

RETROFIT OUR BUILDINGS: OR OUR BRAINS?

**A SCIENCE-BASED
PEOPLE-FIRST
APPROACH**

DR ROBYN PENDER & PROF BILL BORDASS



Richard Webb (CC BY-SA 2.0)

US NavyJim Brooks (Wikimedia Commons)

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Old buildings can have a lot of problems guide, Heritage house maintenance tips, Older property fix advice

Old Buildings Can Have A Lot Of Problems – Guide

post updated 14 February 2024

There's a certain appeal about old buildings that are they designed beautifully, but they also carry match. Simple features in old buildings like exposed of people. Plus, some people prefer to invest in a range many of them offer.



Horizon scanning

Net zero and the UK's historic building stock

Published Wednesday, 12 February, 2025

Horizon scanning Environment

Hobo Marchant Jonny Wentworth

The retrofit of the UK's historic building stock is needed to enhance energy efficiency and achieve net zero targets. How can this be done?



Department for Levelling Up, Housing & Communities



Department for Culture, Media & Sport



Department for Energy Security & Net Zero

Research and analysis

Adapting historic homes for energy efficiency: a review of the barriers

Published 3 January 2024

Applies to England

Contents

Ministerial foreword

1. Introduction
 2. The planning system
 3. Local authority skills, training, and capacity
 4. Guidance and information (for homeowners and occupiers)
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 7. Summary and next steps
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Brussels' big building grab

The EU wants to mandate energy efficiency upgrades for millions of old buildings.



Buildings account for 36 percent of the EU's greenhouse gas emissions (David Ramos/AFP via Getty Images)

Brussels' big building grab

The EU wants to mandate energy efficiency upgrades for millions of old buildings.



Buildings account for 36 percent of the EU's greenhouse gas emissions | David Ramos/AP Photo

... but **THESE** are the energy pigs!



Quintus Petilius (Wikimedia Commons)



dbgg1979 (Wikimedia Commons)



Mr Wabu (Wikimedia Commons)



African Vernacular Architecture Database



Naquib Hossain (Wikimedia Commons)

John Mackenzie Burke (Wikimedia Commons)



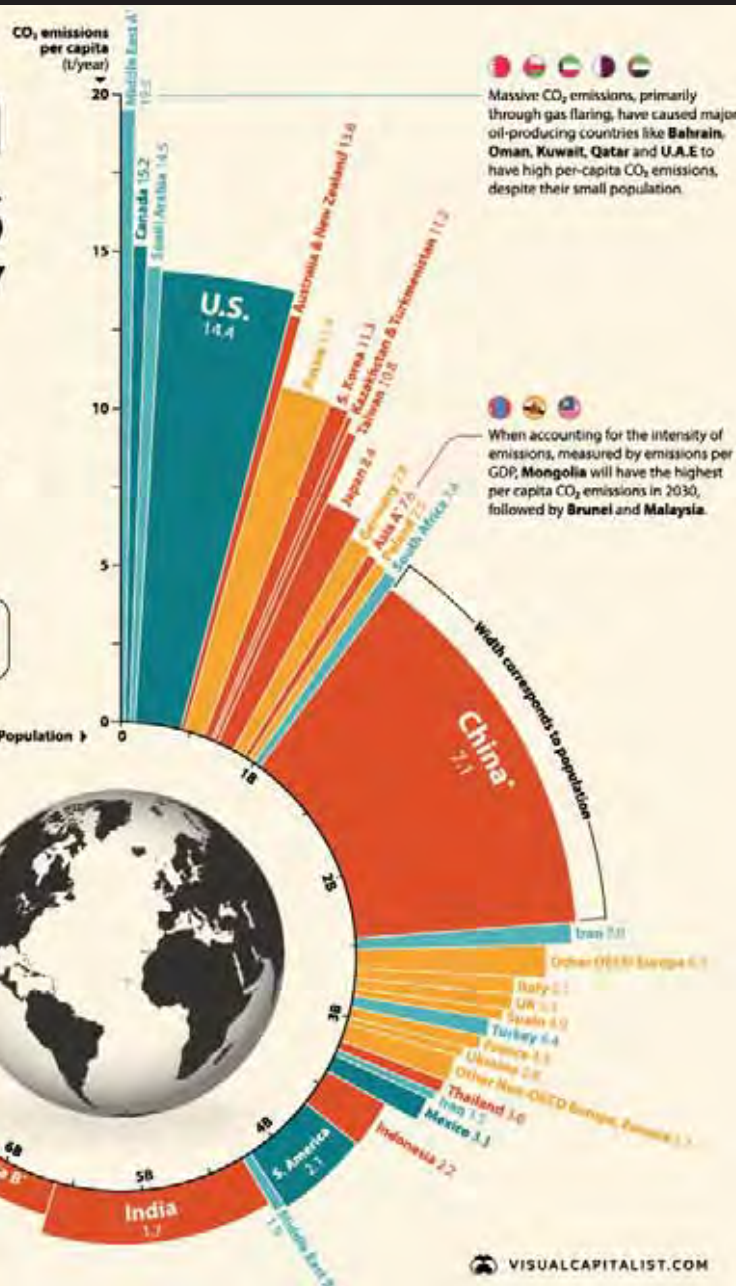
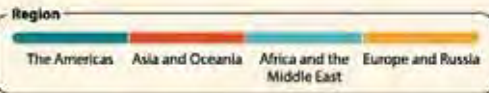
Levan Gokadze (Wikimedia Commons)

Carbon Emissions PER-CAPITA BY COUNTRY

Measuring the total carbon emissions doesn't always paint the most accurate picture of a country's contribution, if their population isn't considered.

For example, even though China is the highest emitter of CO₂, the average American is responsible for producing 14.4 tonnes of CO₂ per person, compared to 7.1 tonnes for a Chinese citizen.

Here's a look at the biggest per-capita carbon emitters in the world:



SOURCE: AQUAL GROUP, IEA (2021)

VISUALCAPITALIST.COM



The Global North is responsible for **92%** of excess global carbon emissions...

Cumulative CO2 emissions

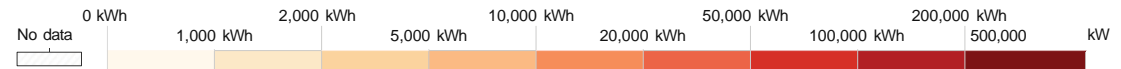
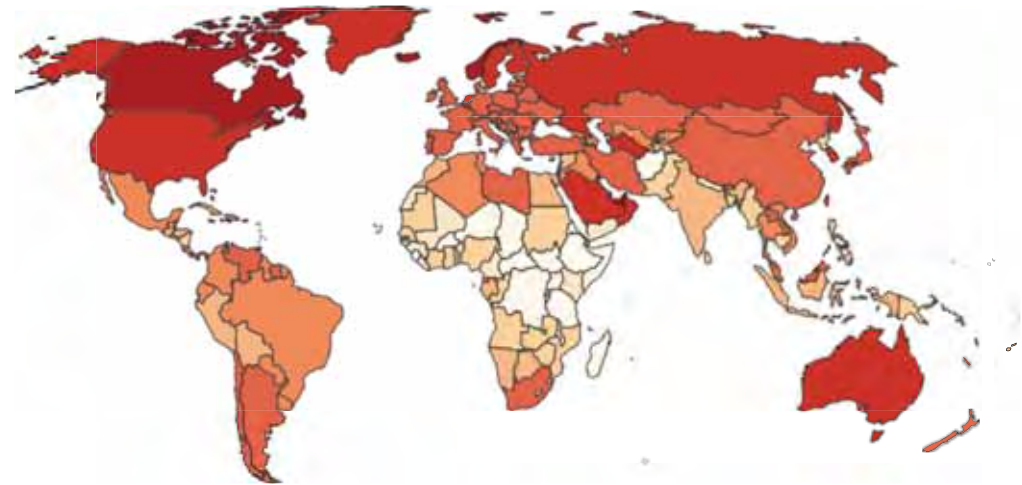


SOURCE: Our World in Data

Energy use per person, 2021

Energy use not only includes electricity, but also other areas of consumption including transport, heating and cooking.

