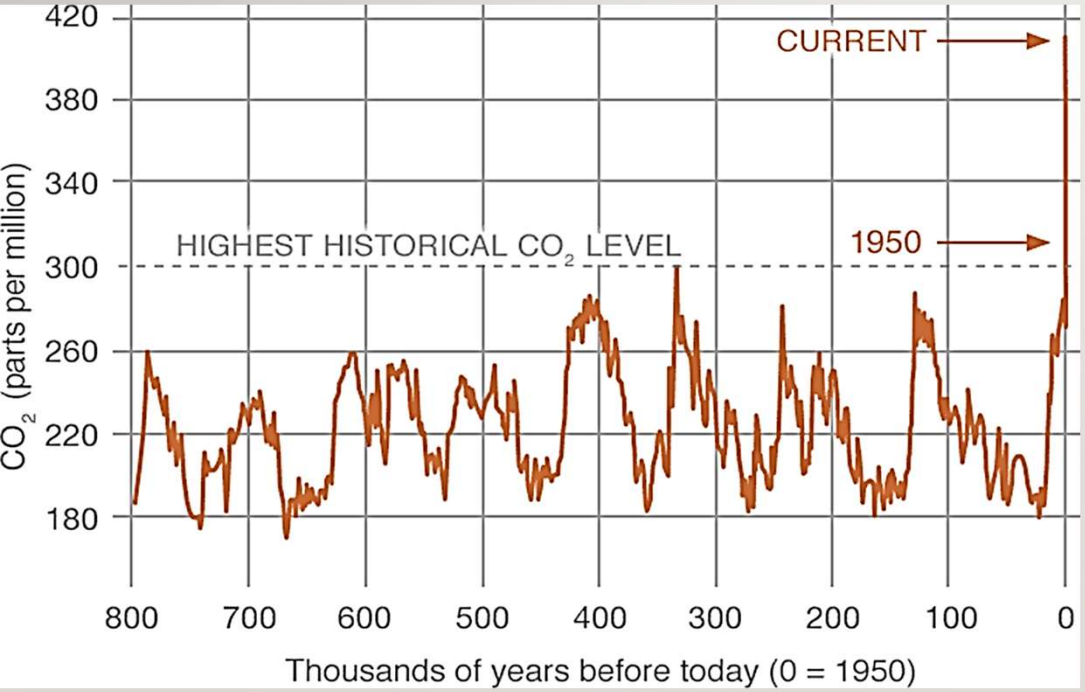
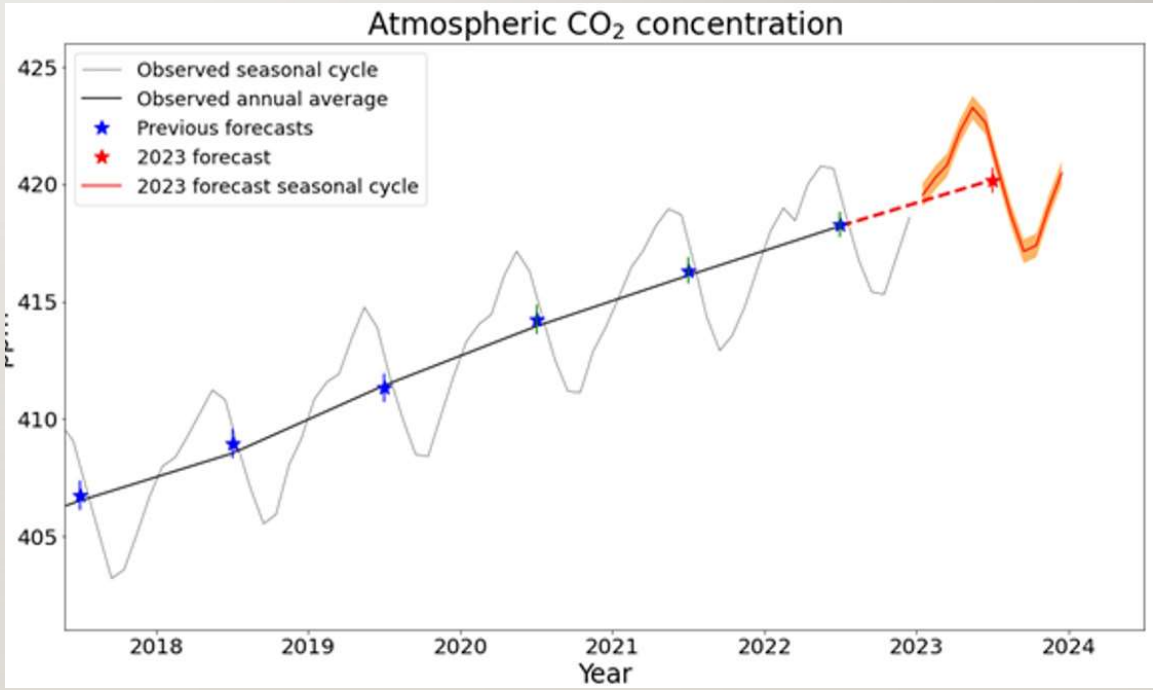
An affordable net zero house retrofit.

Phil Hemsley

CEng FIMechE

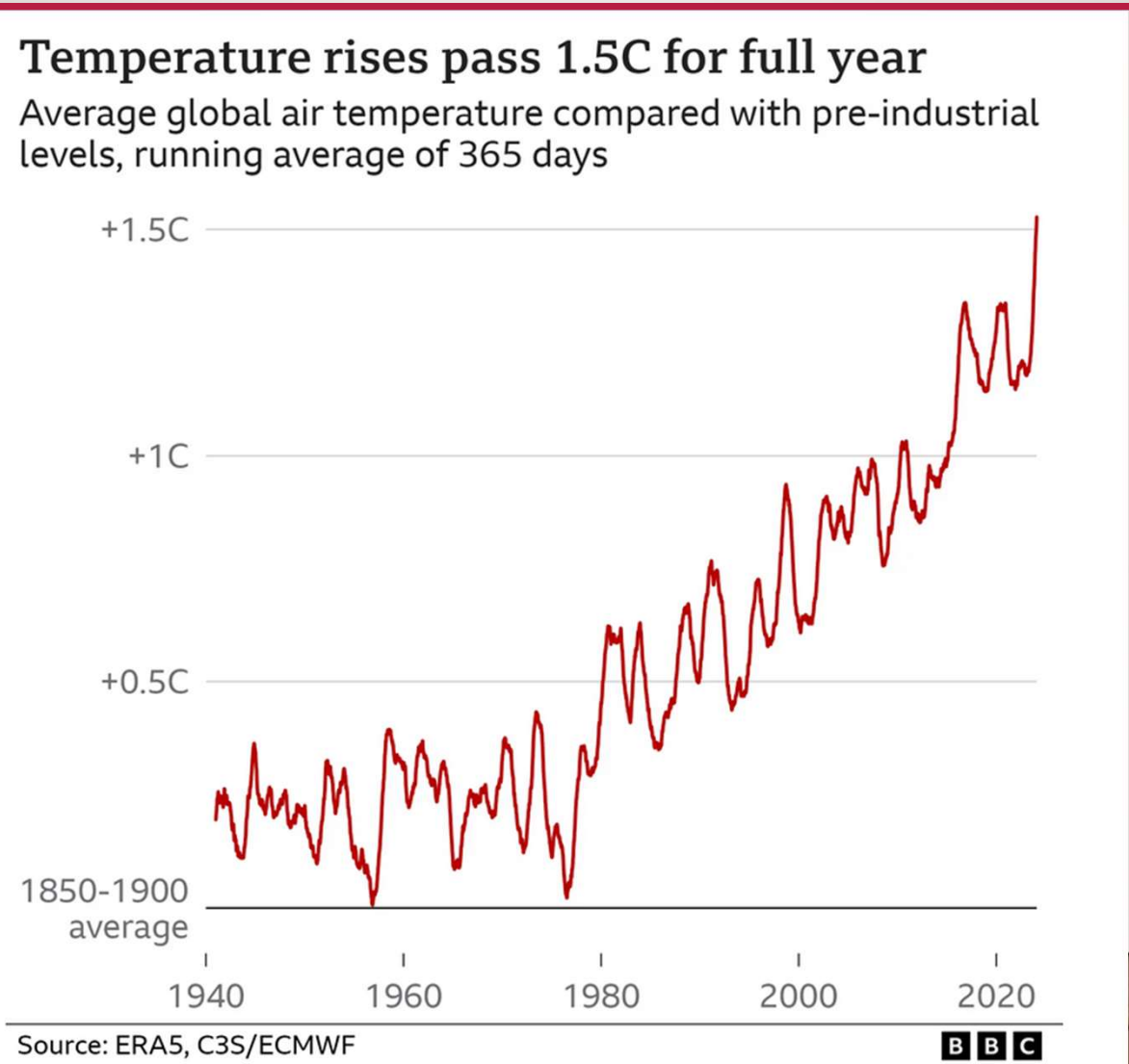
CO_2 concentration is at unseen levels and rising



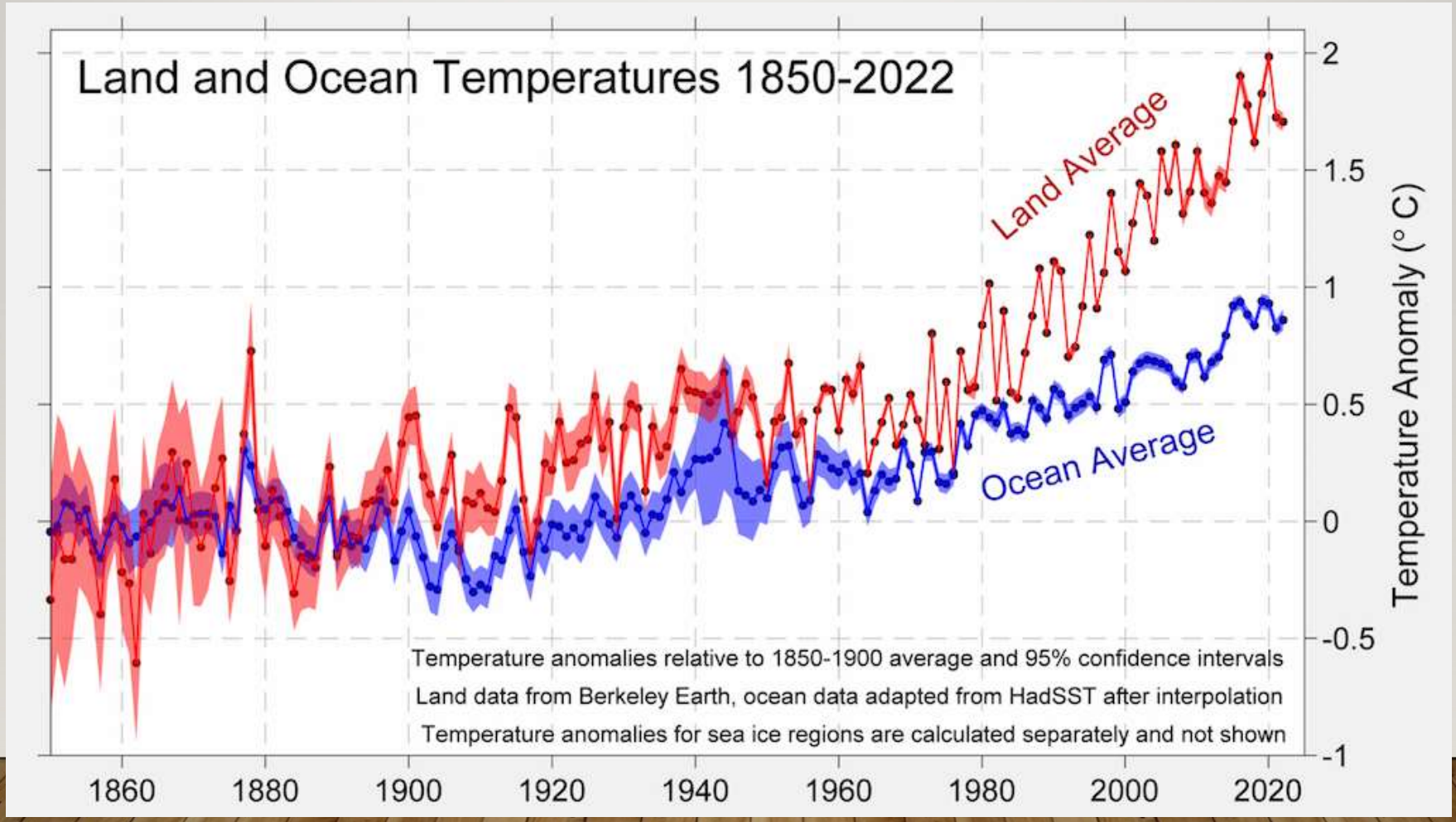


https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/global-carbon-dioxide-forecast-2023

