chief of the UK Medical Research Committee

“ For the purposes of controlling the heating and ventilation of rooms, the thermometer ... has acquired an authority which it does not deserve...

“ It affords no measure of the rate of cooling of the human body, and is, therefore, a very indifferent instrument for indicating atmospheric conditions ... comfortable and healthy to man.”

L Erskine Hill, O W Griffith and M Flack

The measurement of the rate of heat-loss at body temperature by convection, radiation, and evaporation

Phil Trans of the Royal Society Series B, **207**, 335-347 (1916) www.doi.org/10.1098/rstb.1916.0005

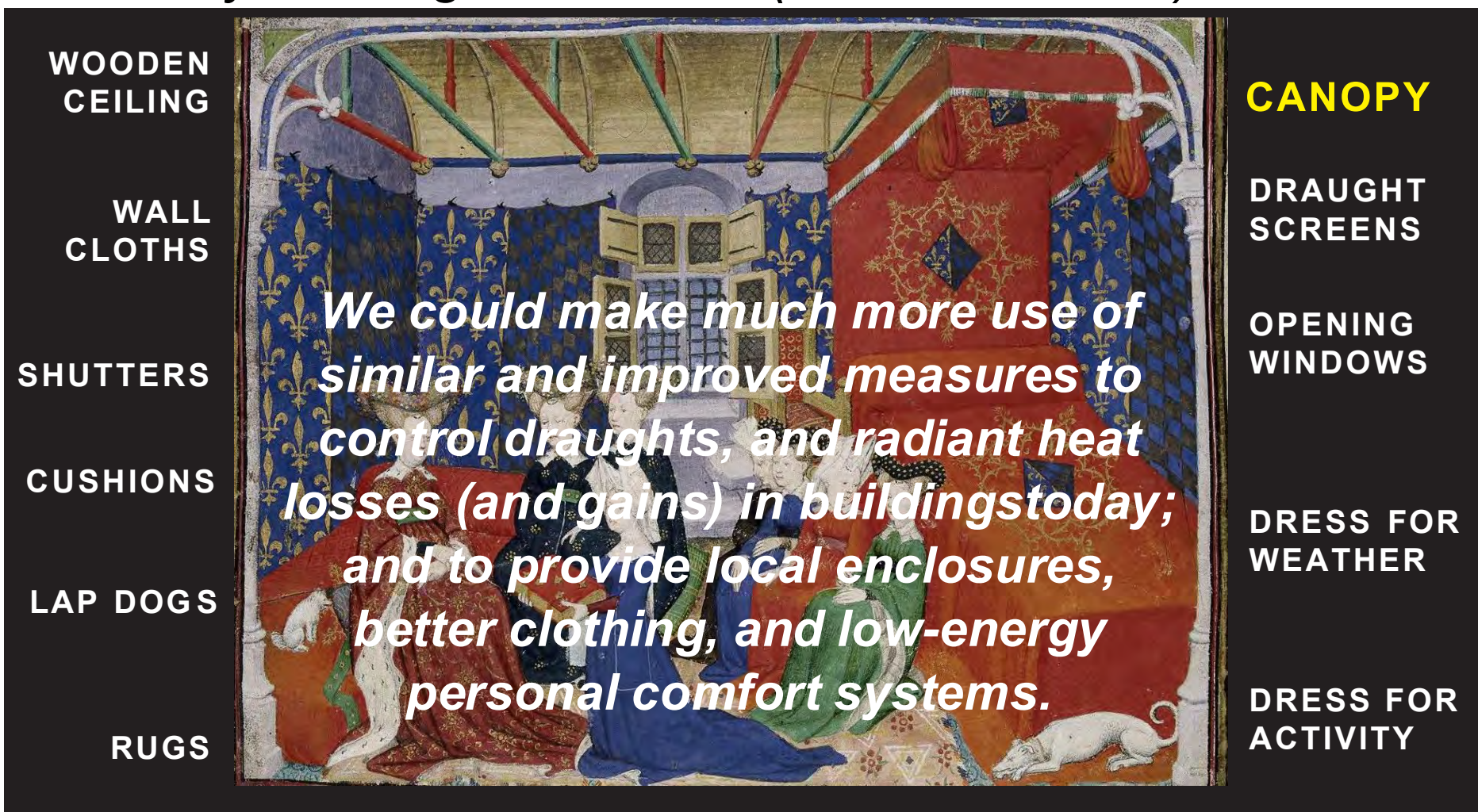
Before fossil fuels, people used many ways to improve comfort without space conditioning