Our World in Data



Source: Our World in Data based on BP & Shift Data Portal

Our World in Data CC BY SA 4.0



Forgetting the air space behind the bricks sure didn't help. After only 10 weeks of occupancy, some new homes built by Zaring of Cincinnati were so wet that most of the brick veneer, sheathing, insulation, and drywall had to be removed and demolished. A portion of the defective walls were sheathed with Celotex fiberboard, which is so vapor-permeable that moisture held in the brick veneer was easily driven into the wall cavity when sun shone on the bricks.

Image Credit: Steve Bostwick



Forgetting the air space behind the bricks sure didn't help. After only 10 weeks of occupancy, some new homes built by Zaring of Cincinnati were so wet that most of the brick veneer, sheathing, insulation, and drywall had to be removed and demolished. A portion of the defective walls were sheathed with Celotex fiberboard, which is so vapor-permeable that moisture held in the brick veneer was easily driven into the wall cavity when sun shone on the bricks.

Image Credit: Steve Bostwick

Rym DeCoster (Wikimedia Commons)





Forgetting the air space behind the bricks sure didn't help. After only 10 weeks of occupancy, some new homes built by Zaring of Cincinnati were so wet that most of the brick veneer, sheathing, insulation, and drywall had to be removed and demolished. A portion of the defective walls were sheathed with Celotex fiberboard, which is so vapor-permeable that moisture held in the brick veneer was easily driven into the wall cavity when sun shone on the bricks.

Image Credit: Steve Bostwick



Miami-Dade Fire Rescue Department (Wikimedia Commons)





COLLAPSE OF COB DUE TO CEMENT RENDER

Death of two-year-old from mould in flat a 'defining moment', says coroner

Awaab Ishak died in 2020, eight days after his second birthday, following 'chronic exposure' in Rochdale



Awaab Ishak. A number of things went wrong in the case, some of them contributing to the boy's death, the coroner said. Photograph: Family handout/PA

The Guardian 15 November 2022



A Stucco Failure - Lessons Learned and How to Fix It

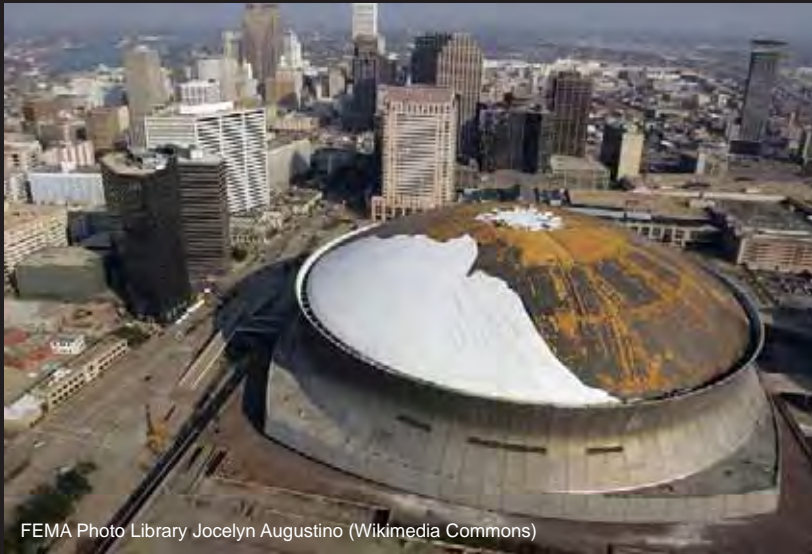
Matt Rieinger
1.0M subscribers

1.3K

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ITV News Wales



FEMA Photo Library Jocelyn Augustino (Wikimedia Commons)

INSIGHT

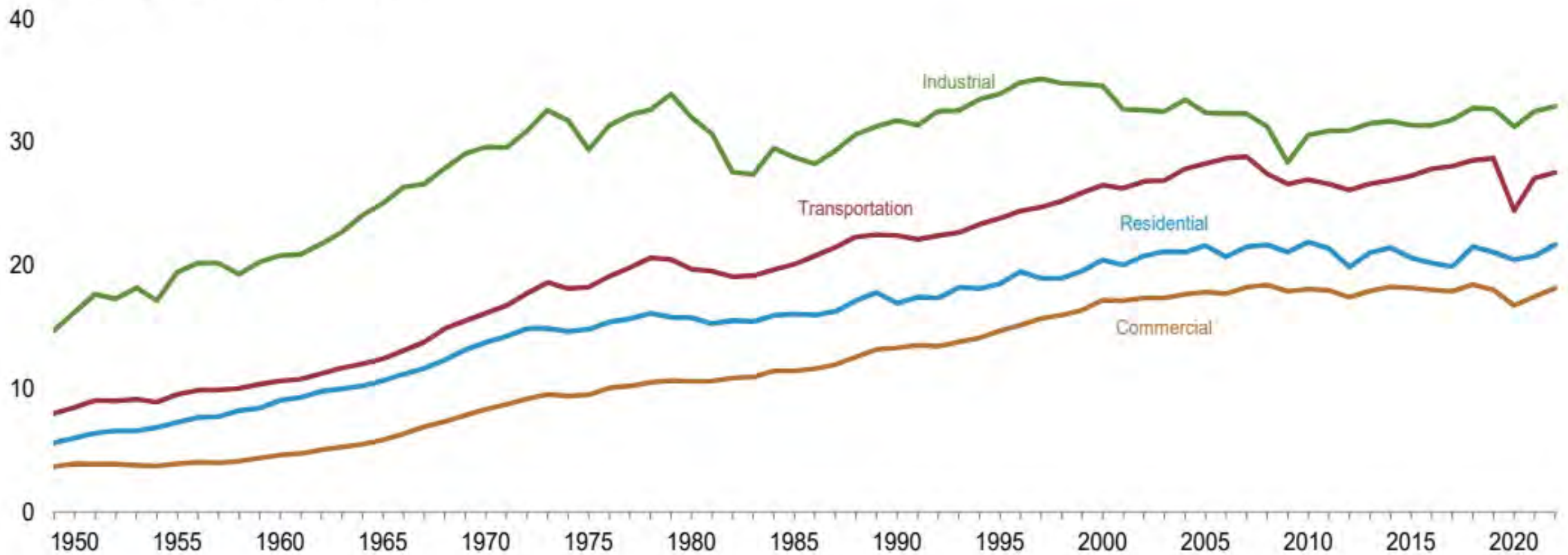
Residents sickened by botched Welsh housing estate insulation scheme that made homes mouldy and cold

HOUSING | WALES | Friday 7 December 2023 at 4:56pm

Rhys Williams
Wales Reporter

The badly fitted installation has left homes badly damaged. ITV News Wales reporter Rhys Williams investigates.

Total Consumption by End-Use Sector



Web Page: <http://www.eia.gov/totalenergy/data/monthly/#consumption>.

Source: Tables 2.1a—2.1b.

???







