

WHAT IS "RETROFITTING" A HOME?

Making significant improvements to an existing home

IMPROVEMENTS TO WHAT?

- Energy usage
- Human comfort
- Human health

**WHY IS ANY OF THIS
NECESSARY?**

MOST PEOPLE AREN'T HAPPY LIKE THIS



The ancestors of this fox have lived in this climate for
300,000 generations

WE LIVE IN SE ENGLAND BUT...

We aren't well suited to the climate

(If you look roughly like me then)

Genetic studies show that 2,500 generations ago 98% of your ancestors lived in a climate roughly like this...



"Ethiopia: the worst drought in a generation" by European Union, 2022 (photographer: Silvy Bolliger) is licensed under CC BY-ND 2.0

HOW WARM?

- **18°C** "negative effects on health start to occur"
- The Royal Society for Public Health 2016 ...ref1
- **22°C** "optimum acceptable temperature" (male)
- Coventry University ...ref2
- **23.5°C** "optimum acceptable temperature" (female)
- Coventry University ...ref2

WARMTH COSTS

- Most balance warmth with expense
- Some conscious of their environmental impact too

"Public Health Wales's 2022 and 2023 winter surveys found that people were increasingly experiencing stress or anxiety in the three months leading up to winter due to rising heating costs (a jump from 57% to 66%)."^{...ref4}

In Jan+Feb 2023, Plymouth University found "**six of the nine** examined households were unable to run their heating systems to warm their homes. In **four cases**, the average hourly air temperatures ranged **between 11°C and 16°C**" ...ref5

CLIMATE IMPACT OF HEATING

**18% of the UK's greenhouse gas emissions in 2021
were from heating homes ^{...ref7}**

**Roughly the same as aviation (7%) and animal
agriculture (11%) combined**

HEALTH IMPACTS OF HEATING

In the UK, we mainly heat our homes by burning stuff

Two of the main air pollutants which significantly impact human health are:

- Airborne particulate matter (PM) e.g. soot
- Oxides of nitrogen ("NO_x")

REMEMBER DIESELGATE?

Volkswagen Group, (and others) cheated on official
vehicle emissions tests

...mainly causing increases in NOx and particulate
pollution

Worldwide govt penalties totalled €30,000,000,000 ...ref8

Diesel car sales have cratered. From 50% in 2016 to
under 4% last month (Feb 2026) ...ref9

MOST UK HOME HEATING RELEASES THE SAME POLLUTANTS

"the largest source of NO_x emissions in central London has transitioned from road transport to space heating [...] **boilers [were] responsible for 72% ±17% of NO_x emissions**" ...ref10

Brighton and Hove Council's 2025 air quality report says "Further emission reductions (diesel vehicles and gas boilers) [are] required to keep pollutant levels (NO₂) below [national] standards" ...ref11

BURN WOOD INSTEAD OF GAS?

... and "In recent years, most [particulate] emissions from domestic combustion came from households burning wood indoors, which contributed **12% of total PM2.5 emissions** [...] in 2024." ...ref12

"one Ecodesign-compliant wood burning stove releases the same amount of particulate matter per hour as 18 newer diesel cars or 6 modern HGVs." ...ref13

HEALTH EFFECTS OF POOR INDOOR AIR

All caused or exacerbated by poor ventilation:

- Asthma and respiratory infections:
 - Mould spores (damp)
 - Gas hob exhaust
 - Indoor PM_x pollution from wood stoves and fires
- Dust mite allergies (damp)
- VOC pollution (e.g. formaldehyde) from furniture and carpets etc.

**HOW MUCH DIFFERENCE CAN
YOU MAKE BY IMPROVING YOUR
HOME'S ENERGY EFFICIENCY?**

OUR ACTUAL GAS USAGE VS THE UK AVERAGES:

85% lower than the national average ...ref14

...but we heat our house 3°C warmer than average ...ref15

OUR ACTUAL GAS USAGE VS. THE EPC ESTIMATE FOR NEXT DOOR:

90% lower (heating+hot water) energy consumption

...and we've increased the floor area by 55%

AIR QUALITY AND COMFORT

More difficult to quantify, but...