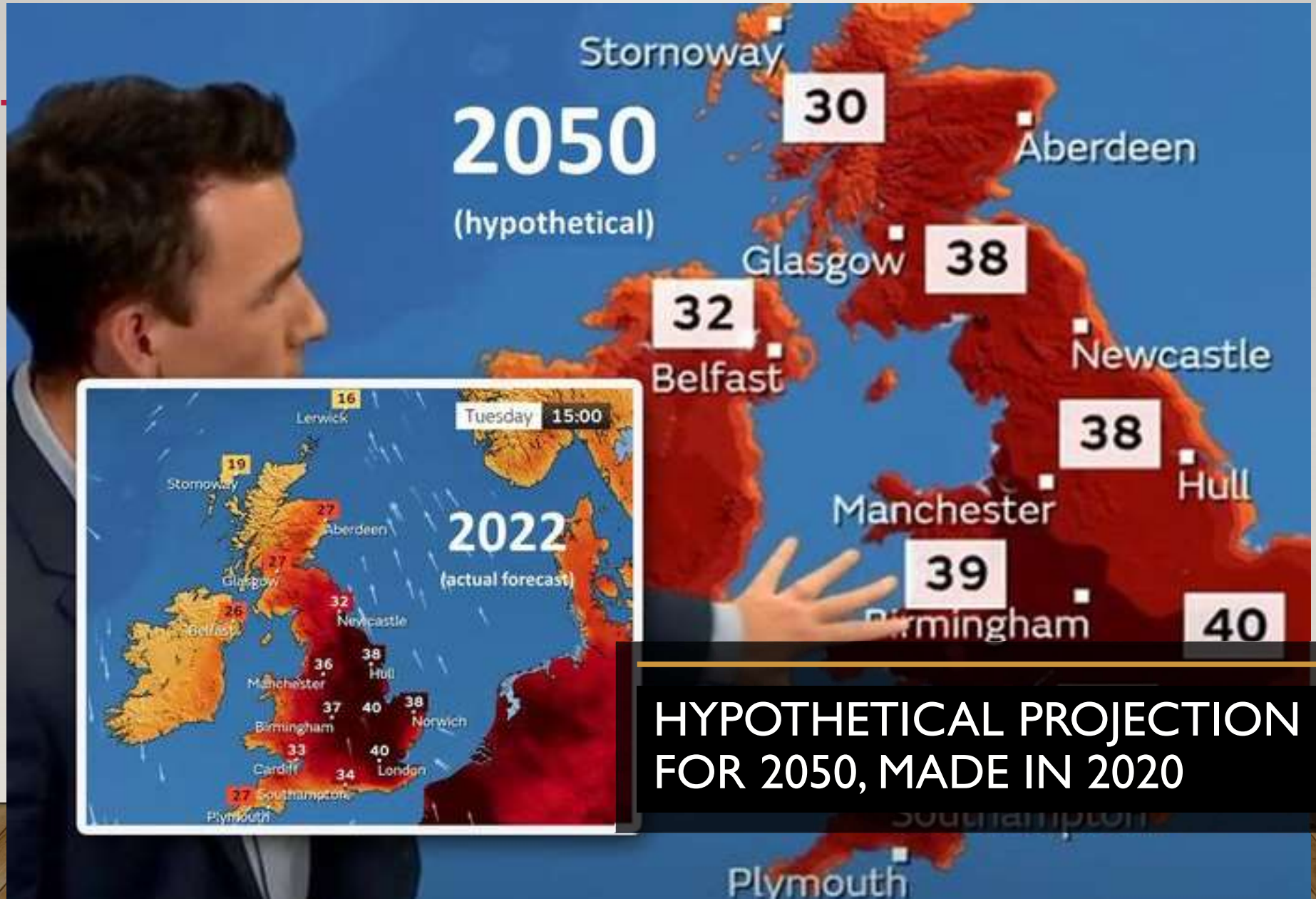
Global warming exceeds 1.5 degrees



Global temperature increase is higher on land



https://www.carbonbrief.org/state-of-the-climate-how-the-world-warmed-in-2022/



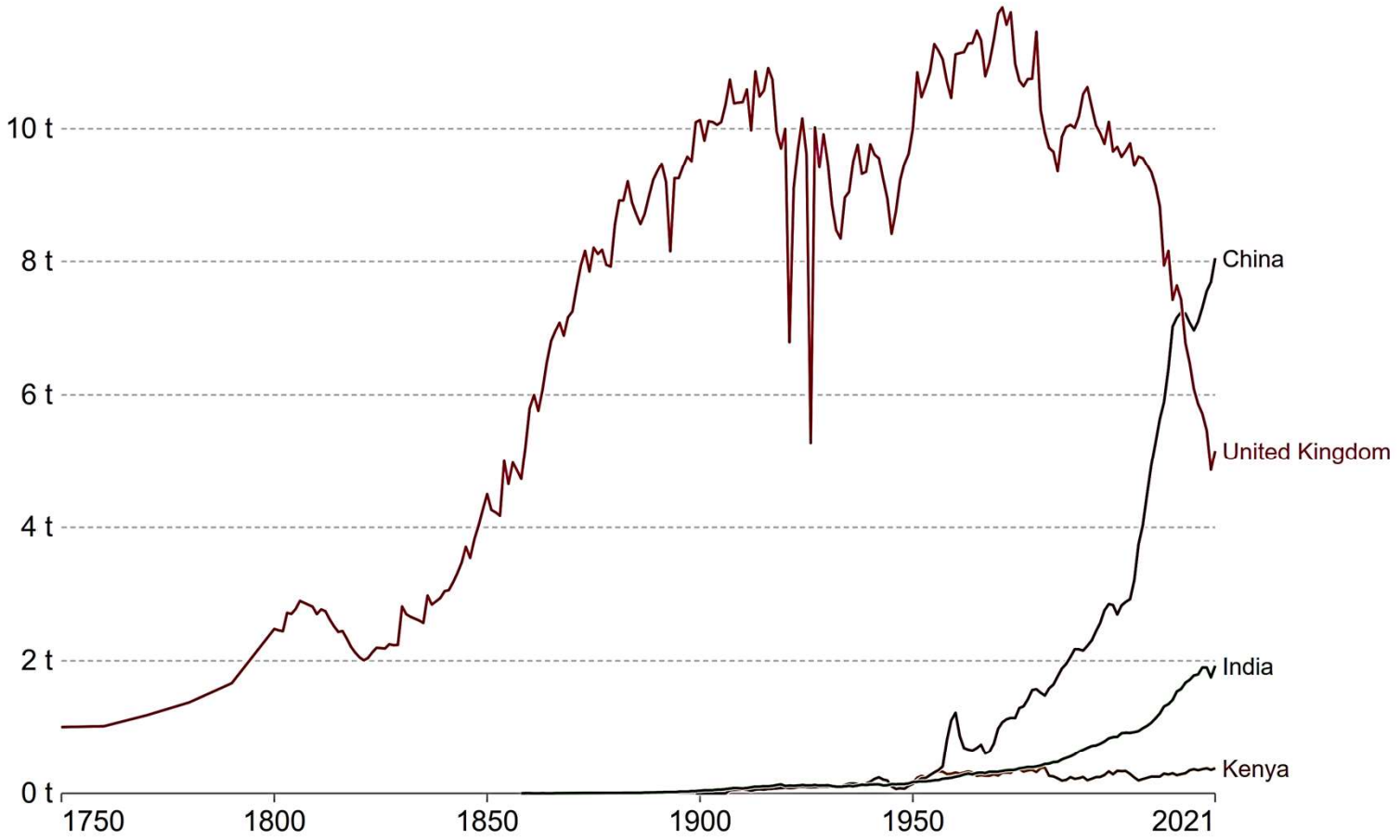
HYPOTHETICAL PROJECTION FOR 2050, MADE IN 2020

UK lifestyle has been unsustainable since the industrial revolution

Per capita CO_2 emissions

Carbon dioxide (CO_2) emissions from fossil fuels and industry[1]. Land use change is not included.

Our World in Data

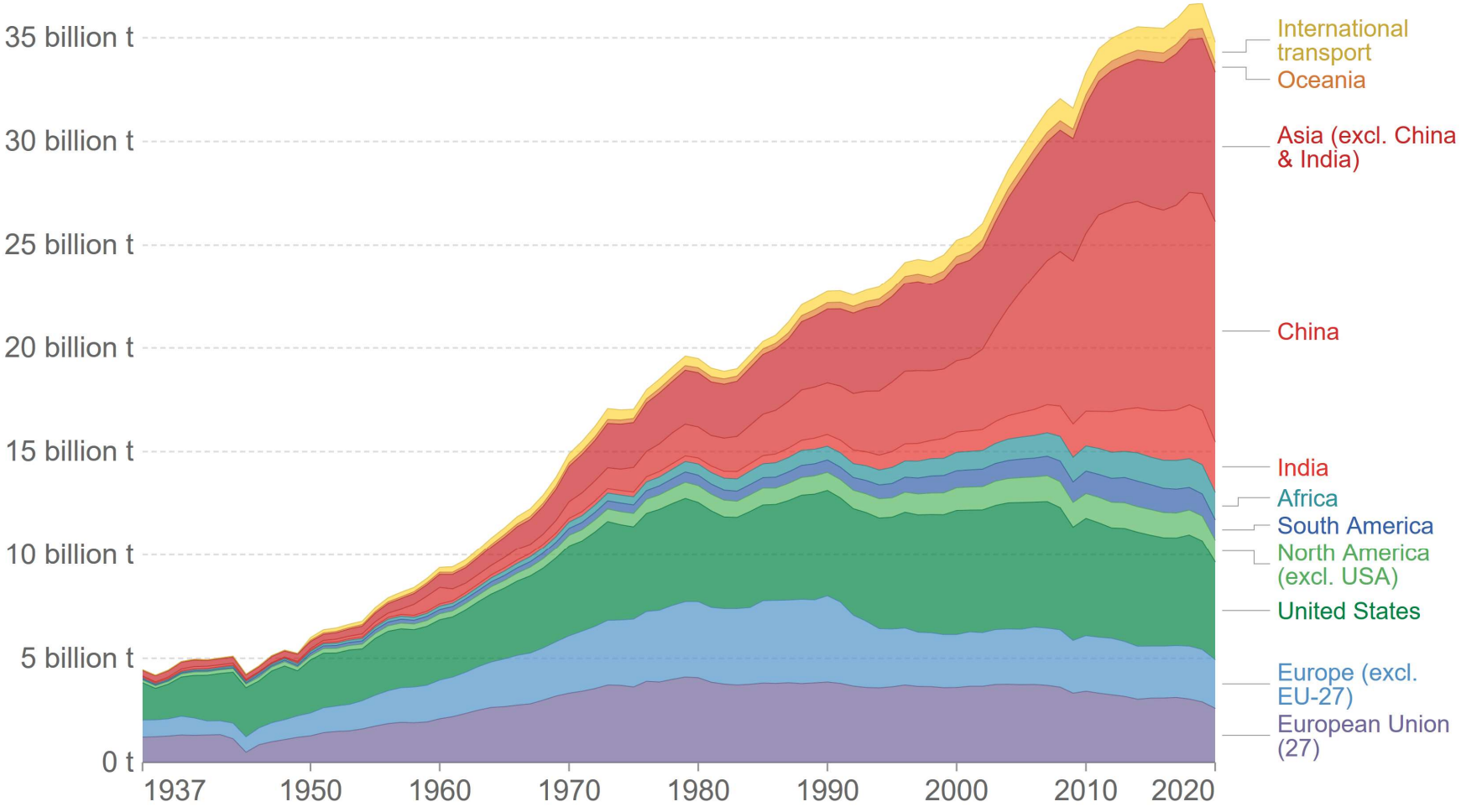


Source: Our World in Data based on the Global Carbon Project (2022)

OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Annual CO_2 emissions from fossil fuels, by world region