Many in the global south (and elsewhere) still do



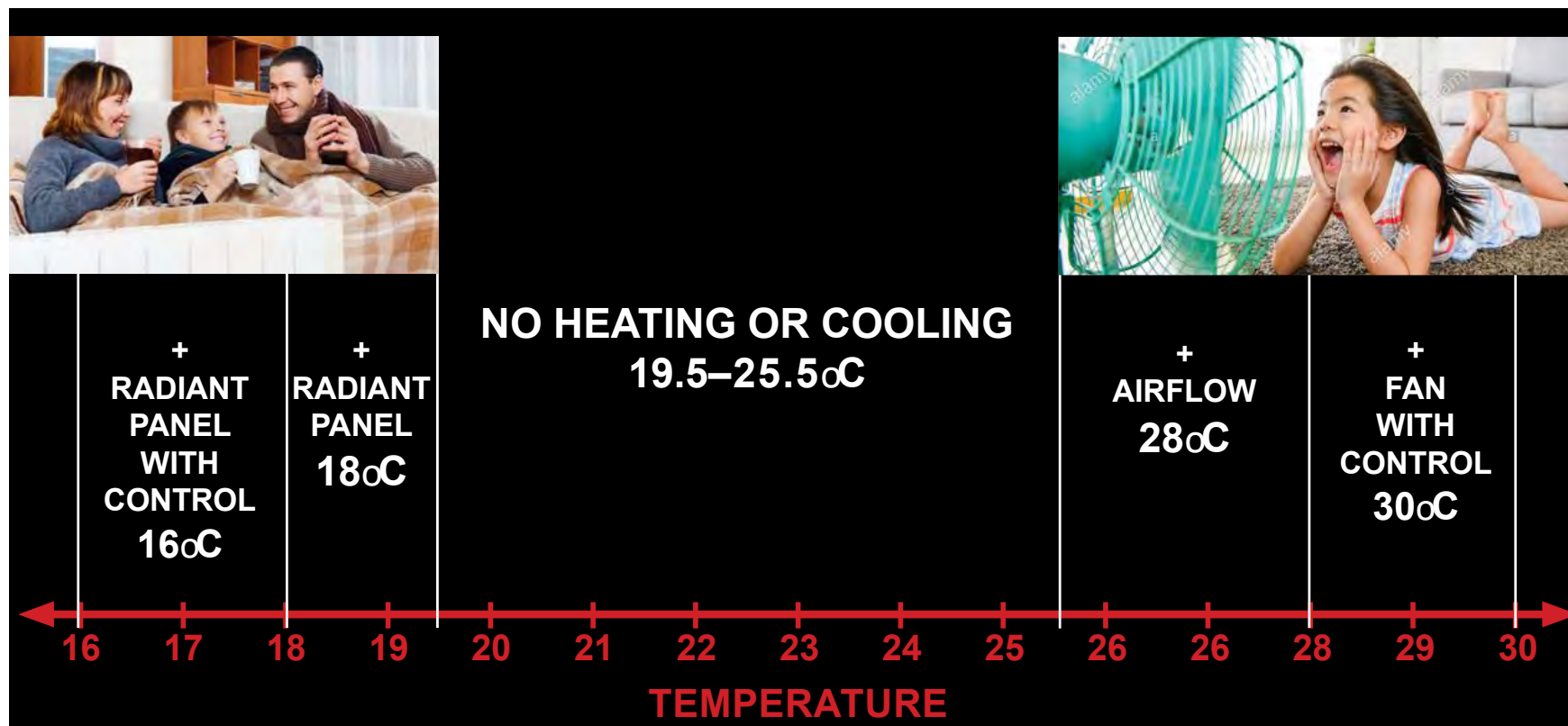
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QUESTIONING COMFORT STANDARDS

What do we really need to heat and cool spaces to?