Tate Modern: Alexander Svensson (Wikimedia Commons)



**TRADITIONAL SYSTEMS
ARE LIKE GREATCOATS**





IWM Non Commercial Licence (Wikimedia Commons)



TikTok: Manchester Honey Company

**'MODERN' SYSTEMS
ARE LIKE RAINCOATS**





OPEN WINDOW



WINTER



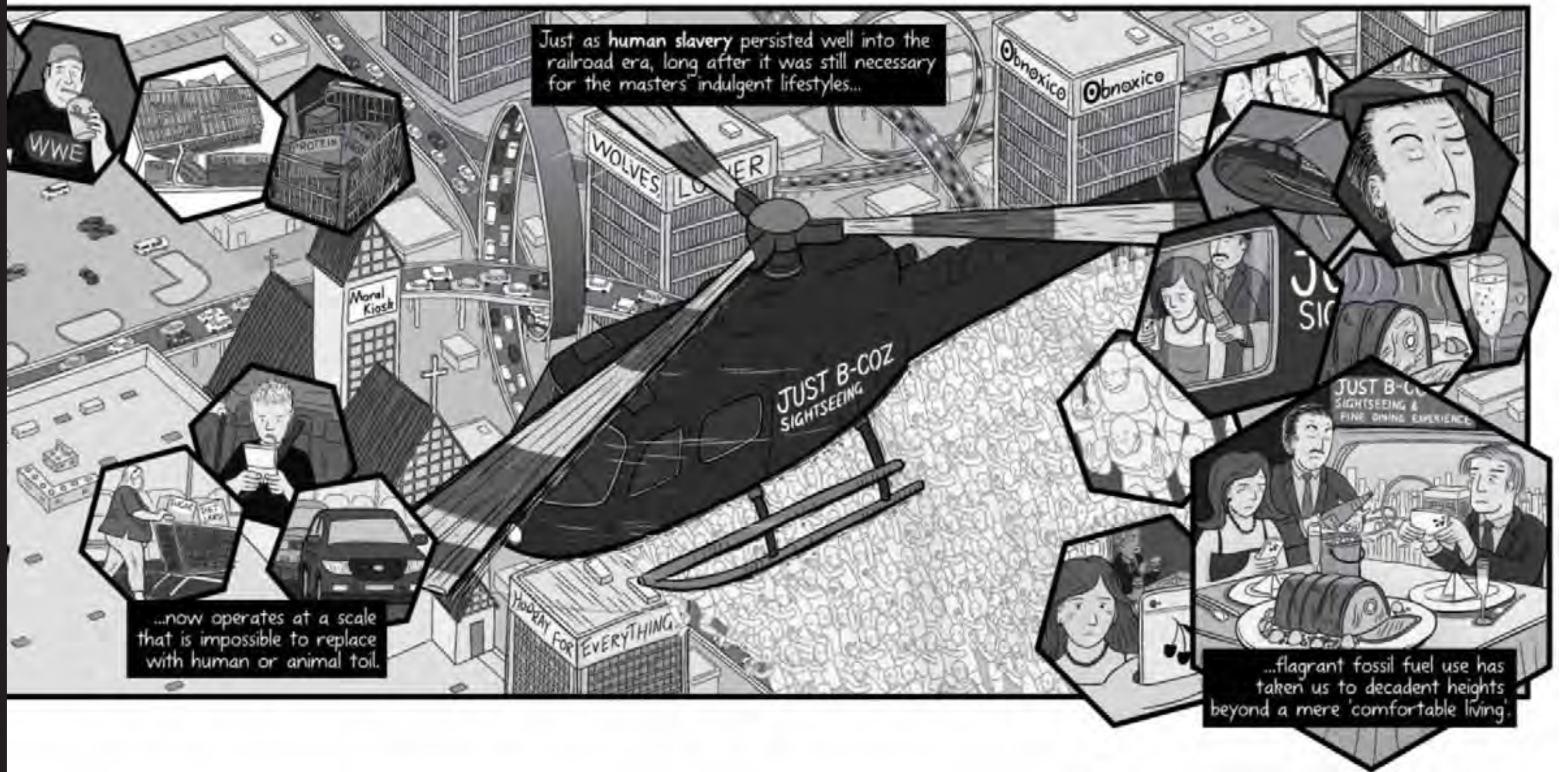
Image by Freepik



Sellers, A. J., van Beek, S. M. M., Hashim, D., Baak, R., Pallubinsky, H., Moonen-Kornips, E., Schaart, G., Gemmink, A., Jorgensen, J. A., van de Weijer, T., Kalkhoven, E., Hooiveld, G. J., Kersten, S., Hesselink, M. K. C., Schrauwen, P., Hoeks, J., & Lichtenbelt, W. D. V. M. (2024). *Nature Metabolism*, 6(12), 2246-2253. Article 1516. doi.org/10.1038/s42255-024-01172-y



Cold acclimation with shivering improves metabolic health in adults with overweight or obesity.



Just as human slavery persisted well into the railroad era, long after it was still necessary for the masters' indulgent lifestyles...

...now operates at a scale that is impossible to replace with human or animal toil.

...flagrant fossil fuel use has taken us to decadent heights beyond a mere 'comfortable living'.

BBC one



Bang Goes the Theory: The Human Power Station

3 Dec 2009

BBC one





People's Collection Wales (Creative Commons)



talknerway.com





People's Collection Wales (Creative Commons)

talknerway.com







Ibrahim Tchan

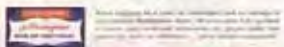




WHEREVER YOU LIVE YOU CAN NOW ENJOY COOL, DRY, RESTFUL COMFORT

with the New Westinghouse Room Air Conditioner

When you live in a hot climate, you know your air conditioner is the most important appliance in your home. It's the one that keeps you cool, dry, and comfortable all day long. The new Westinghouse Room Air Conditioner is the one that's been designed to give you the most comfort and protection. It's the one that's been designed to give you the most comfort and protection. It's the one that's been designed to give you the most comfort and protection.



YOU CAN BE SURE...if it's Westinghouse



All new G-E Tinline Air Conditioner takes up 1/3 less space!



G-E Tinline is 16 1/2 inches "thin," no unsightly overhang!

Why bother when you can watch from the back of the room?

It's a compact, slim, modern air conditioner that fits in a window and is almost invisible. It's the one that's been designed to give you the most comfort and protection.

If the heat gets too hot, you can watch from the back of the room. It's a compact, slim, modern air conditioner that fits in a window and is almost invisible.

Best Value. Price even lower if you order it.

It's a compact, slim, modern air conditioner that fits in a window and is almost invisible. It's the one that's been designed to give you the most comfort and protection.

Special Service. Service by General Electric. Service by General Electric. Service by General Electric.

Progress is Our Most Important Product
GENERAL ELECTRIC

Don't dodge draughts

Nearly every house has its own particular draught. Sometimes it is in the hall. Sometimes just round the dining-room door. Chilly draughts...ugh! Here's the way to tame them. A Radiant-Panel Gas Heater's the thing. You can place it anywhere—it needs no flue or chimney—and catch those draughts where they start. The black panel soaks up the heat then radiates glowing warmth just where you want it. Whenever the absence of a flue makes heating a problem the Radiant-Panel Gas Heater is the logical solution. Find out about it today. It's economical to run and inexpensive to purchase.



Fit a Flavel **RADIANT-PANEL GAS HEATER**

As Made at Your Choice, in all sizes (by Flavel Radiant Panel Co., Ltd., 20 Hatchedwood, London, W.1.), also from a general Exhibition of the Cabinet, the Fine and the Beautiful.

Dial your favorite weather!

Admiral

AIR CONDITIONER



- HIDES AWAY** Behind blinds or curtains... does not stand into room.
- COOLS** When it's hot.
- HEATS** When it's chilly.
- DEHUMIDIFIES** Removes up to 40 litres of water a day from the air.
- VENTILATES** Brings in outside air... removes food odors and tobacco smoke.
- CIRCULATES** Directs cool flow upwards for swift room circulation.
- FILTERS** Removes dust and pollen.

Wake up to the luxury of solid fuel central heating.

[It even serves you tea in bed!]



When it comes to running costs, solid fuel central heating is hard to beat. And it offers you more security than any other kind of fuel. When you have a solid fuel central heating system installed by a Registered Heating Contractor you get the backing of the NCB Guarantee - the best in the business. It covers everything - design, workmanship, materials and performance for two full years.