Source: Global Carbon Project

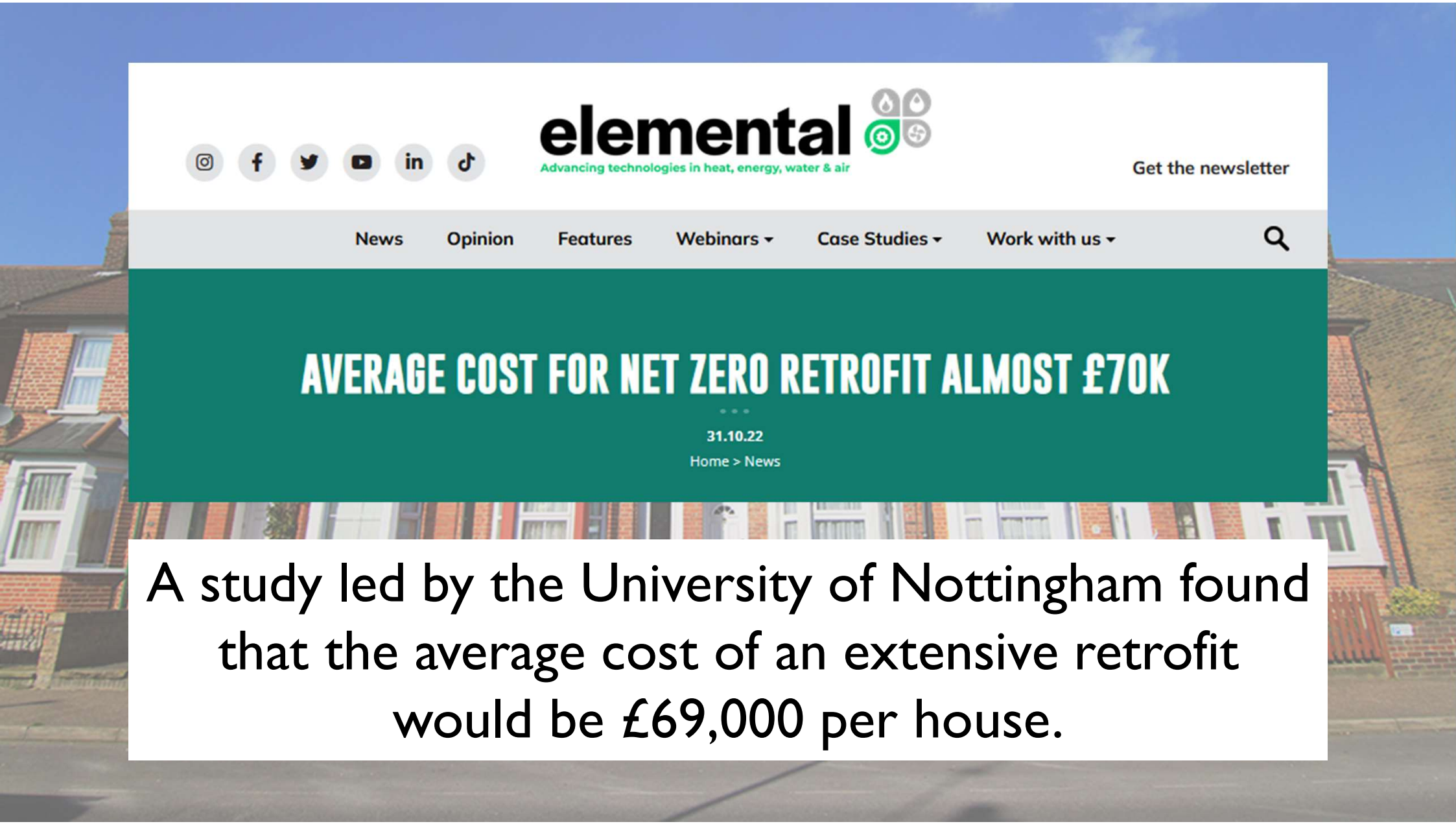
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

Note: This measures CO_2 emissions from fossil fuels and cement production only – land use change is not included. 'Statistical differences' (included in the GCP dataset) are not included here.

How do we respond?

- Do we try to prevent the rest of the world sharing our standard of living?
- Are we willing change our behaviour and expectations?
- Do we abdicate responsibility to government?
- Do we give up in despair?
- Do we 'do our bit'?

WHAT CAN **WE** DO TODAY?



A study led by the University of Nottingham found that the average cost of an extensive retrofit would be £69,000 per house.

Doing the sums

27 million homes in UK @ £70,000 each

= £2 trillion (£2,000,000 million)

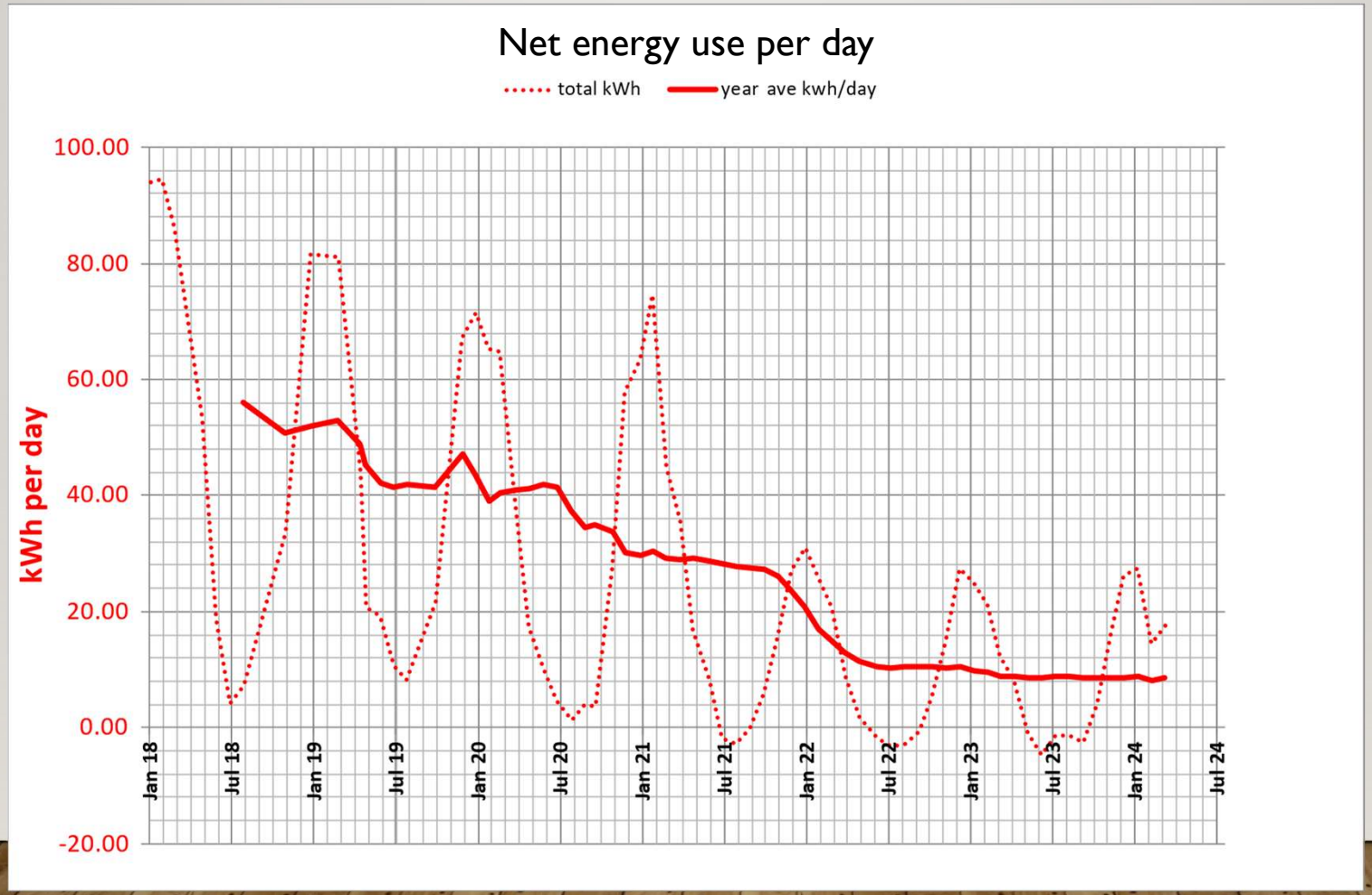
~10 years funding for NHS

2/3 of UK GDP

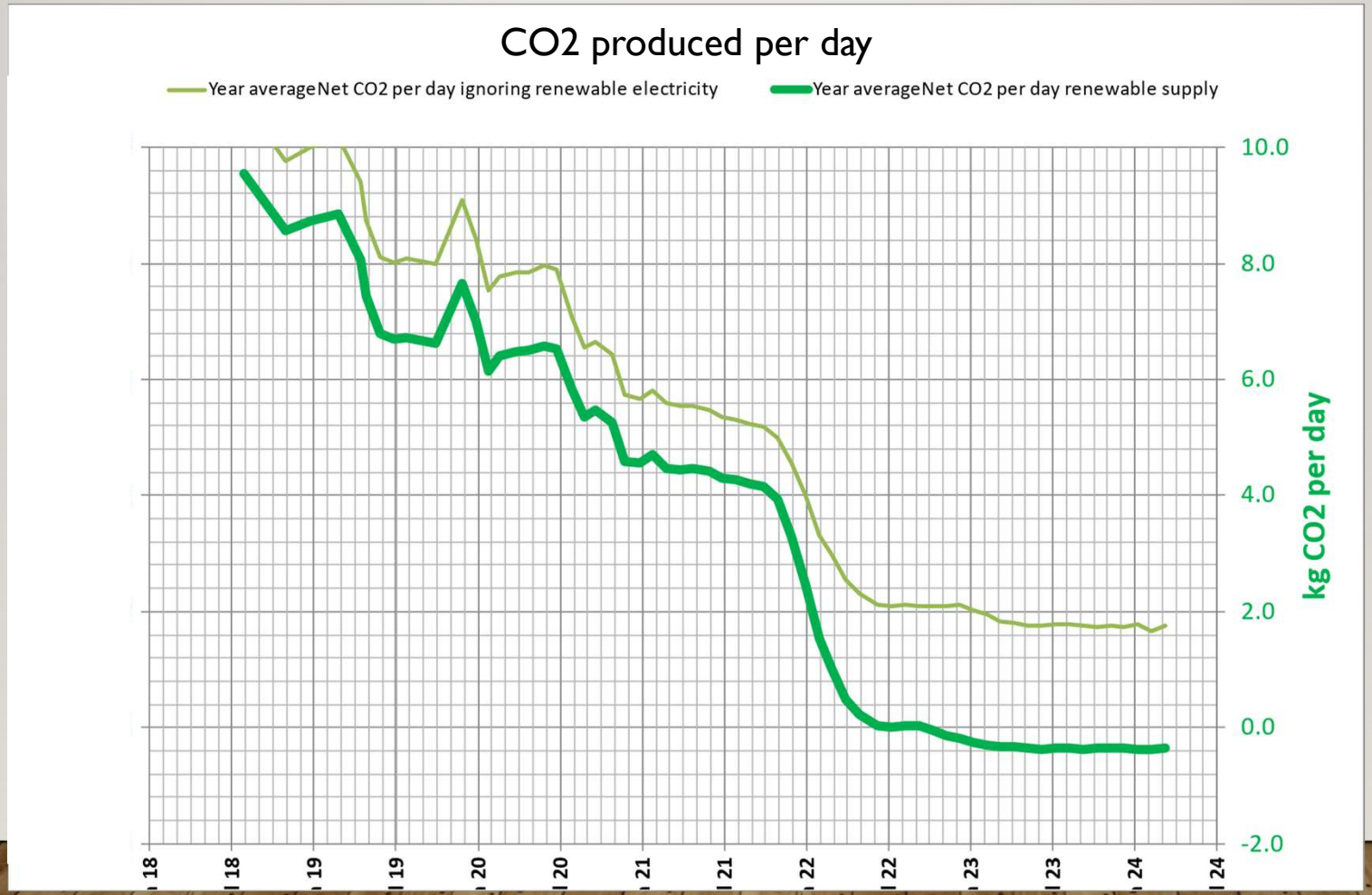
Is there a better way?

My experience: 1930s ‘retrofit’ – cost ~£10k

Progress so far…



Progress so far… better than “net zero”



LED lights

LEDs use

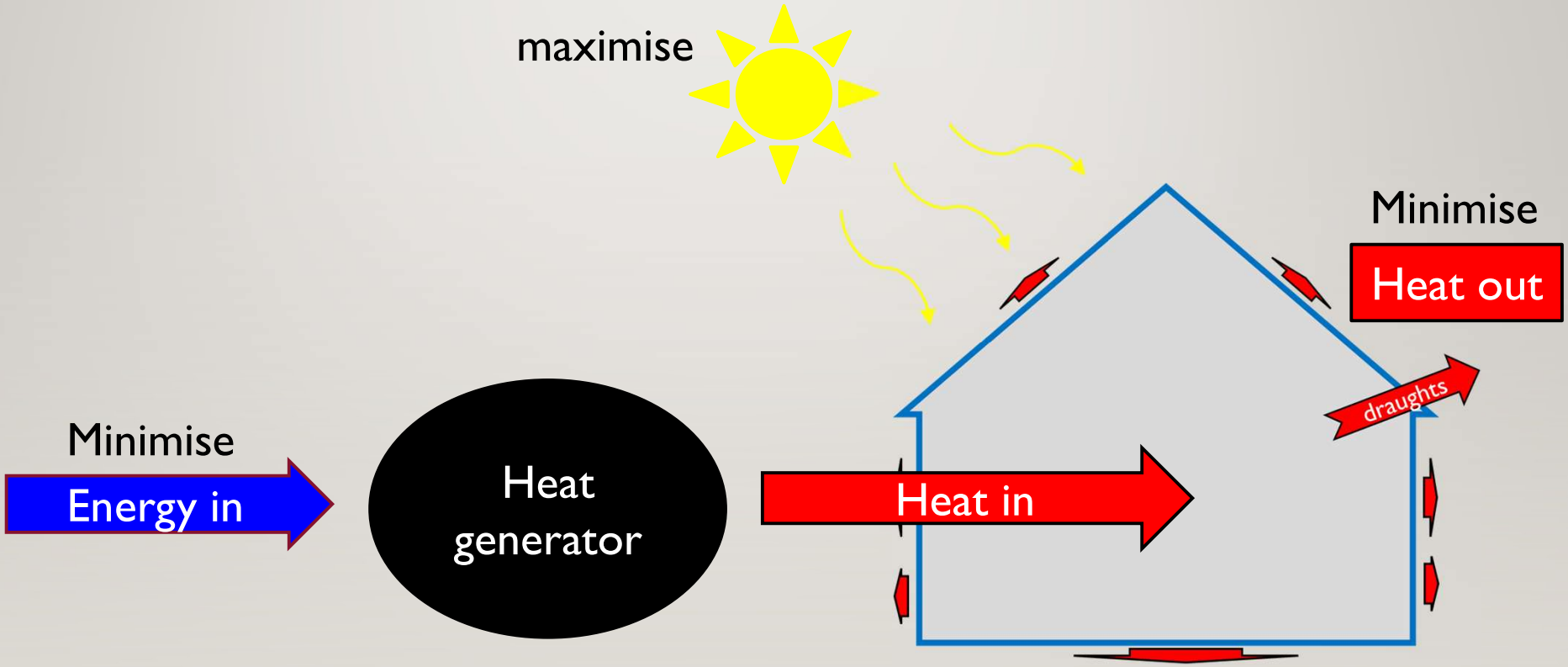
- half the energy of fluorescent lights
- 90% energy saving compared to incandescent lights

Solar energy

9 Solar panels

Conservatory

Biggest energy consumer: heating



‘Consumer’ scams

I Recently Discovered How To Heat Any Space In My House In Under 5-Minutes, WITHOUT Using My Home's Costly Heating System

Andrea Stewart | **Smarter Choice** | Oct 15, 2022

★★★★★

Did you know there’s a new portable heater the size of a car battery that can warn up any room in under 5-minutes?