What about UK's recommended minimum 18°C Health requirement?

In its Minimum Home Temperature Thresholds review (2014) Public Health England says it is a “*weak recommendation*” with little robust support, but *may be beneficial to the over-65s and those with pre-existing medical conditions.*

Might uniform temperatures be a bad idea?

Recent findings from physiology research

“An enormous amount of energy and resources are spent to provide tightly controlled thermal environments, often with the same target temperature all year round.

“However, being mostly exposed to constant, comfortable indoor temperatures can have negative impacts on health and deteriorate our human capability to deal with thermal challenges. ”

Pallubinsky, H., Kramer, R. P., & van Marken Lichtenbelt, W. (2023).

Establishing Resilience in Times of Climate Change: A perspective on humans and buildings.

Climatic Change, 176(10), Open Access Article 135. <https://doi.org/10.1007/s10584-023-03614-0>

THERMOREGULATORY FITNESS

Use it or lose it?

- **Habituation** to uniform thermal environments *has reduced our thermoregulatory capacity to cope with temperatures outside the range of conditions we normally experience.*
- **We CAN be more resilient.** *Acclimatisation has been shown to improve the ability to regulate body temperature in young, middle-aged and overweight individuals.*
- **This will require “temperature training”** *More thermal variation in everyday life will improve cardiovascular and metabolic health, save energy, and help us adapt to climate change.*

BUT *We will still need to protect ourselves (and particularly vulnerable individuals) from the hazardous effects of thermal extremes and other health issues.*

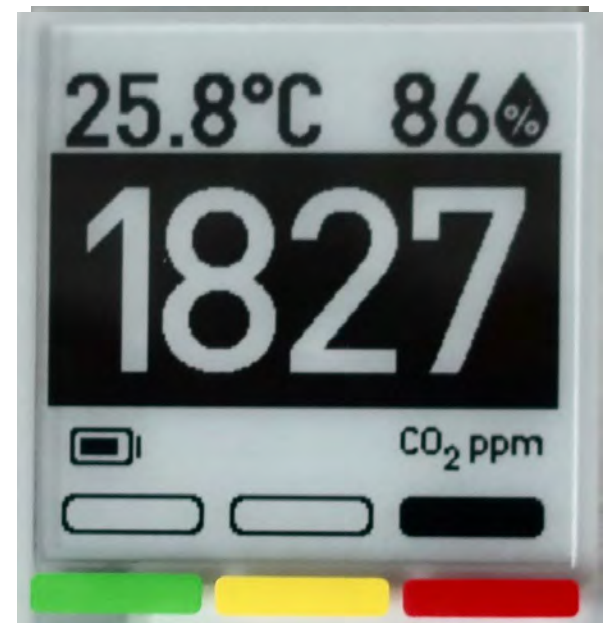
We may be able to run our buildings cooler,
but what about moisture?

DAMPNESS IS A MAJOR SOURCE OF ILL HEALTH FOR PEOPLE AND BUILDINGS, DIRECTLY AND INDIRECTLY:

- Water penetration, leaks – *needs maintenance*
- People – *ventilation needs to be adequate*
- Kitchens, bathrooms etc. – *extract at source*
- Insulation – *can make things worse.*

**ALL ENERGY SAVING STRATEGIES
MUST INCLUDE EFFECTIVE
MOISTURE MANAGEMENT**

***Need for careful survey work
and low-cost monitoring.***



ENERGY SUFFICIENCY: *Avoid unhealthy environments, allow escape from crises of discomfort*

MAIN METHODS:

1. Review appropriate standards *and promote adaptive comfort*
2. Control draughts, air movement and radiant heat gains and losses
3. Wear the right clothing and have suitable furniture etc.
4. Consider local and personal heating and cooling systems
5. Have accessible, responsive user-friendly controls
6. Improve thermoregulatory fitness where practicable
7. ADD thermal refuges, *both hot and cold, local and communal.*
8. *Plan to avoid health and moisture-related unintended consequences.*



"He gets so dramatic when I lower the thermostat."