I record internal humidity and temperature, and they generally stay within the recommended limits (including in the summer)

My children say that their friends' homes are cold/draughty/hot/uncomfortable

ONGOING COSTS

This wasn't cheap to do, but...

Gas bill is now £25 pcm, about the same as broadband
(nearly half of that is the standing charge)

REALLY?

A copy of the slides with reference links, and also links to some other resource can be found at:



REFERENCES

Follow [this link](#) for general resources

ref1 "Minimum indoor temperature threshold recommendations for English homes in winter - A systematic review" <https://doi.org/10.1016/j.puhe.2016.02.007>.

ref2 "The influence of acclimatization, age and gender-related differences on thermal perception in university buildings: Case studies in Scotland and England" - <https://doi.org/10.1016/j.buildenv.2020.106933>

ref4 "Battle of the thermostat: The science behind your central heating arguments" - <https://www.bbc.co.uk/future/article/20250228-battle-of-the-thermostat-the-science-behind-your-central-heating-arguments>

ref5 "Impact of the energy crisis on indoor temperatures and thermal comfort in UK houses during winter 2023" - <https://doi.org/10.1016/j.enbuild.2024.114750>

ref6 "Energy Follow Up Survey: thermal comfort, damp and ventilation" - 2021 UK Govt
Department of Business, Energy and Industrial Strategy -

<https://assets.publishing.service.gov.uk/media/61449c52d3bf7f05b4562b66/efus-thermal.pdf>

ref7 "Decarbonising home heating" for Department for Energy Security & Net Zero carried out
the National Audit Office" - [https://www.nao.org.uk/wp-
content/uploads/2024/03/Decarbonising-home-heating-HC-581.pdf](https://www.nao.org.uk/wp-content/uploads/2024/03/Decarbonising-home-heating-HC-581.pdf)

ref8 Reuters [https://www.reuters.com/article/us-volkswagen-emissions/u-s-court-refuses-to-
shield-volkswagen-in-diesel-scandal-lawsuits-idUSKBN2383GV/](https://www.reuters.com/article/us-volkswagen-emissions/u-s-court-refuses-to-shield-volkswagen-in-diesel-scandal-lawsuits-idUSKBN2383GV/)

ref9 Society of Motor Manufacturers and Traders - [https://www.smmt.co.uk/vehicle-data/car-
registrations/](https://www.smmt.co.uk/vehicle-data/car-registrations/)

ref10 "Evidence of heating-dominated urban NOx emissions" UK Centre for Ecology & Hydrology
(UKCEH) - <https://doi.org/10.1021/acs.est.4c13276>

ref11 "2025 Air Quality Annual Status Report" Brighton and Hove City Council -
[https://www.brighton-hove.gov.uk/sites/default/files/2025-](https://www.brighton-hove.gov.uk/sites/default/files/2025-07/Annual%20Status%20Report%20Air%20Quality%20Brighton%20%20Hove%202025%20V2.pdf)

[07/Annual%20Status%20Report%20Air%20Quality%20Brighton%20%20Hove%202025%20V2.pdf](https://www.brighton-hove.gov.uk/sites/default/files/2025-07/Annual%20Status%20Report%20Air%20Quality%20Brighton%20%20Hove%202025%20V2.pdf)

ref12 "Emissions of air pollutants in the UK – Particulate matter" DEFRA Feb 2026 - <https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-particulate-matter-pm10-and-pm25>

ref13 "Wood burning stoves: pollution and health impacts" <https://www.which.co.uk/reviews/gas-and-electric-fires-and-stoves/article/stoves-and-pollution-a1PXC8g7lbu5>

ref14 "Average gas and electricity usage" OFGEM - <https://www.ofgem.gov.uk/average-gas-and-electricity-use-explained>

ref15 "Investigating Changes in Natural Gas Demand across Great Britain for Domestic Heating Using Daily Data" <https://pure-oai.bham.ac.uk/ws/portalfiles/portal/240029402/energies-17-04884.pdf>

ref16 Tado press release - <https://www.tado.com/en-gb/press/the-cost-of-comfort-how-indoor-temperatures-shape-heating-bills-across-europe>