WARMOOL

SAVE 30% ON YOUR ENERGY BILLS & HEAT YOUR ROOM FAST WITH THE MOST EFFICIENT HEATER ON THE MARKET

★★★★★

Rated **4.8/5** By **8K+ Customers**

- Slash your electric bills as much as 30% with ultra-energy efficient technology
- Advanced safety features for worry-free, continuous heating – great for families
- Sleek, attractive design for your home
- No waiting – Heat any room to a cosy temp in less than 2 minutes
- Noise Free Operation – so quite you won’t even notice it’s on

ORDER NOW & SAVE 50%! 👉

‘Professional’ scams

HEATING AND HOT WATER PRODUCT INFORMATION
MODEL 3 HYDRO-ZERO
HYDRO ZERO HEAT ENGINE

HYDRO ZERO
UNLOCK THE POWER OF HYDROGEN

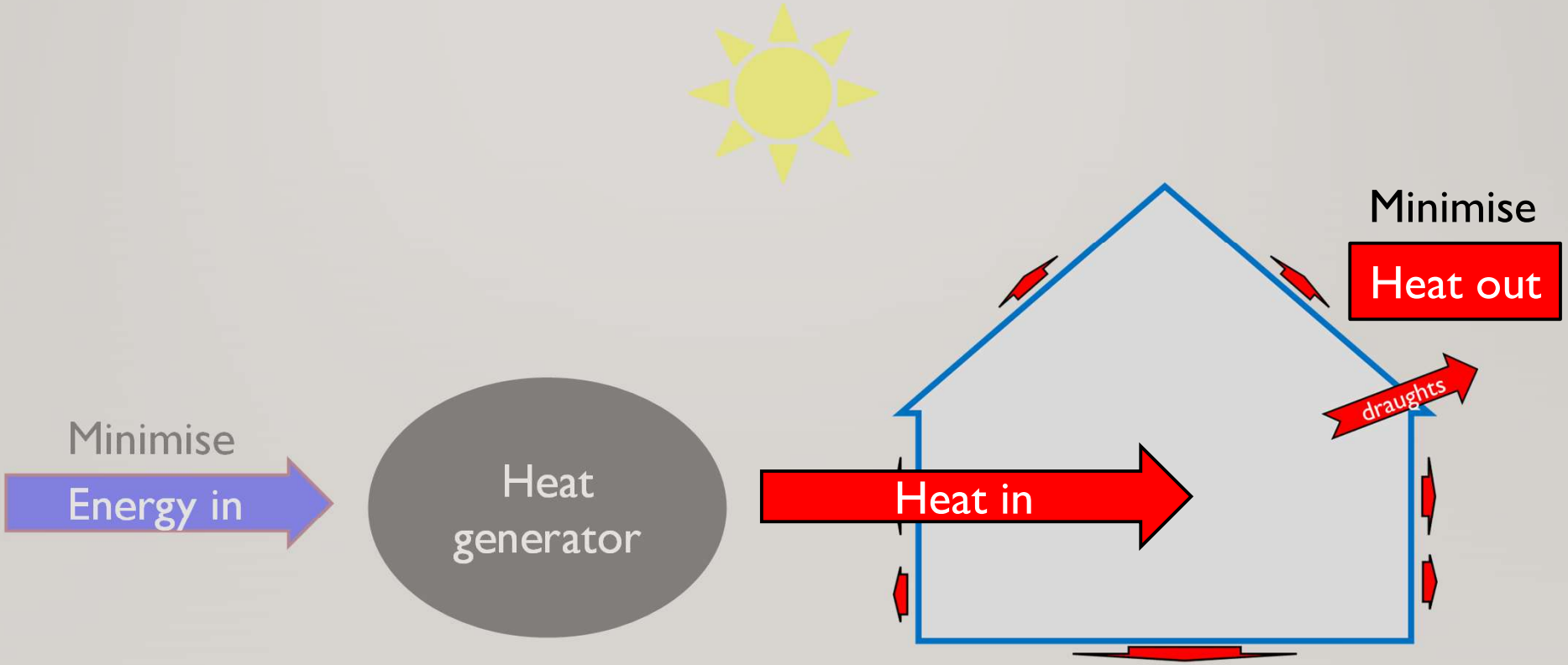
The Model 3 Hydro-Zero is the UKs first self-generating hydrogen powered heat generation unit. It retains the same features as traditional combination boilers, without the need for any non-renewable carbon fuels or the need for an external flue. This Heat Generation Unit paves the way for zero-carbon and emission home heating products with high COP values and the added benefit of AAA+ ErP rating.

KEY FEATURES

- Zero carbon emissions
- High COP Values - Up to 3 COP
- Compatible with existing radiators and underfloor heating systems
- Fast installation time
- Extremely quiet- Less than 10dB
- No need to install on an external wall with no flue.

Designed to meet the zero-carbon targets of the future whilst delivering the heating and hot water demands of today.

Reduce the leakage

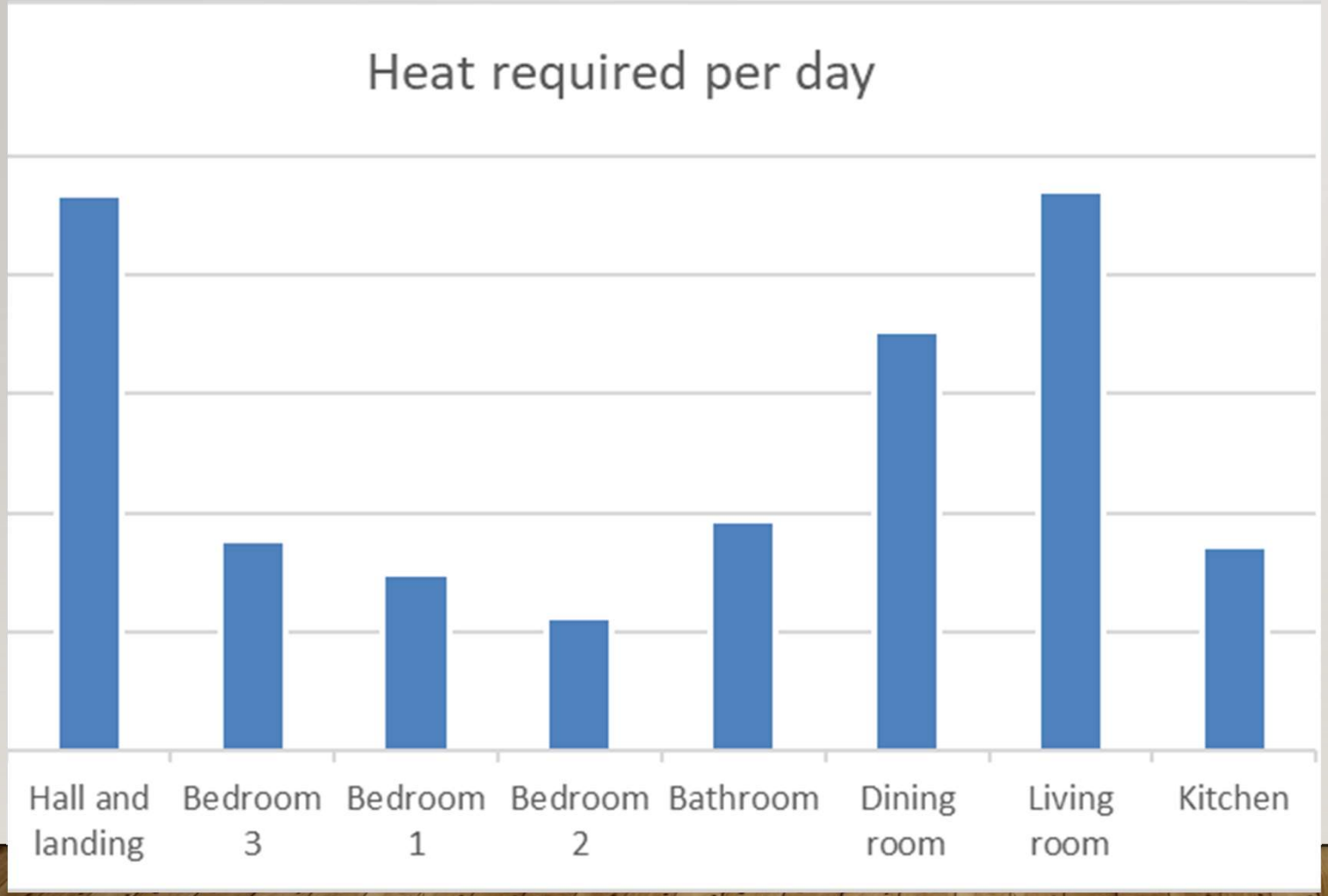


Reduce the leakage

When we moved in:

- ✓Loft insulation
- ✓Double glazing

Where does the heat leak out?



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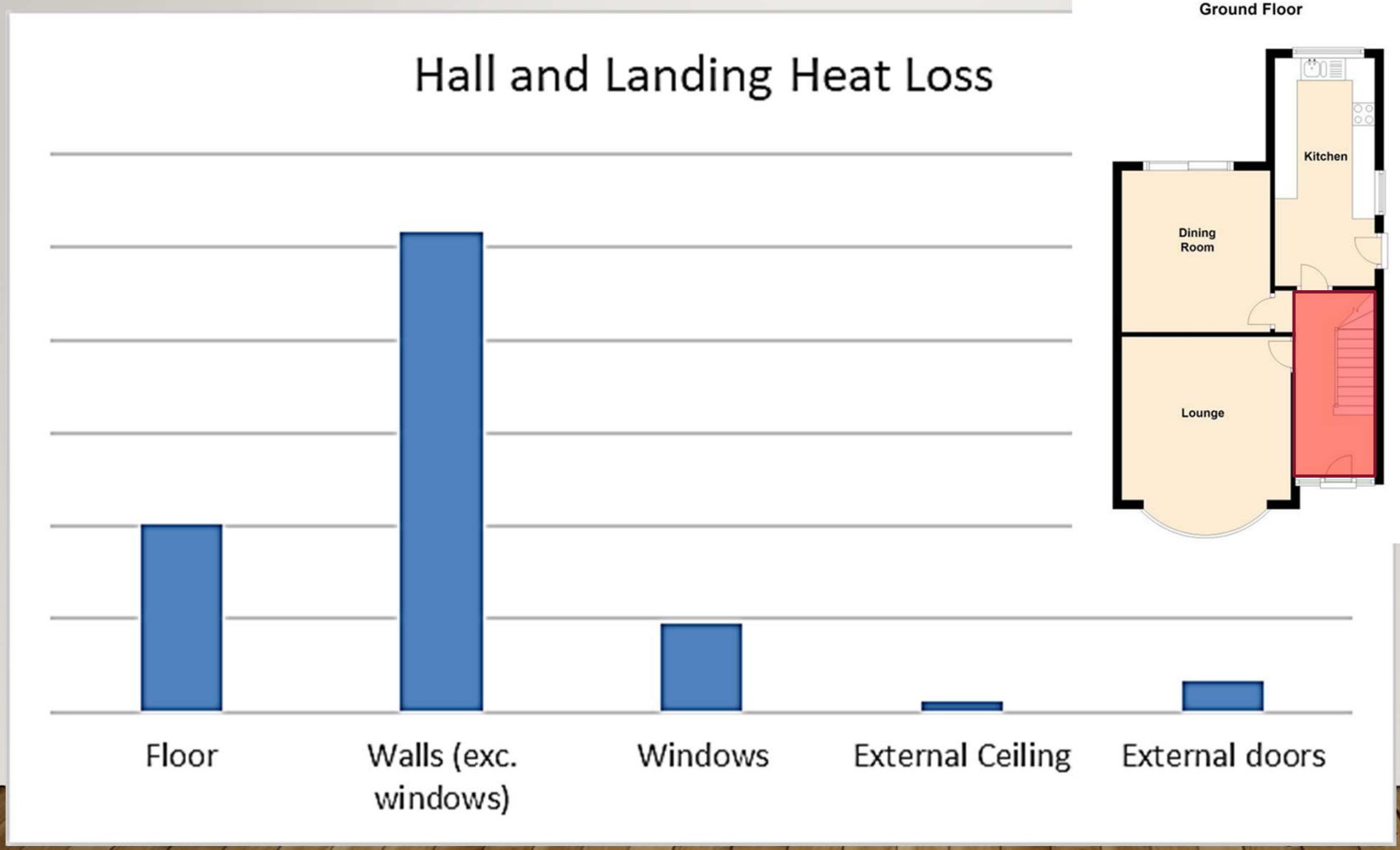
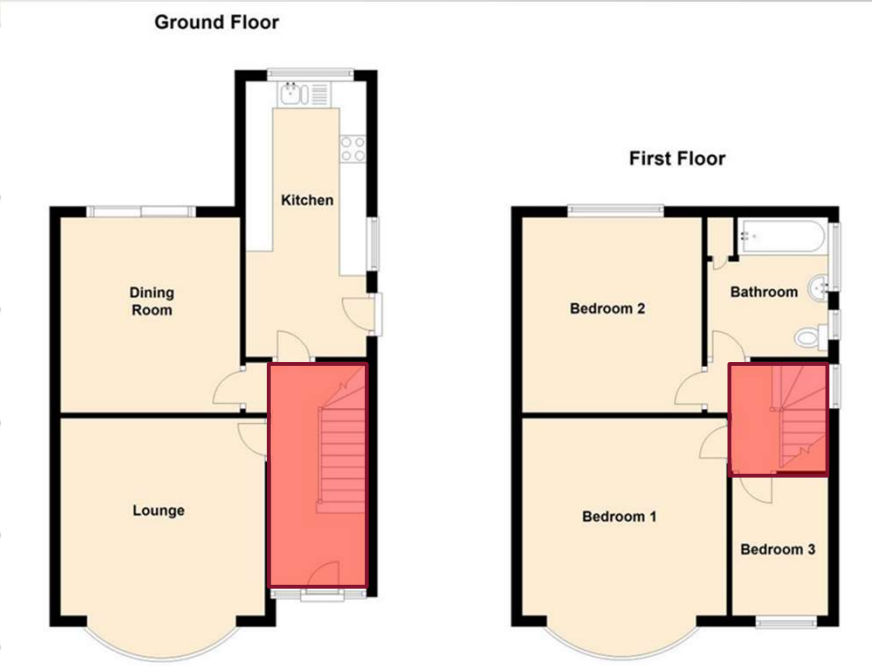