P C Vey cartoon from the New Yorker (1 April 2019).

These also save energy and carbon much more quickly and cheaply than heavy capital investment.

Different levels of energy and carbon-saving retrofit

TYPE	COMMENT	INDICATIVE COST *	SOME INGREDIENTS	NOTES
1. BASIC ENERGY SAVING <i>People first</i>	Simple, <i>but too often still not done.</i>	Less than £ 1,000	Basic insulation, draughtproofing, equipment, control	Often absent from retrofit plans. <i>Advisers needed!</i>
2. "SOFT" RETROFIT <i>People first</i>	A rather different mindset. <i>More about this later.</i>	Less than £ 5,000	Work out to the fabric, rather than in from it. <i>Useful for heritage.</i>	Quick and simple, but includes novel ingredients
3. COST EFFECTIVE AT SCALE	Pareto optimum? <i>80% of the way with 20% of the money.</i>	£ 20,000 <i>Anticipated when supply chains are optimised</i>	Pragmatic fabric <i>to halve annual heat requirement from current 130 kWh/m² median.</i>	Could include highly simplified and compact MVHR and ASHP.
4. GOOD PRACTICE <i>e.g. AECB</i>	More practical and economic.	£ 50,000	Reduced set of measures.	Still relatively costly <i>and needs capacity.</i>
5. DEEP <i>EnerPHit or LETI Exemplar</i>	The mantra until recently.	£ 100,000	Full suite of measures.	Nice work if you can get it, but rare.

* Costs are per typical 90 m² dwelling and exclude any necessary repairs to the fabric

4.

GLIMPSES OF ONGOING WORK



31 People-first
projects
underway:
*in churches in
Yorkshire
and just starting
in houses.*



More about the church project in the Sheffield Diocese will become available at www.cheribimapp.com