Comfort in the new home

IDEAL CLASSIC WARMING

Avoid future disappointment and expense by enjoying your new home at the outset with Ideal Classic Warming - comfort in every room, simple but warm for baths and house hold use. Burns coke in automatic - smokeless. In new houses most practically covered by saving in materials and labor. Booklet ZHS, just free.

Visit Stands 35, 36, 37, 39 & 40, Ideal Home Exhibition, New Hall, Grand Place, OLYMPIA.

NATIONAL RADIATOR COMPANY LIMITED
2 National Avenue, HULL
London Showrooms: 44, Oxford Street, W.1

MRS 1970 knows what she wants

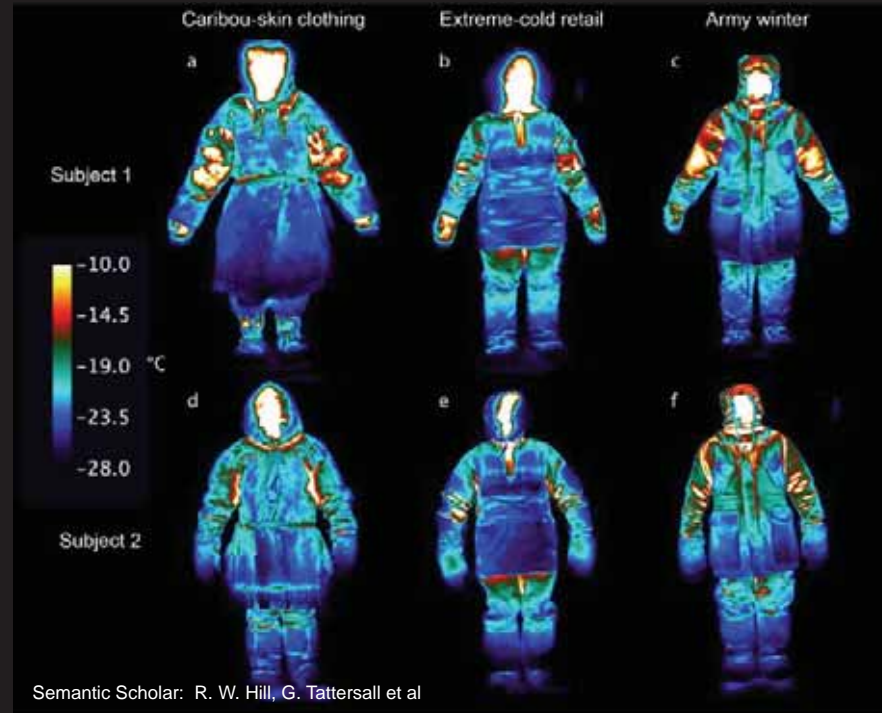
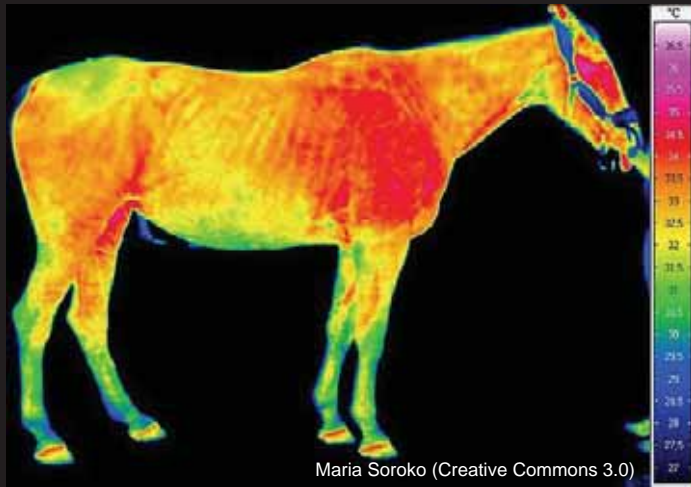
The Central Heating

Feel the chill essence of life

Special Ramadan Offer
Cash Discount | Free Installation | 12 EMI*
*For selected models only