Wall insulation costs

Checkatrade Homeowner | Trades

How much does external wall insulation cost?

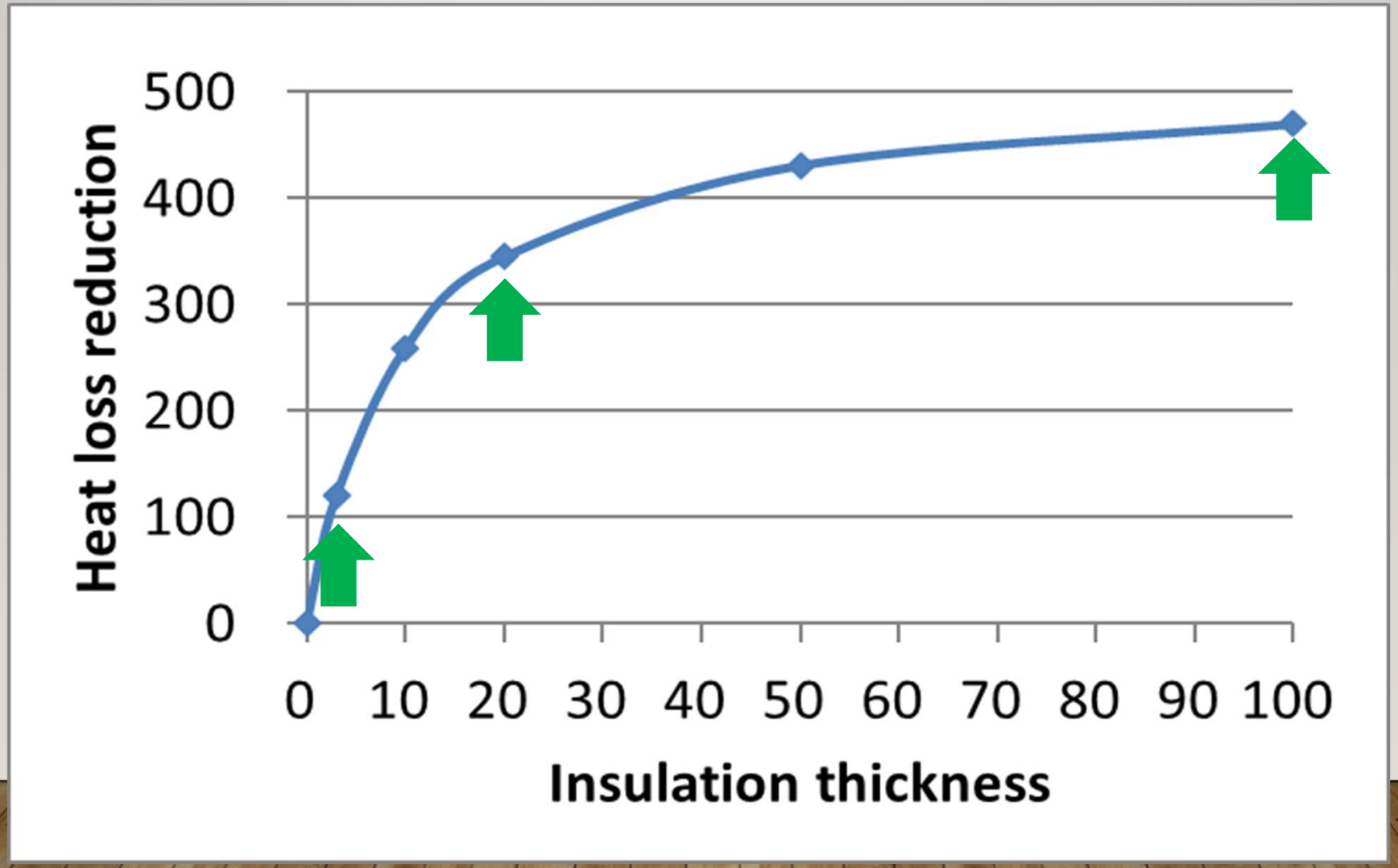
The cost of external wall insulation depends on a number of factors, including:

Cost provided item	Cost+VAT (Lower range)	Cost+VAT (Higher range)	Average cost
Detached	£15,000	£20,000	£17,500
Semi-detached	£8,000	£10,000	£9,000
Mid-terrace	£6,000	£8,000	£7,000

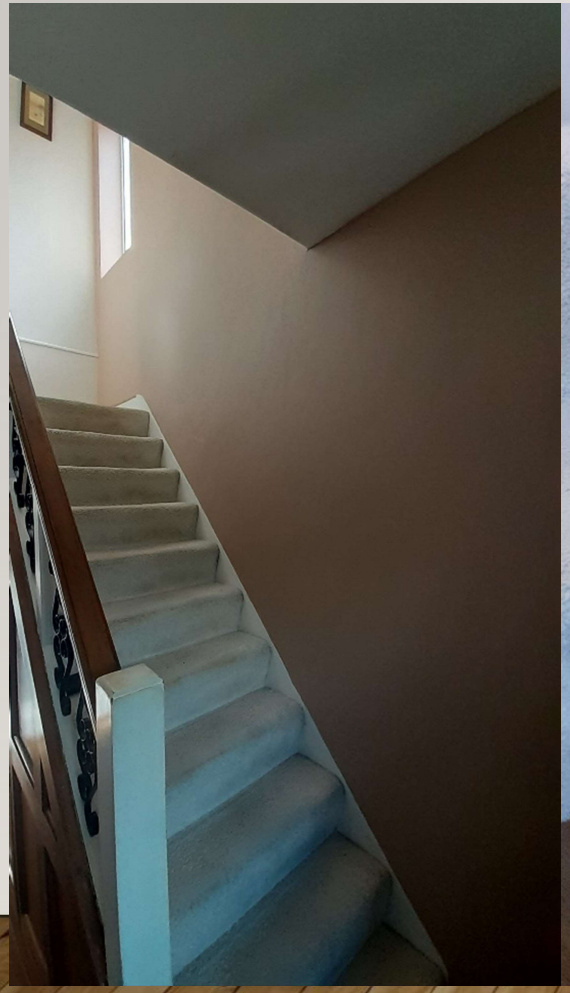
Our costs are ballpark averages – get a local tradesperson to quote now

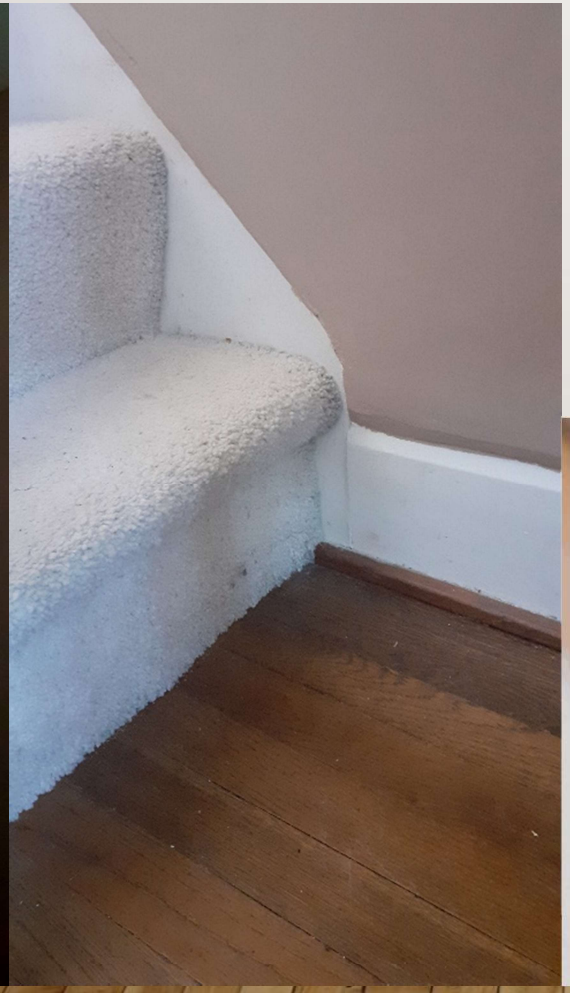
Cavity walls are common in houses that were built post-1920. These are generally quick and easy to insulate, with the typical semi-detached house costing around **£475** to insulate.

Reduce the leakage - the benefit of insulation



Simple internal wall insulation - 20mm tile backer board:

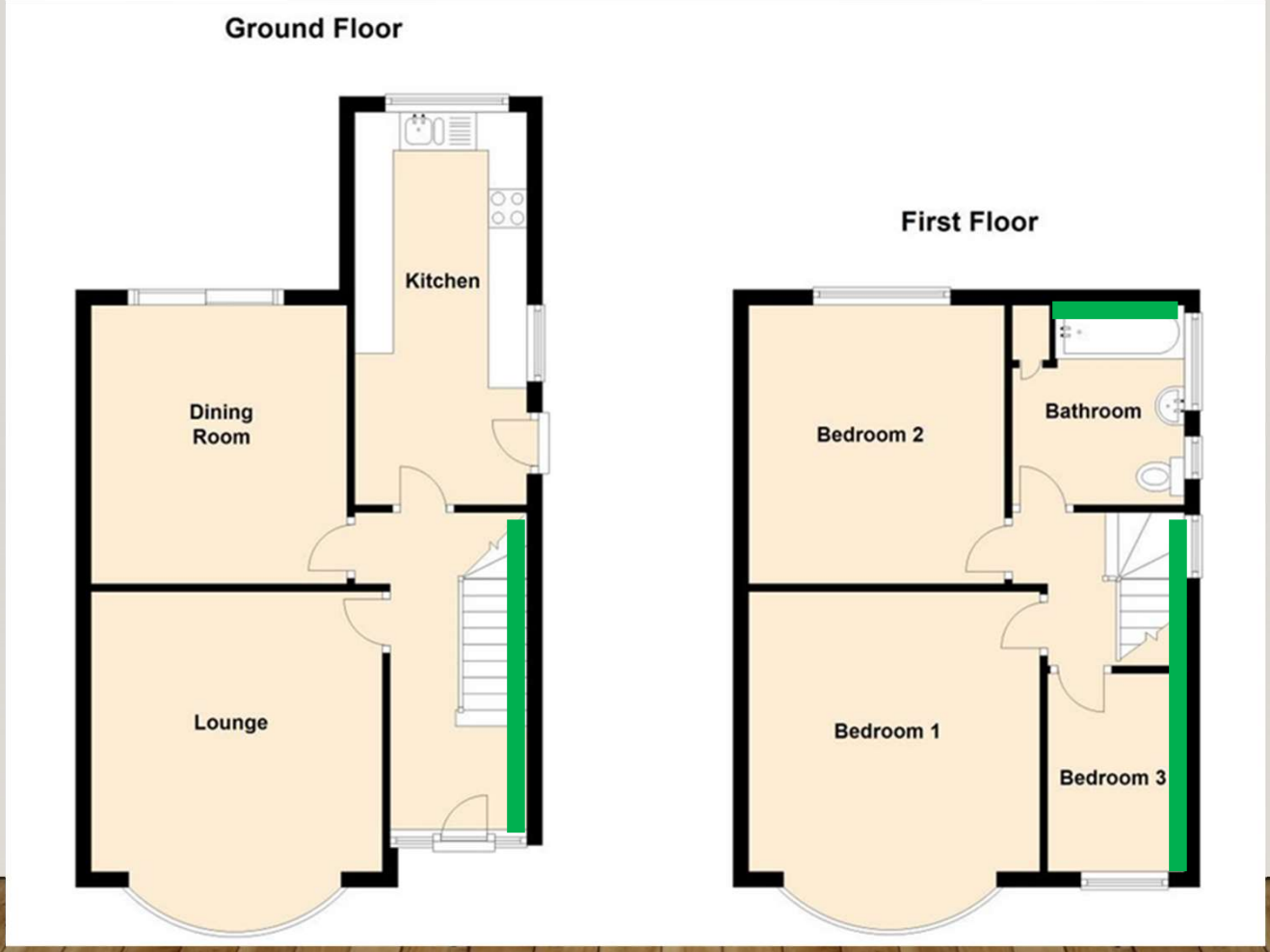




10 panels at ~£20 each, £400 for plasterer

Cost ~£600 installed
Saving ~0.5kW

Hall/landing, part of bathroom and small bedroom



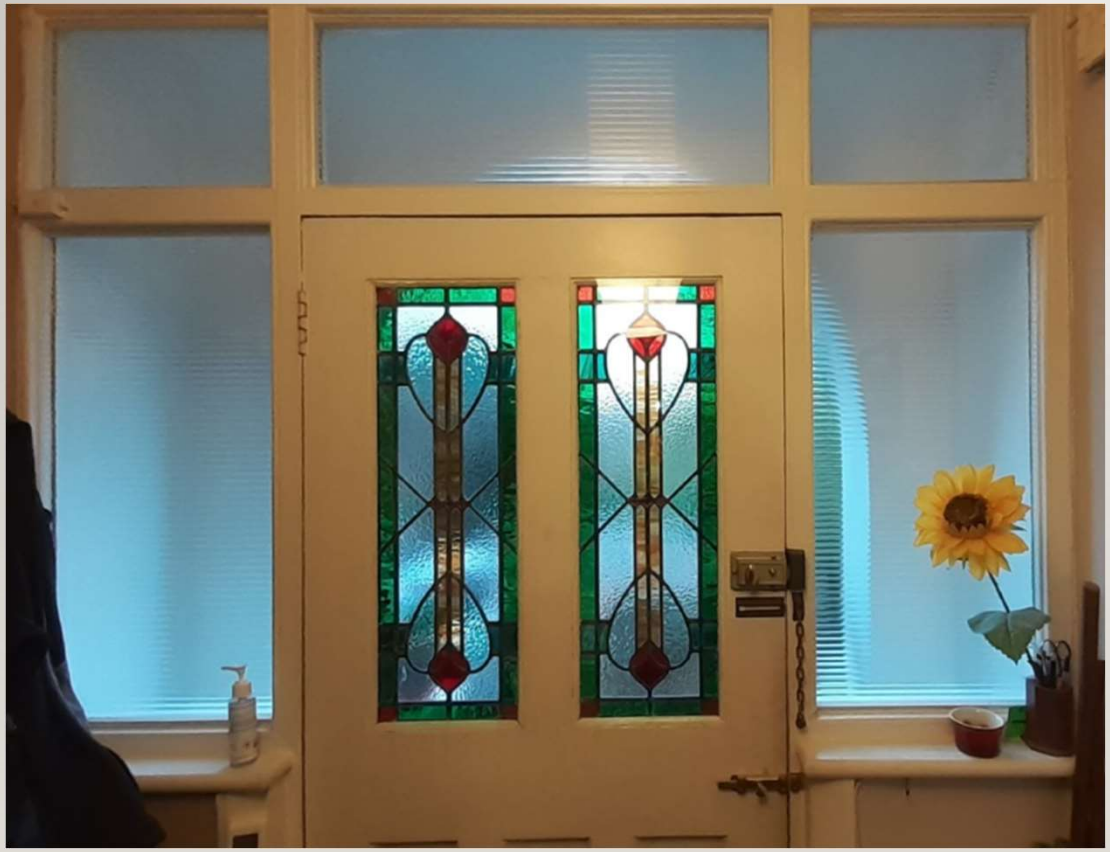
Under floor insulation

Dining room: 12m^2
Cost ~£200 for insulation (100mm)
No labour cost (DIY)
Saving ~0.5kW

Under floor insulation

Living room: 15m^2
Cost ~£150 for insulation and membrane
No labour cost (DIY)
Saving ~0.6kW

Low cost secondary glazing

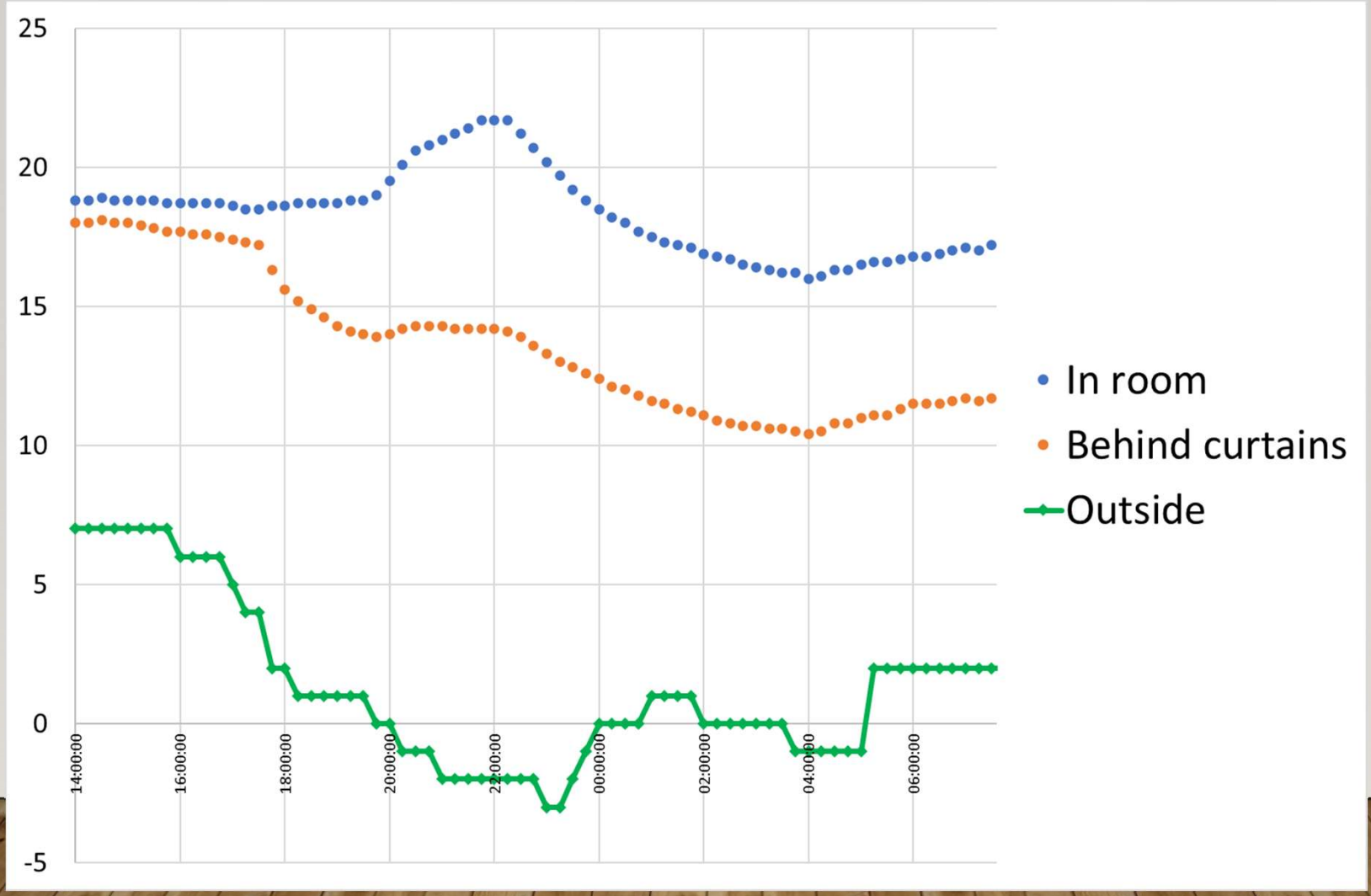


Window glass:
Wooden spacer and glass held in place with silicone sealant

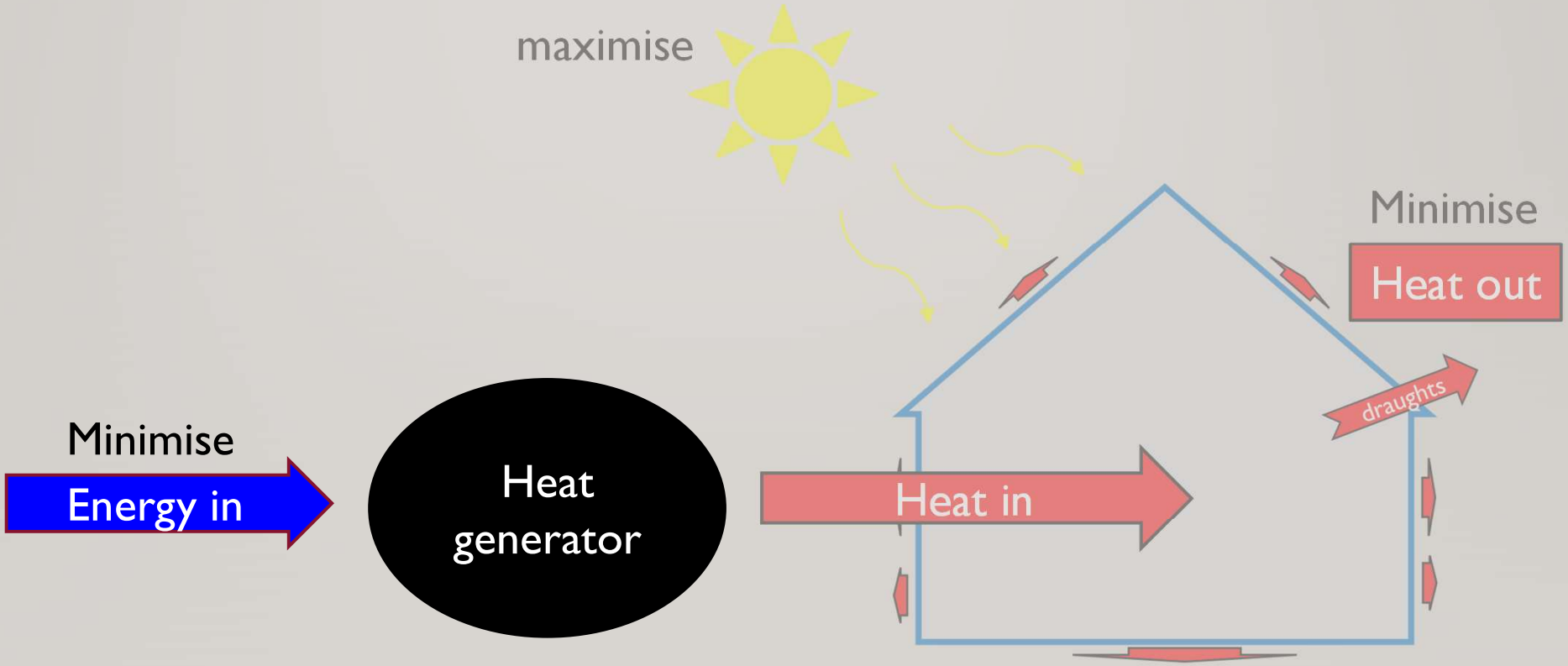
Door ‘glass’:
Wooden spacer and perspex held in place with silicone sealant

Single brick bay window

Thick curtains inside double glazed windows:

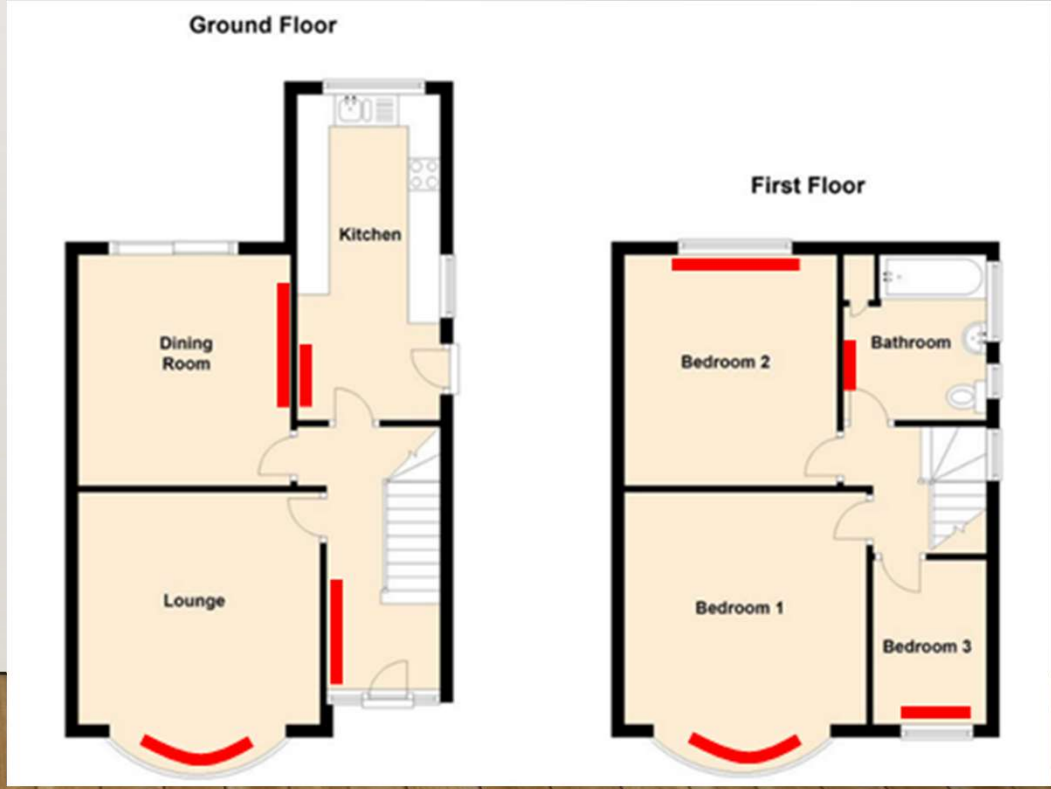


Minimise the energy in per unit of heat in?



Traditional UK solution – gas boiler and water filled radiators

- ☹ Condensing gas combi boiler + radiators
  - ☹ Non-renewable energy source
  - ☹ At best ~95% efficiency
  - ☹ Heat up radiators before heat up rooms – slow and inefficient
  - ☹ Heat lost to walls



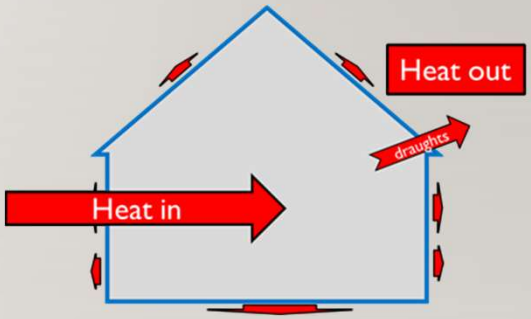
Direct heating analogy (e.g. gas boiler)

1kW energy gives 0.9kW heat

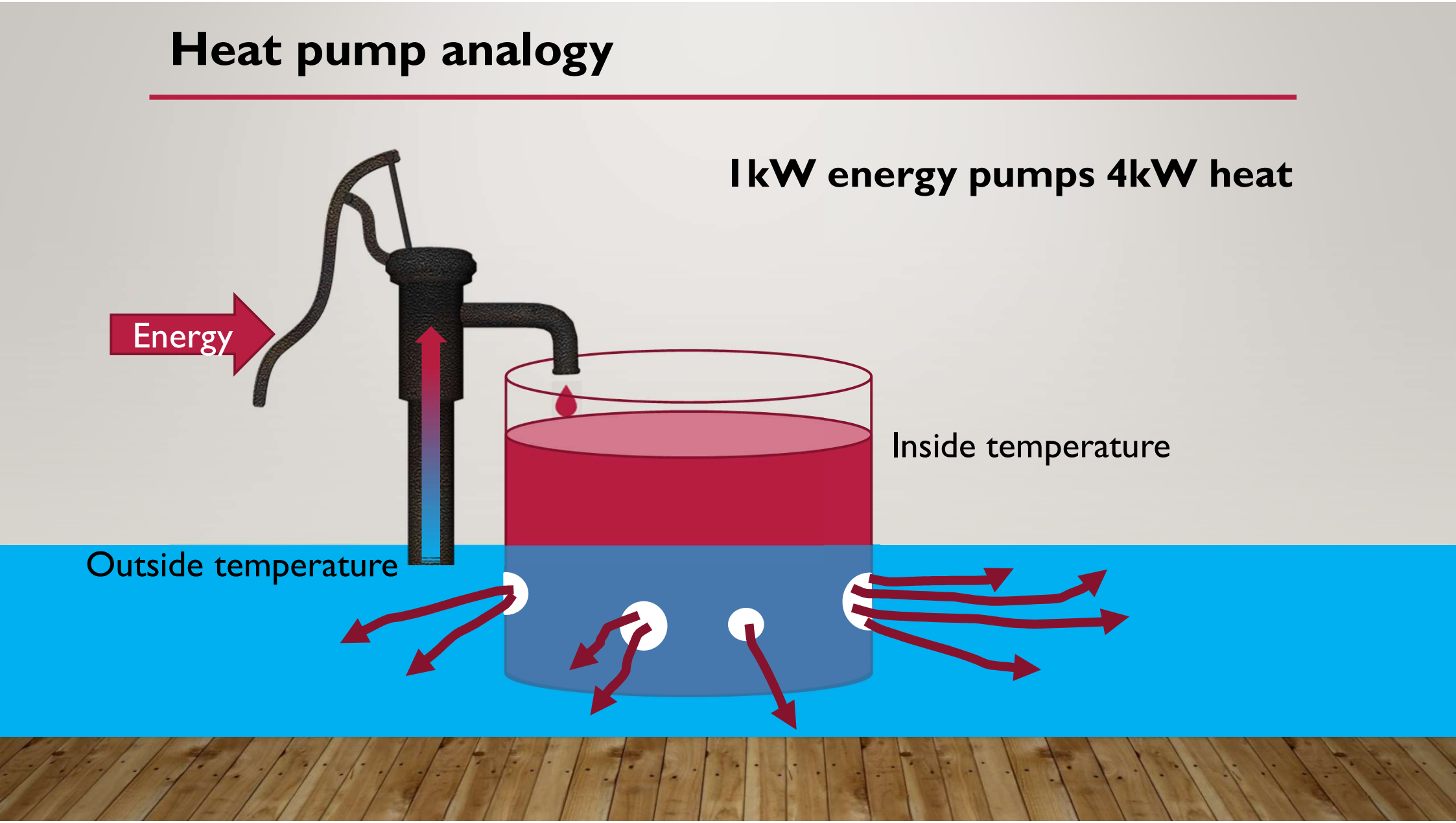
Boiler converts chemical energy to heat

Inside temperature

Outside temperature



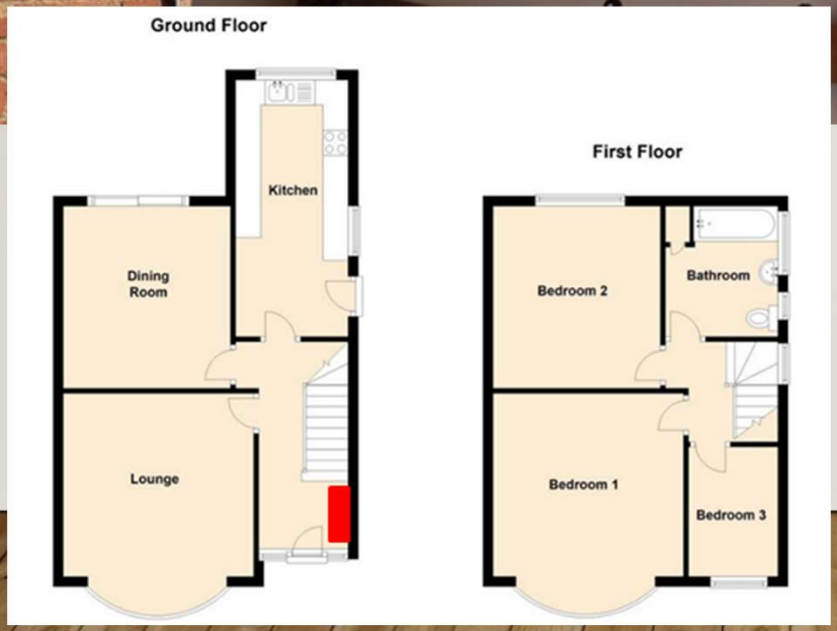
Heat pump analogy



Air to water heat pumps: Cost £12–18k

- ☺ Renewable energy source – electricity
- ☺ Heats domestic water
- 😐 Typically, 350% 'efficiency'
- ☹ Fully replace existing system
- ☹ Disruptive installation
- ☹ Probably need to replace radiators and pipework
- ☹ Large installation space needed
- ☹ Expensive – even with government grant
- ☹ Slow heat up – must run continuously
- ☹ Integrated electrical resistance heater – risk of high running cost
- ☹ Radiated heat lost to walls
- ☹ High embodied carbon

Air to air heat pump: Cost £1.5k



- ☺ Renewable energy source - electricity
- ☺ Typically 420% 'efficiency'
- ☺ Fast heat up
- ☺ Fast and easy installation
- ☺ Old system not removed
- ☺ No radiated heat lost to walls
- ☺ Lower embodied carbon
- ☺ Cooling in summer

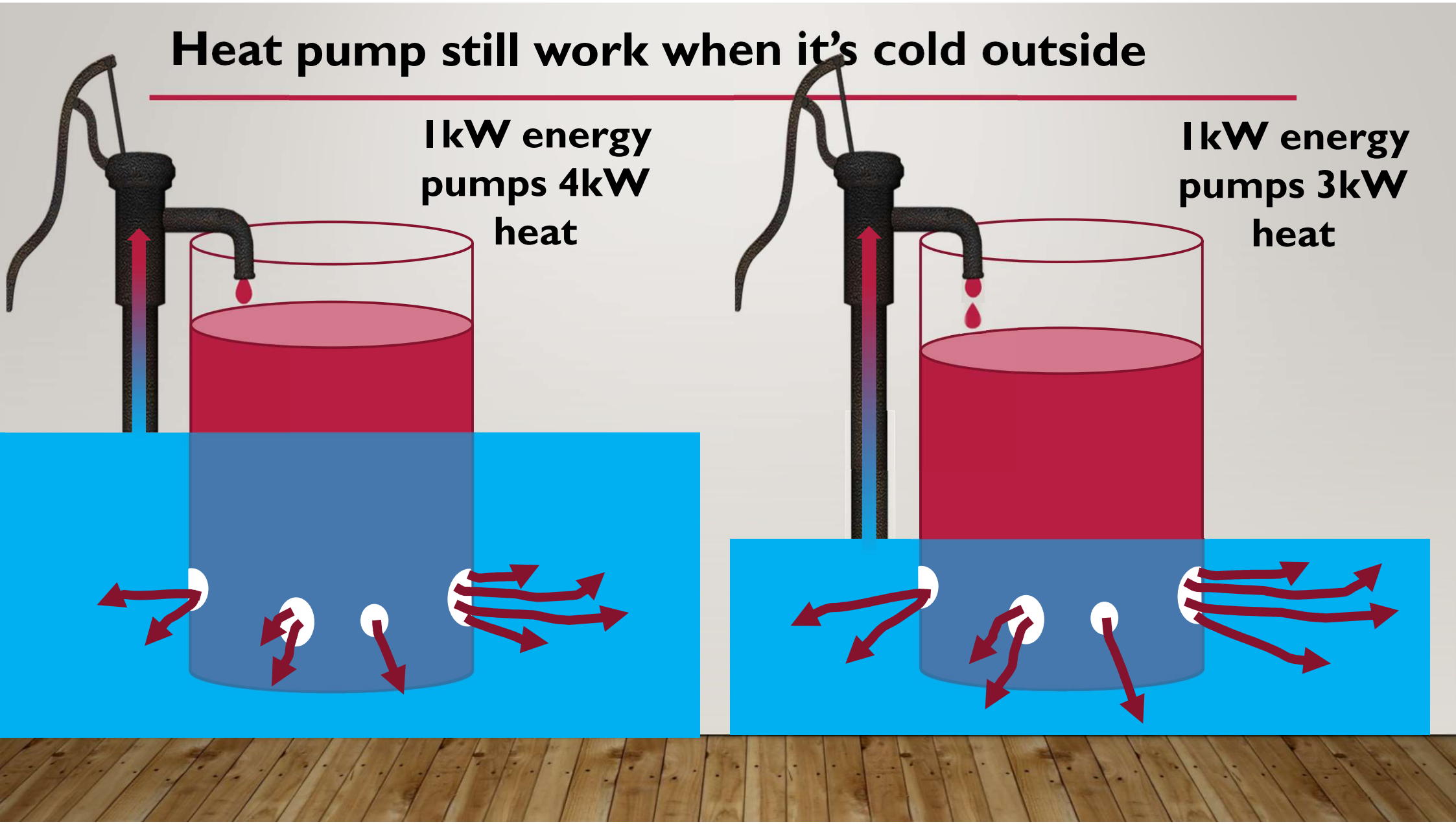
Self-contained air conditioning units are available