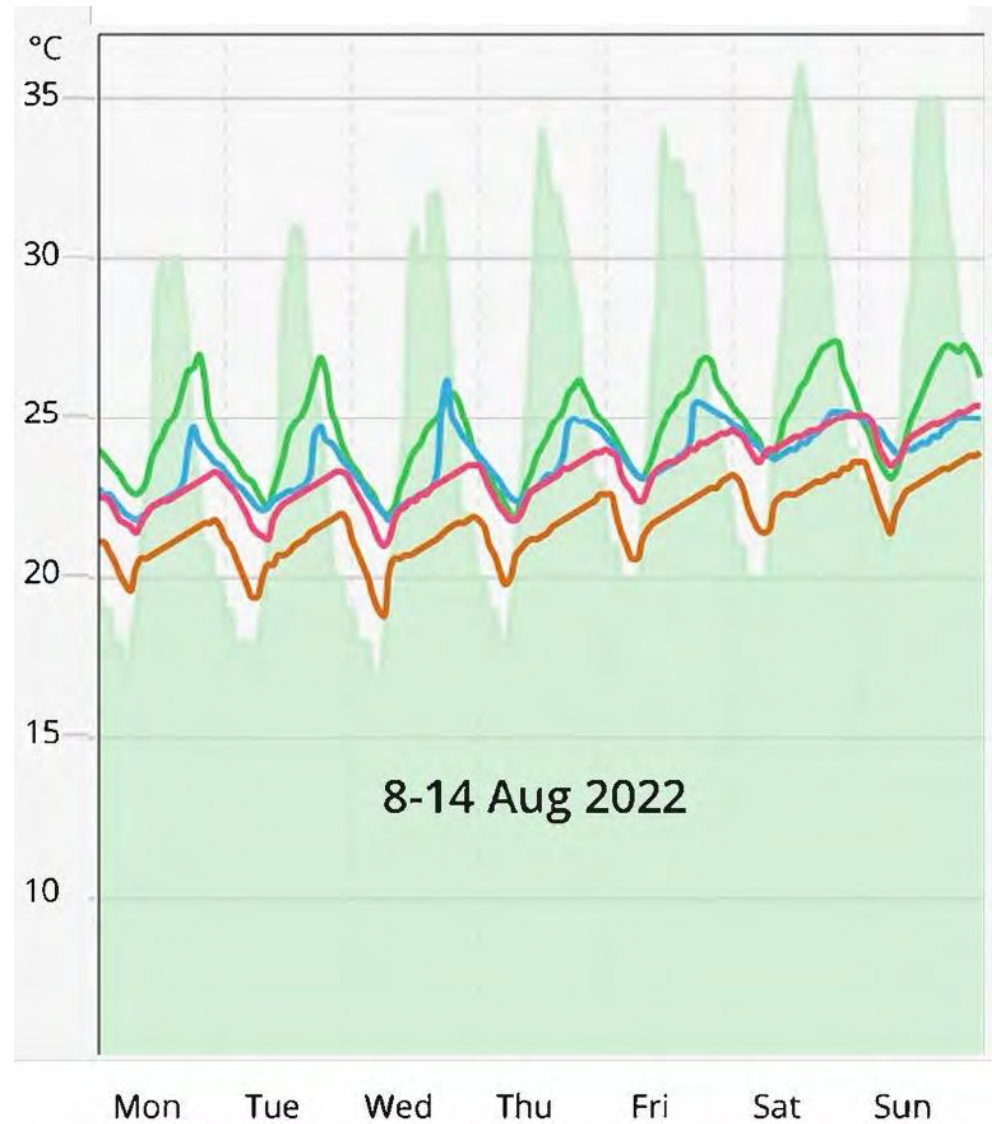
Some ingredients of the Yorkshire projects:

Co-creation with occupiers, to help improve their understanding and agency

- Monitor temperature, relative humidity and CO₂, with wireless mesh-networked LoRa battery equipment.
 - Work with occupiers, managers and others to think about how their buildings work and the scope for improvements, including re-discovery of measures used in the past.
 - Keep an eye on ventilation and moisture-related issues.