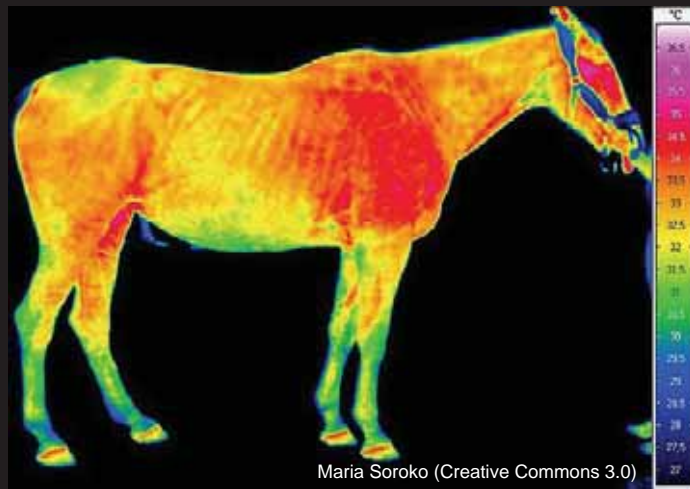


THERMAL PHYSIOLOGY



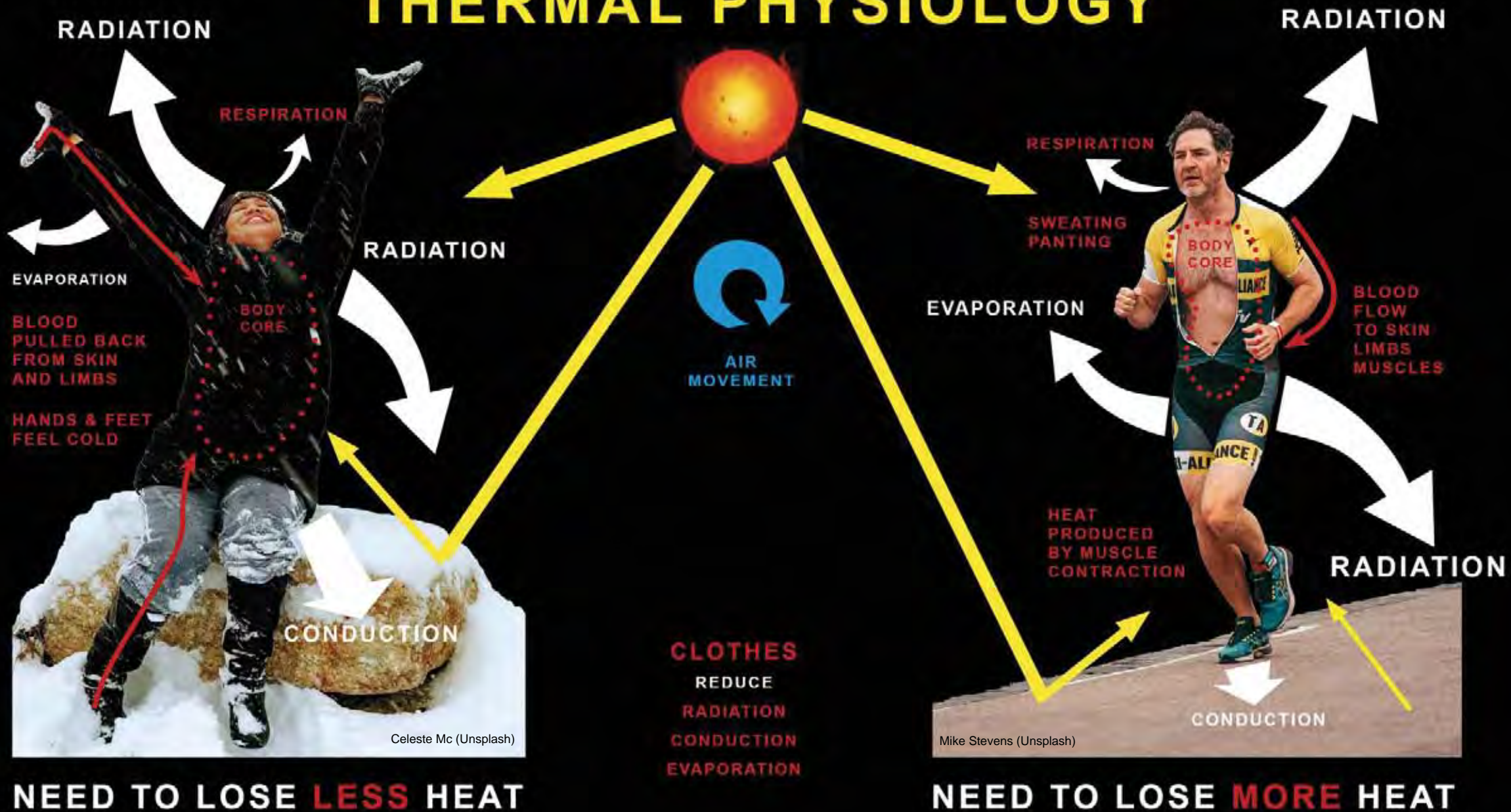
HUMANS ARE WARM-BLOODED ANIMALS

THERMAL PHYSIOLOGY



HUMANS ARE WARM-BLOODED ANIMALS
WE ALWAYS NEED TO LOSE SOME HEAT
TO OUR SURROUNDING

THERMAL PHYSIOLOGY



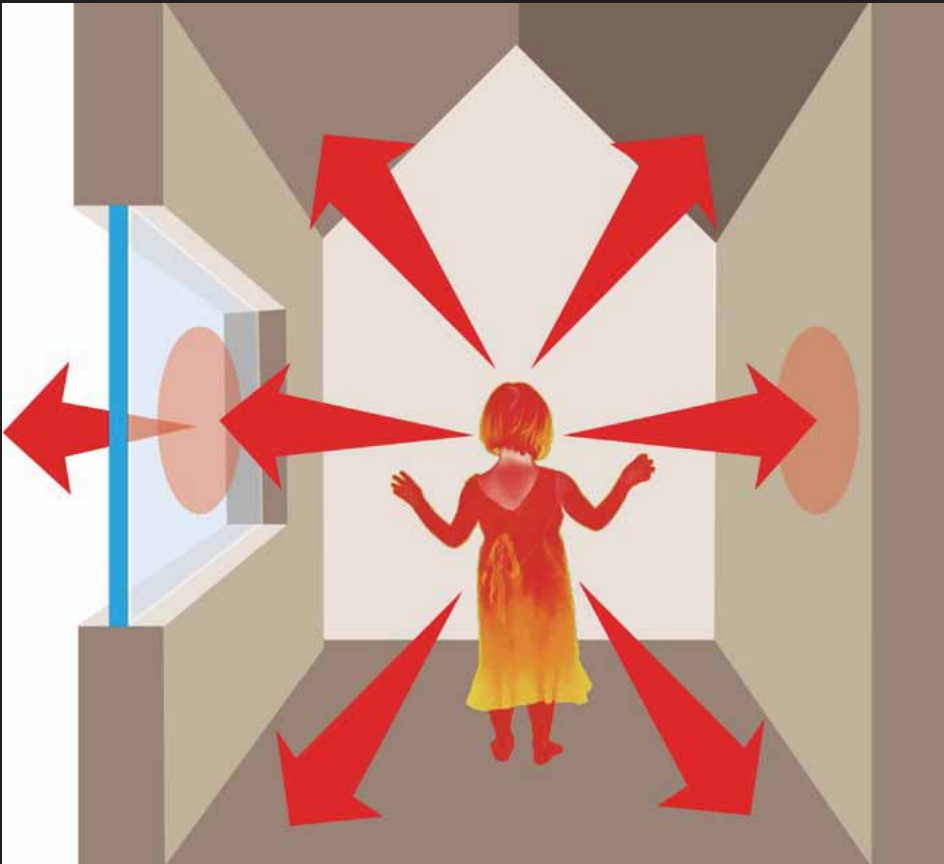
Celeste Mc (Unsplash)

Mike Stevens (Unsplash)

DOMINANT:

AT LEAST 50%

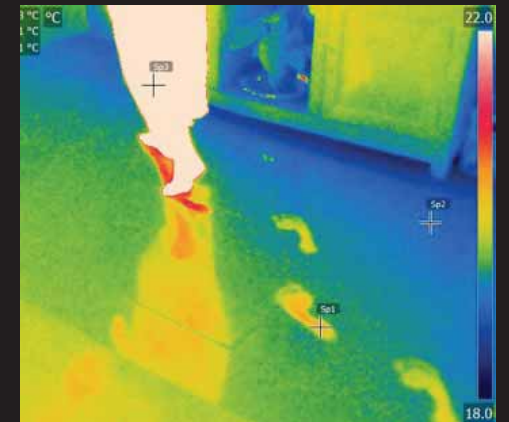
RADIATION (MUCH MORE IF SURROUNDINGS ARE COLD)



UP TO 50%
CONVECTION PLUS
EVAPORATION
INTO AIR
(VERY LOW INDOORS)



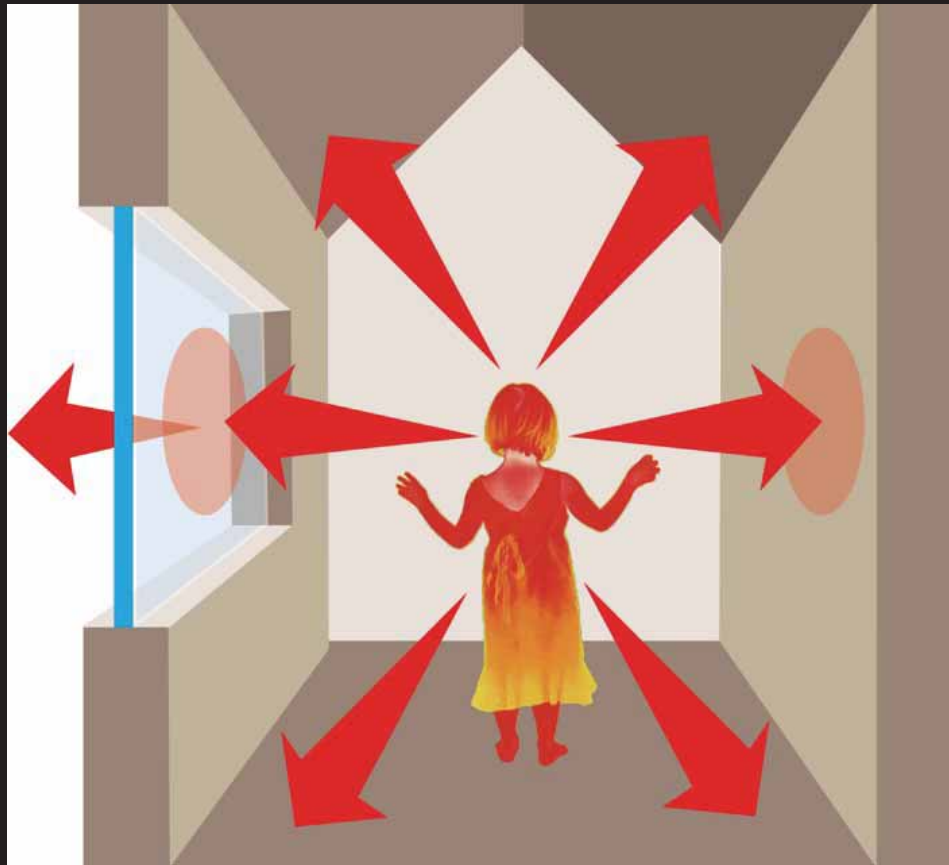
ALSO
CONDUCTION
(DEPENDS ON BODY PART, AREA, TYPE OF SURFACE ...)



DOMINANT:

AT LEAST 50%

RADIATION (MUCH MORE IF SURROUNDINGS ARE COLD)



JUST LISTEN TO YOUR SENSES!!!

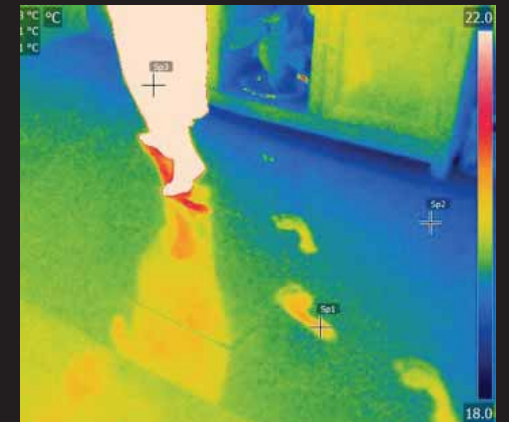
UP TO 50%

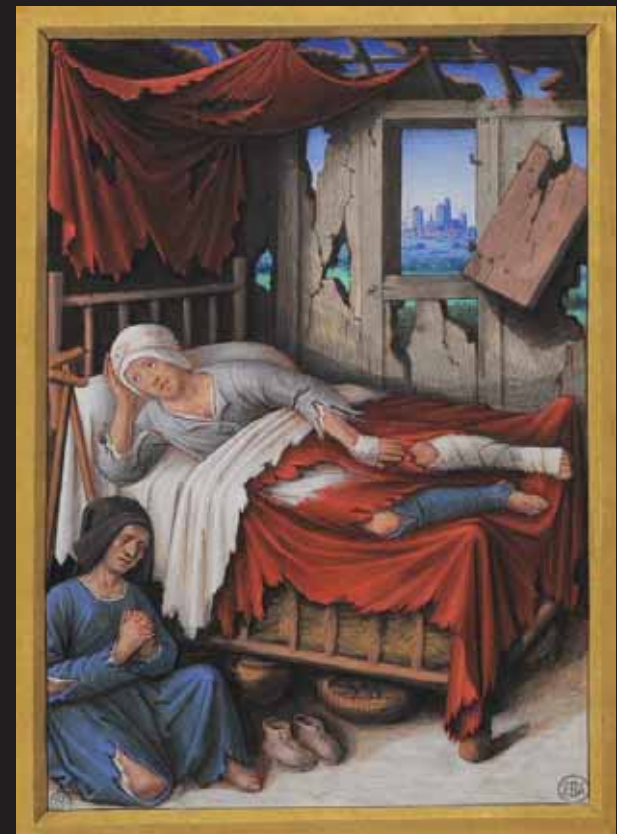
CONVECTION PLUS EVAPORATION INTO AIR (VERY LOW INDOORS)



ALSO

CONDUCTION (DEPENDS ON BODY PART, AREA, TYPE OF SURFACE ...)













Pposchadel CC BY-SA 3.0

ROMANESQUE

NO GLASS (UP TO c.1200)



GOTHIC

GLASS (FROM AROUND 1200)