 - Occupiers are encouraged and supported to try out simple measures to improve comfort and reduce energy needs
 - and share experiences between their various buildings.
 - Promises to help occupiers become better-informed clients for more substantial interventions, when necessary
 - and identify and grow trusted local advisers & contractors.
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TRIALS OF SIMPLE MEASURES

Old linen sheets and night cross-ventilation in heatwave

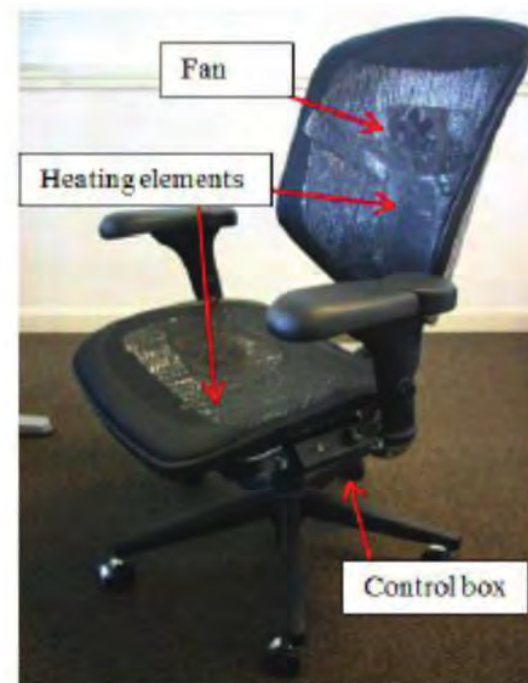
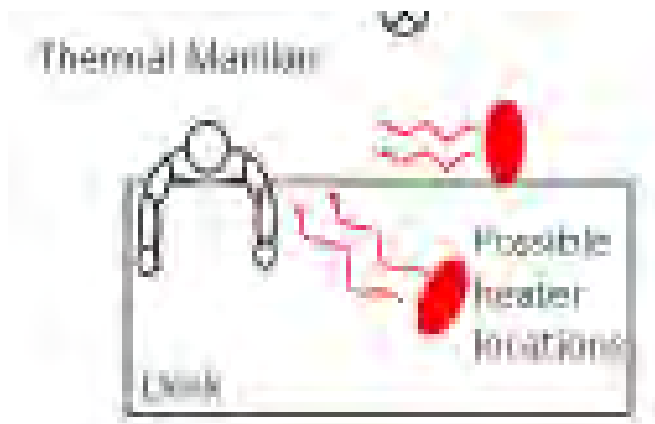


TRIALS OF SIMPLE MEASURES

Personal environmental control systems

Indicative Watts to increase personal comfort by 1°C:

250	Local convector heater
100	Local radiant panel
35	Local foot warming mat
<10	Heated chair or cushion



Max heating power 14 W
Max cooling power 3.6 W

Heated cushions have proved efficient in our case studies.

IEA EBC Annex 87 (2021-2026)

Personalised Environmental Control Systems is doing more rigorous field studies in offices

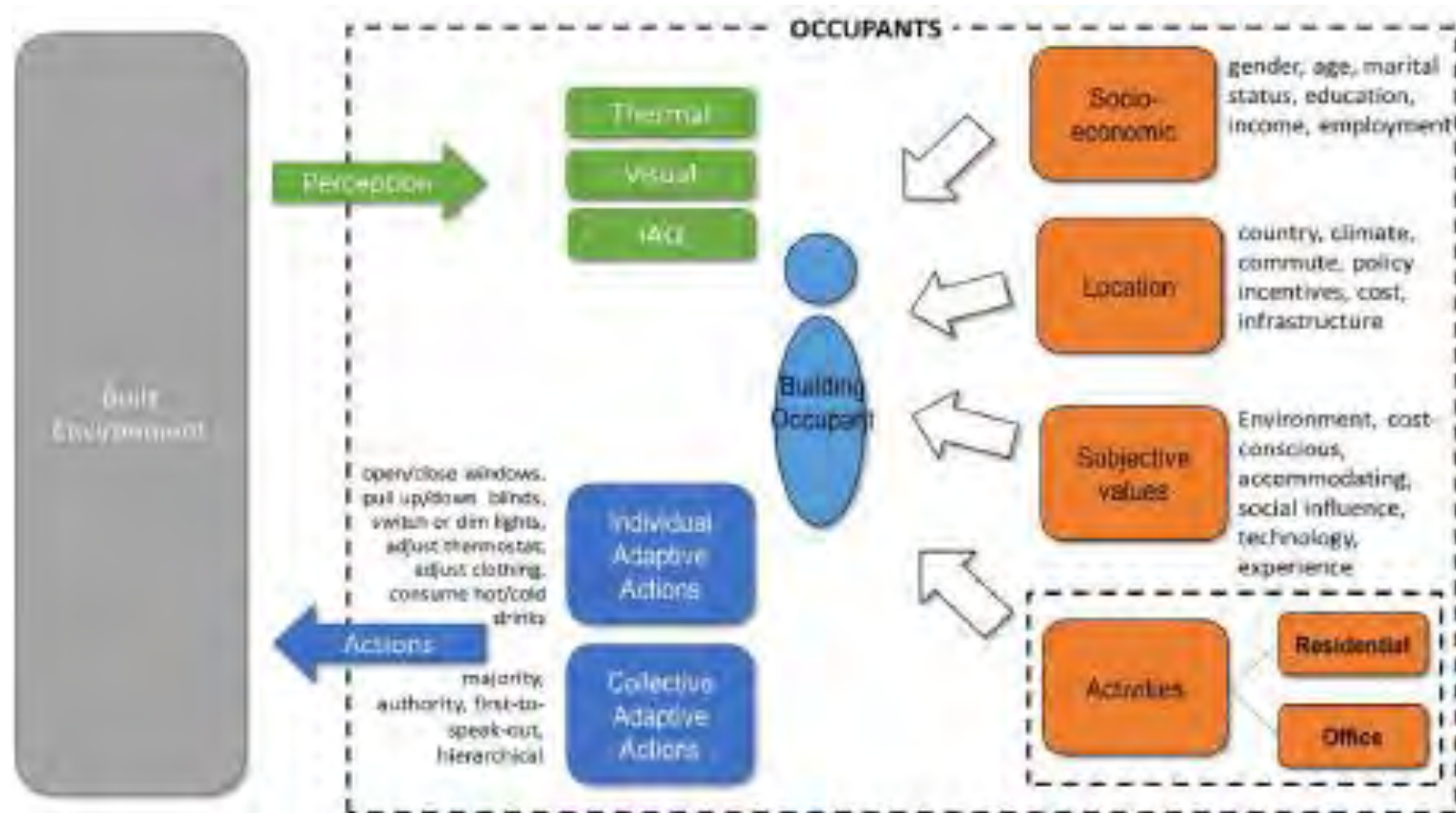
PROJECT OBJECTIVES

- 1 defining design criteria for personalized environmental control systems
- 2 developing operation guidelines for personalized environmental control systems
- 3 establishing control concepts and guidelines for operating personalized environmental control systems in spaces with general ambient systems for heating, cooling, ventilation, and lighting
- 4 quantifying the benefits of personalized environmental control systems regarding health, comfort, energy, and costs



IEA EBC Annex 79 (2020-2024)