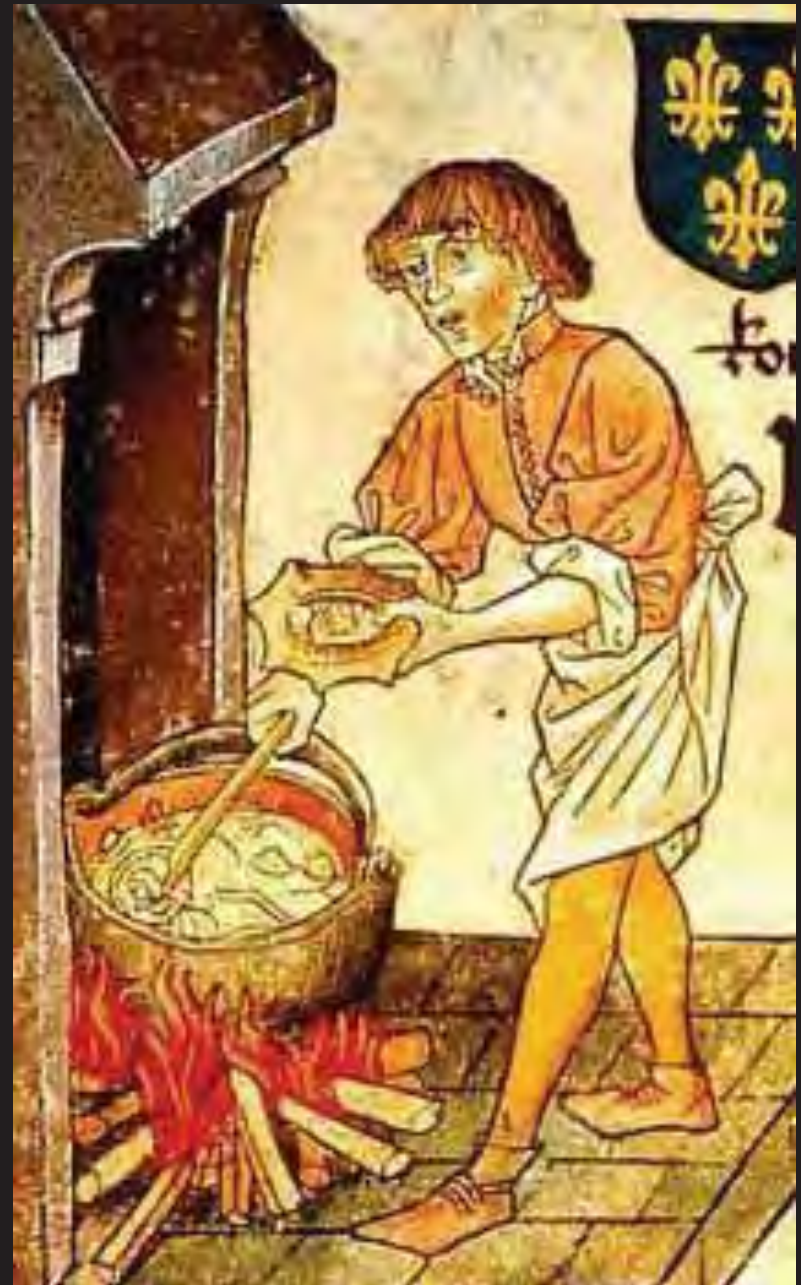


**WARM AIR
MEETING
COLD
GLASS
IS CHILLED
AND FALLS,
CREATING
DRAUGHT**











**WHEN NOT
BEING USED
FOR COOKING,
HEARTH
WERE
BLOCKED OFF**



Mike Dixon / Norfolkstainedglass.org



thatchinginfo.com/thatching-in-devon/

PREHISTORY



FIRED BRICK
4400BC



LIME MORTAR
c.6500BC



UNFIRED BRICK
before 7500BC

**WINDOW
GLASS**



1670s

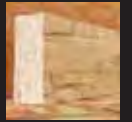


1550s



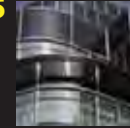
800AD

**ENGINEERED
WOOD**



1960s

SS



Al

1930s



1900

IRON



1790

**INDUSTRIAL
FOSSIL FUEL USE
BEGINS**

**PORTLAND
CEMENT**

1870s



SILICONE



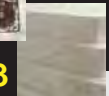
1940s

PLASTICS

1907



1933



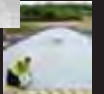
1953



1965



LEAD
200BC













Richard Webb/Geograph CC BY-SA 2.0



Property Care Association



'Too much glass' risks overheating modern buildings

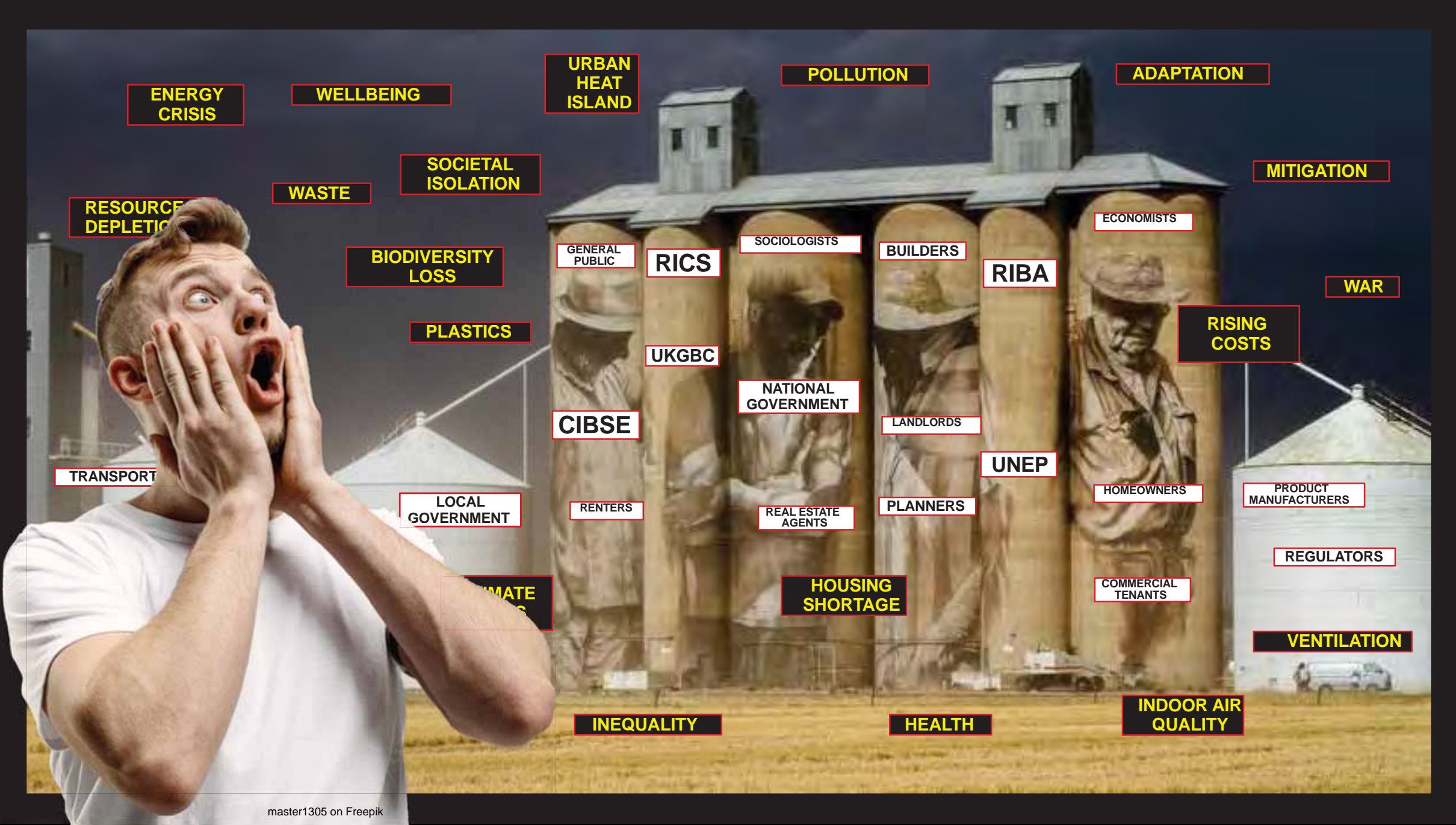
Climate change committee calls for review of building rules on high temperatures



Modern towers, including Swiss Re's 'The Gherkin', in the City of London © Bloomberg

Financial Times 29 June 2017





ENERGY CRISIS

WELLBEING

URBAN HEAT ISLAND

POLLUTION

ADAPTATION

RESOURCE DEPLETION

WASTE

SOCIETAL ISOLATION

MITIGATION

BIODIVERSITY LOSS

GENERAL PUBLIC

RICS

SOCIOLOGISTS

BUILDERS

ECONOMISTS

WAR

PLASTICS

UKGBC

NATIONAL GOVERNMENT

RIBA

RISING COSTS

CIBSE

LANDLORDS

UNEP

PRODUCT MANUFACTURERS

TRANSPORT

LOCAL GOVERNMENT

RENTERS

REAL ESTATE AGENTS

PLANNERS

HOMEOWNERS

REGULATORS

CLIMATE CHANGE

HOUSING SHORTAGE

COMMERCIAL TENANTS

VENTILATION

INEQUALITY

HEALTH

INDOOR AIR QUALITY



NEW
or **IMPROVED**



Only After a Product has Met the High Standard set by Scientific Tests, is the Certain-teed Label Put on It

When you buy a Certain-teed product you can be sure it will be entirely satisfactory—in quality, price, utility and beauty. An unusual standard governs the production of each one of these hundred and more different products. An ideal of giving the public extra value and quality, regulates the buying, selling and manufacturing operations of Certain-teed.

Beginning with the various raw materials as they arrive at the plants, and following through the

finely-processed steps of manufacture, a corps of scientists is always busy applying rigorous chemical and physical tests. There are tests to determine the exact composition of each product; tests for strength, permanence, resilience; tests for fire and weathering protection.

Every Certain-teed product has to be right! It can bear the Certain-teed label only after it has met that exceptional standard now known by users in all parts of the world.

ASPHALT ROOFINGS
ASPHALT SHINGLES
BUILDING PAPERS
BUILDING FELTS
PAINTS - VARNISHES



Certain-teed

LINOLEUM
FLOORTEX (MILKAM)
OIL CLOTH
GYPSUM PLASTERS
BUILDING BLOCKS





Morris & Co













LONDON going out of Town. — or — The Marth of Bricks & Mortar! —





No guarantee of compensation for Caerau residents affected by poor Arbed insulation work

One member hit out at the council, saying he felt a "profound sense of shame and embarrassment" over what residents have had to go through

Bookmark

SHARE



Comments: 2

By **Ted Peskett** Local Democracy Reporter

12:19, 11 FEB 2022



Bridgend Councillors were told that there is no guarantee that Caerau residents will receive compensation under the remedial fu

Wales Online 11 February 2022

Carmarthenshire News Online 28 January 2023

“We’ve never lived like this before, and the house used to be perfect before this happened... It’s always freezing in here now and you can’t do anything to decorate as its ruined within a matter of weeks.”



Jayne Roberts (Credit: Lewis Smith)

No guarantee of compensation for Caerau residents poor Arbed insulation work

One member hit out at the council, saying he felt a "profound sense of shame and embarrassment" over what residents

Bookmark [SHARE](#)    [Comments 2](#)

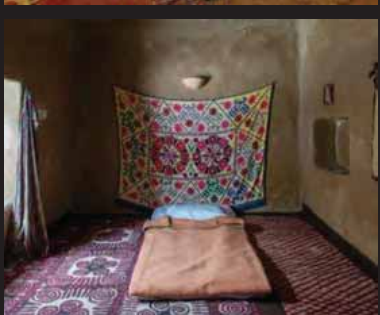
By [Ted Peskett](#) Local Democrat
12:19, 11 FEB 2022

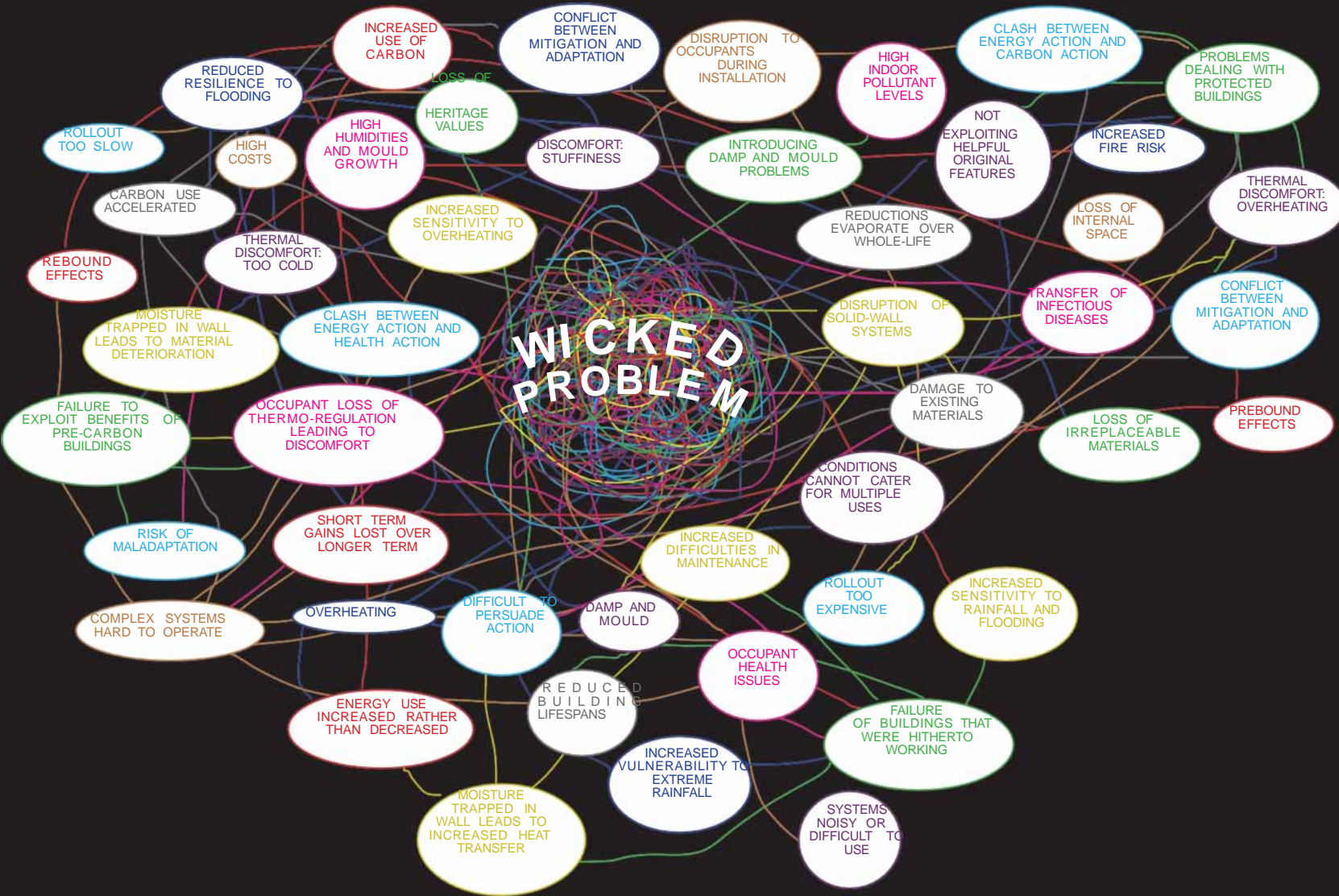


Bridgend Councillors were told that there is no guarantee that Caerau residents will receive con

“We’ve never lived like this before, and the house used to be perfect before this happened... It’s always freezing in here now and you can’t do anything to decorate as its ruined within a matter of weeks.”







POLICY + ACTION
 HERITAGE
 HEALTH
 COMFORT + USABILITY
 BUILDING PHYSICS
 ENERGY USE
 CARBON USE
 MANAGEMENT
 FUTURE CLIMATE





ENVIRONMENT RESISTS MOULD GROWTH (AIR MOVEMENT, HUMIDITY) NO CONFLICT BETWEEN ENERGY & CARBON NO NEED TO SEAL THE ENVELOPE
 MINIMAL RISK COMFORT FROM OCCUPANT CONTROL OCCUPANTS LEARN HOW TO 'SAIL' THEIR BUILDING FOR OPTIMUM BENEFIT
 LOW COST EASY TO PERSUADE OCCUPANTS OF THE BENEFITS OF ACTION LOW-CARBON OPERATION MAXIMISES BENEFITS OF ALTERATION
 NO CONFLICT BETWEEN KEEPING WARM AND FRESH AIR RESILIENT TO OVERHEATING LOW-CARBON MANUFACTURE RE & INSTALLATION
 HIGHLY AFFORDABLE EASY TO 'TRY BEFORE BUY' PROTECTION FROM RADIANT HEAT LOSS IN WINTER NO NEED TO INSULATE
 OPTIMISED BUILDING ENVELOPE LOW-ENERGY MANUFACTURE AND INSTALLATION NO CONFLICT BETWEEN MITIGATION AND ADAPTATION

PRESERVES HERITAGE VALUE
 ADAPTABLE TO A WIDE RANGE OF OCCUPANTS & USES
 LOW-ENERGY OPERATION
 SUPPORTING GOOD HEALTH
 LONG LIFESPAN
 RAPID ROLL-OUT
 DECREASED SENSITIVITY TO OVERHEATING
 BENEFITS FROM RADIANT HEAT LOSS IN SUMMER
 ENERGY USE DRAMATICALLY DECREASED
 EXPLOITS HISTORIC FEATURES

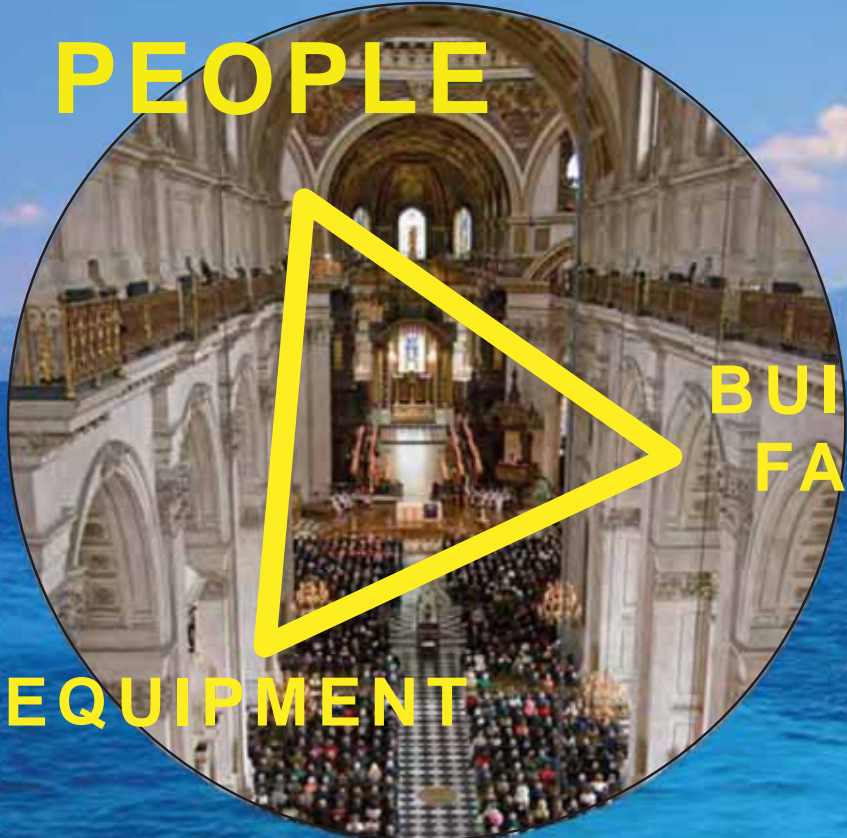


Hannah Pallubinsky

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), Article 135. <https://doi.org/10.1007/s10584-023-03614-0>

“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.**”

PEOPLE



**BUILDING
FABRIC**

EQUIPMENT