Occupant-Centric Building Design & Operation



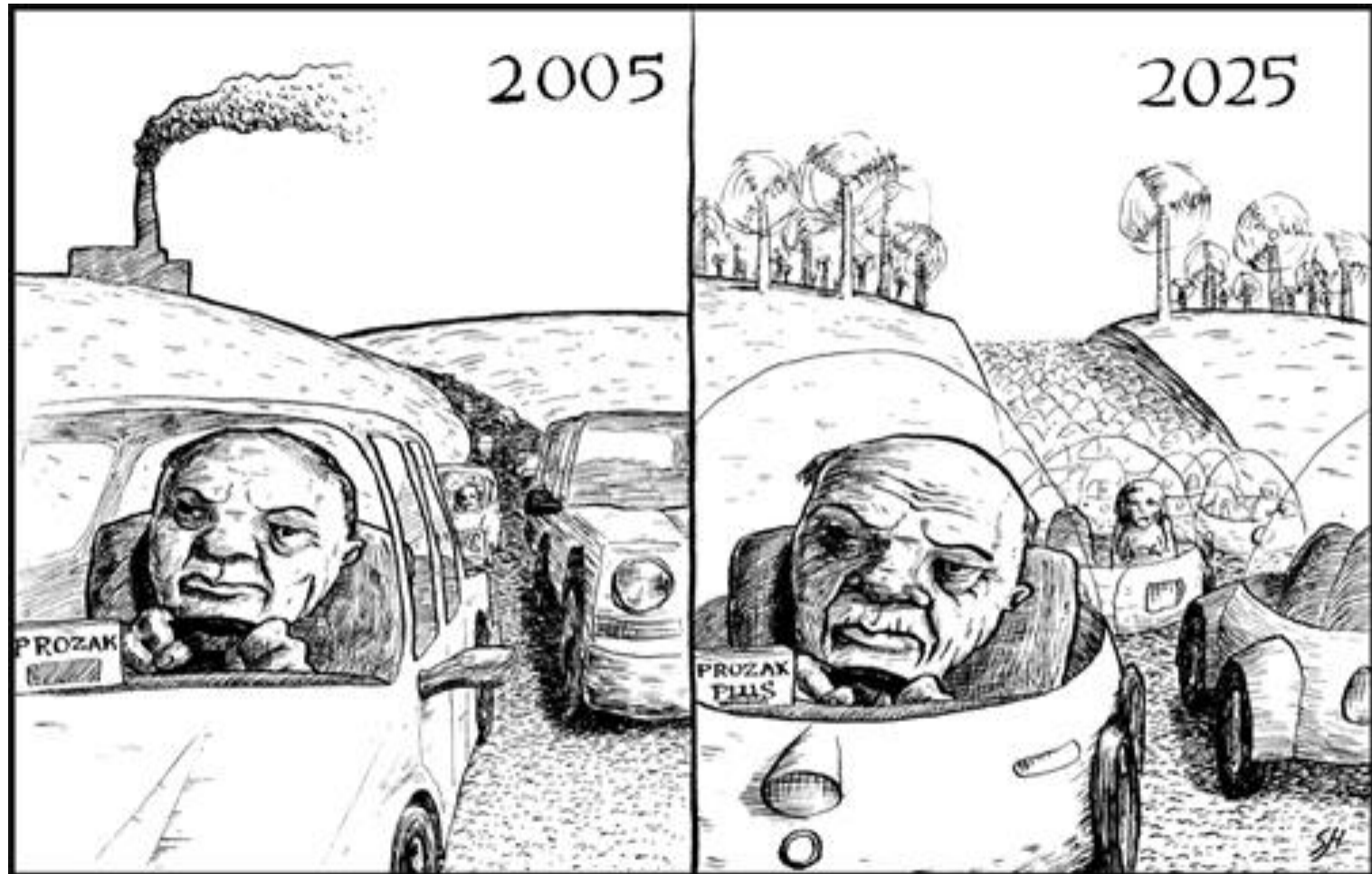
Final Report October 2024. This is more devoted to design guidance than co-creating solutions with building occupiers.

Some possible implications of soft retrofits for heating in traditional buildings

Possible advantages	Caveats
Fewer alterations required to fabric, reducing associated risks too.	Some improvements may nevertheless be appropriate, depending on context.
Lower internal air temperatures.	Sometimes they are too low already, <i>increasingly so with recent price spikes</i> .
Less necessary to limit air infiltration if air temperatures are lower.	Some draughtproofing will sometimes also be helpful, depending on context.
Could help to reduce condensation and moisture problems that can occur after draughtproofing etc.	Cooler buildings can be more prone to problems from any internally-generated moisture - needs removal at source.
Potentially much faster, cheaper energy savings than deep fabric retrofits.	New technology is often electric and used at peak times. Storage needed.
Local electric systems simpler and less intrusive to install than traditional HVAC	Additional, dispersed electric heating equipment might increase fire risks.
Local systems could be particularly useful in lightly-occupied buildings.	Less energy-saving potential in heavily- or densely- occupied buildings.

Thank you

DISCUSSION



The technofixers' best-case scenario

www.usablebuildings.co.uk

The energy-to-carbon hierarchy *when improving performance*

1. Engage people: *make energy and carbon performance visible and actionable, or there may be unintended consequences.*
 2. Reduce demand: *change habits, question standards and provision, use passive measures. Prevention is better than cure!*
 3. Increase efficiency: *of building services, ICT and other appliances; and improve integration.*
 4. Improve controls and monitoring: *massive opportunities here, not least with better functionality and ergonomics.*
 5. Avoid waste: **<< a good place to start in existing buildings
AND THEN ...**
 6. Seek lower-carbon energy supplies: *both on and off-site.*
- Have you got the priorities right?
 - Get quick results by doing things simply, cheaply ... **and well!**
 - Make use of *Opportunity Points*, when doing other work.
-