AIRCO290

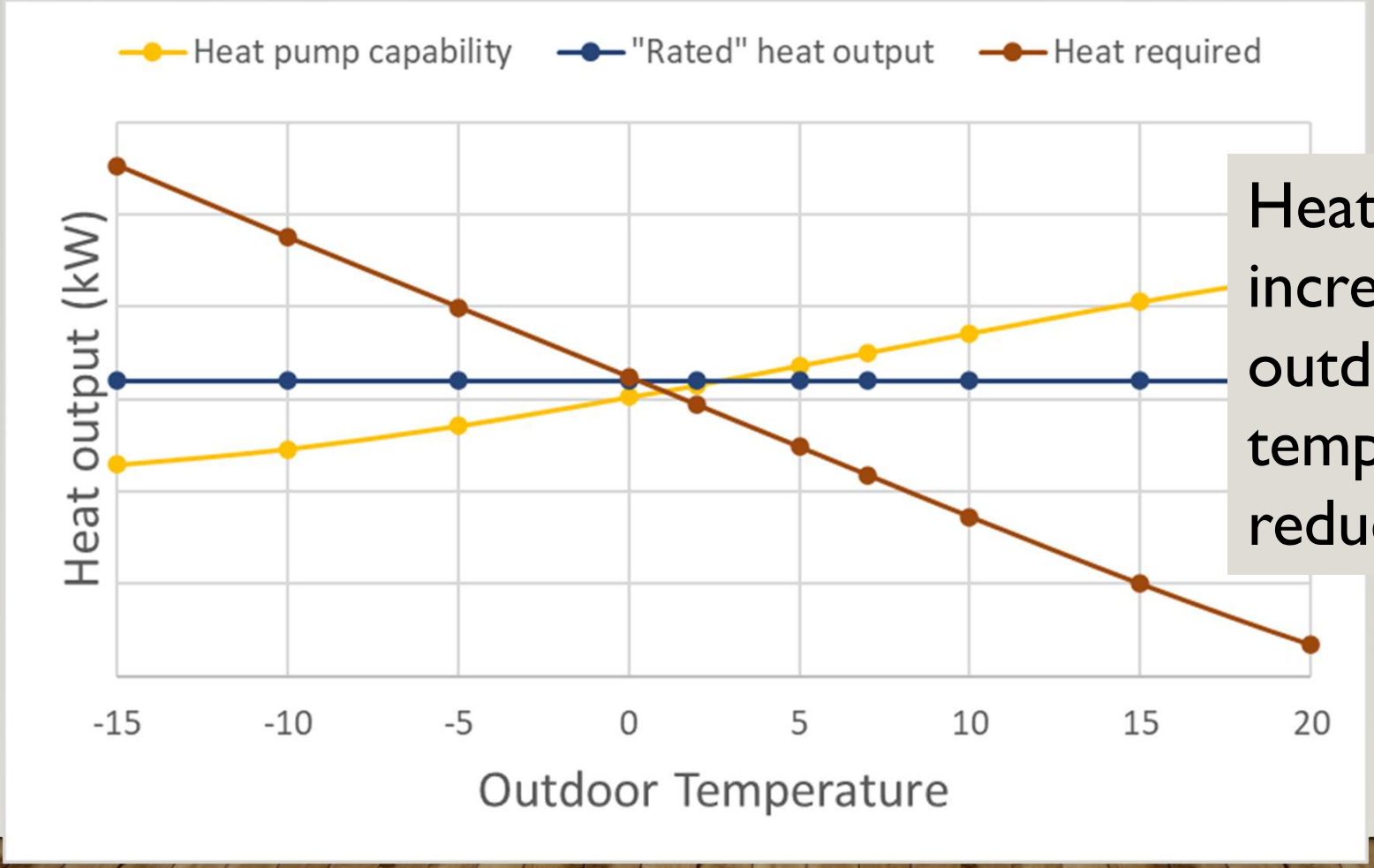
The new AIRCO290 is a packaged wall-mounted twin duct heat pump air-conditioning unit that is compatible and built and ready for the UK, European and American markets. It's technically advanced to use R290 refrigerant gas, which has the lowest GWP (Global Warming Potential) of any gas in its class. The new AIRCO290 is an affordable and economical air conditioning for homes, offices, hotels and garden rooms with rapid installation and minimalistic design without needing any outdoor condenser unit.

MOUNTING	SUPPLY	INSTALLATION TIME
HIGH & LOW WALL	ELECTRIC	3/4 HOURS

CE


Heat pump still work when it's cold outside
1kW energy pumps 4kW heat
1kW energy pumps 3kW heat

How big to make the heat pump?



Heat require increases as outdoor temperature reduces.

What to do if there is not enough heat in?

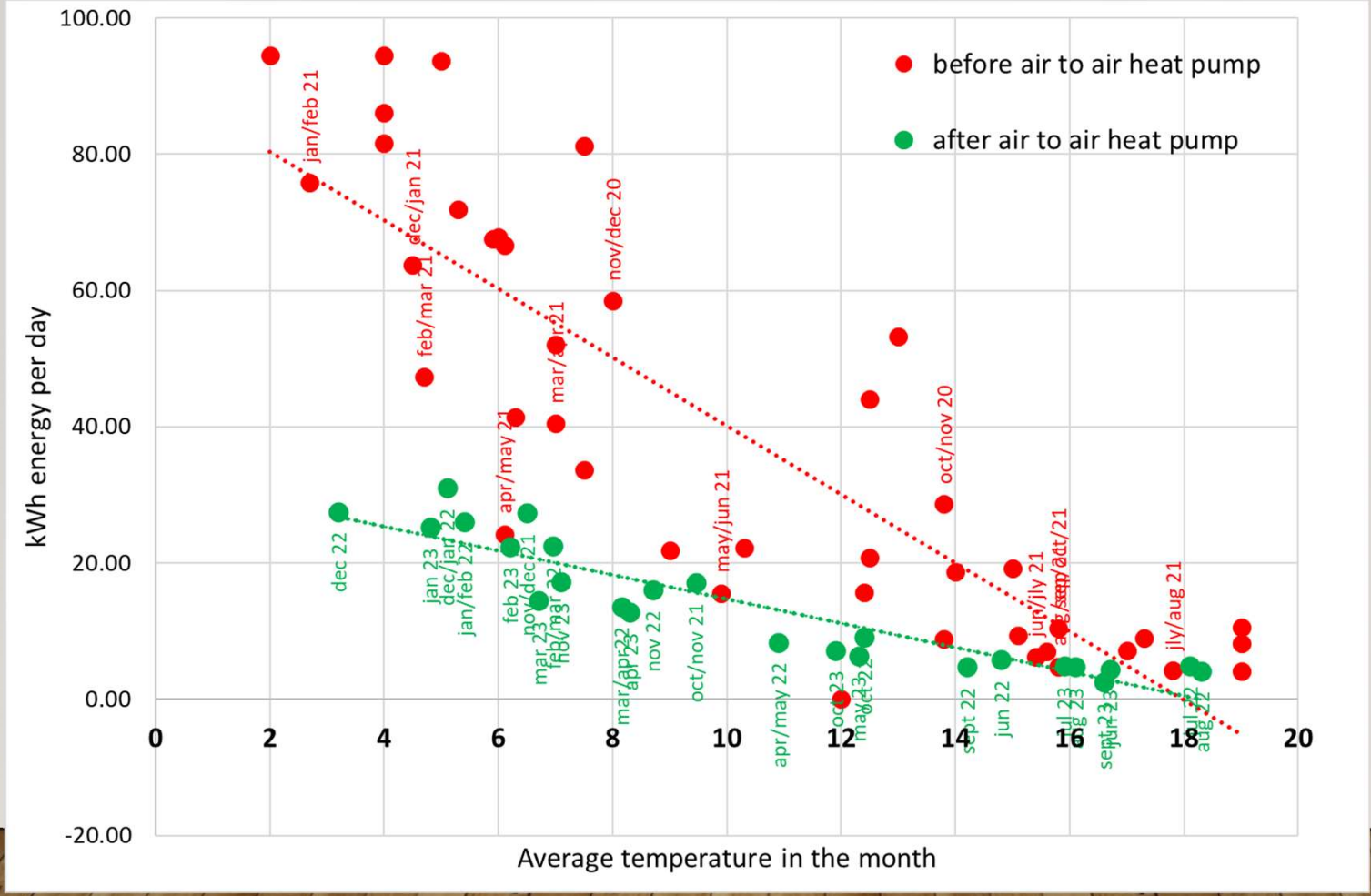
- Shut off rooms to reduce heat loss
- Accept lower temperature (put a woolly on!)
- Supplementary local heat:
  - Wood burning stove / electric fan heater
  - Heated cushions / blanket ….

Remember: **Gas boiler still in place as 'back-up'**

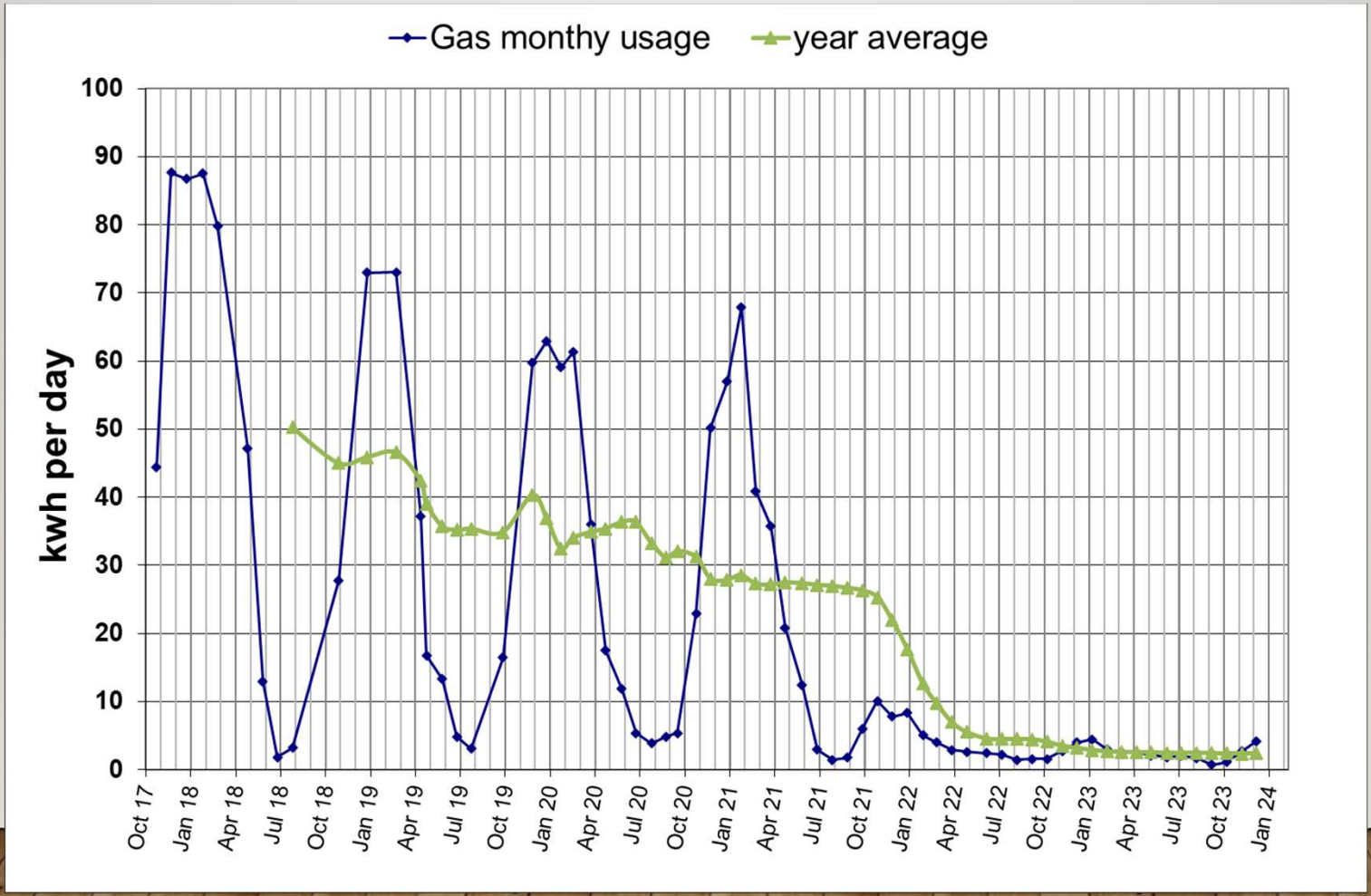
Supplementary heating

Cost ~£1000 installed
Up to 4kW
Renewable energy
DEFRA approved

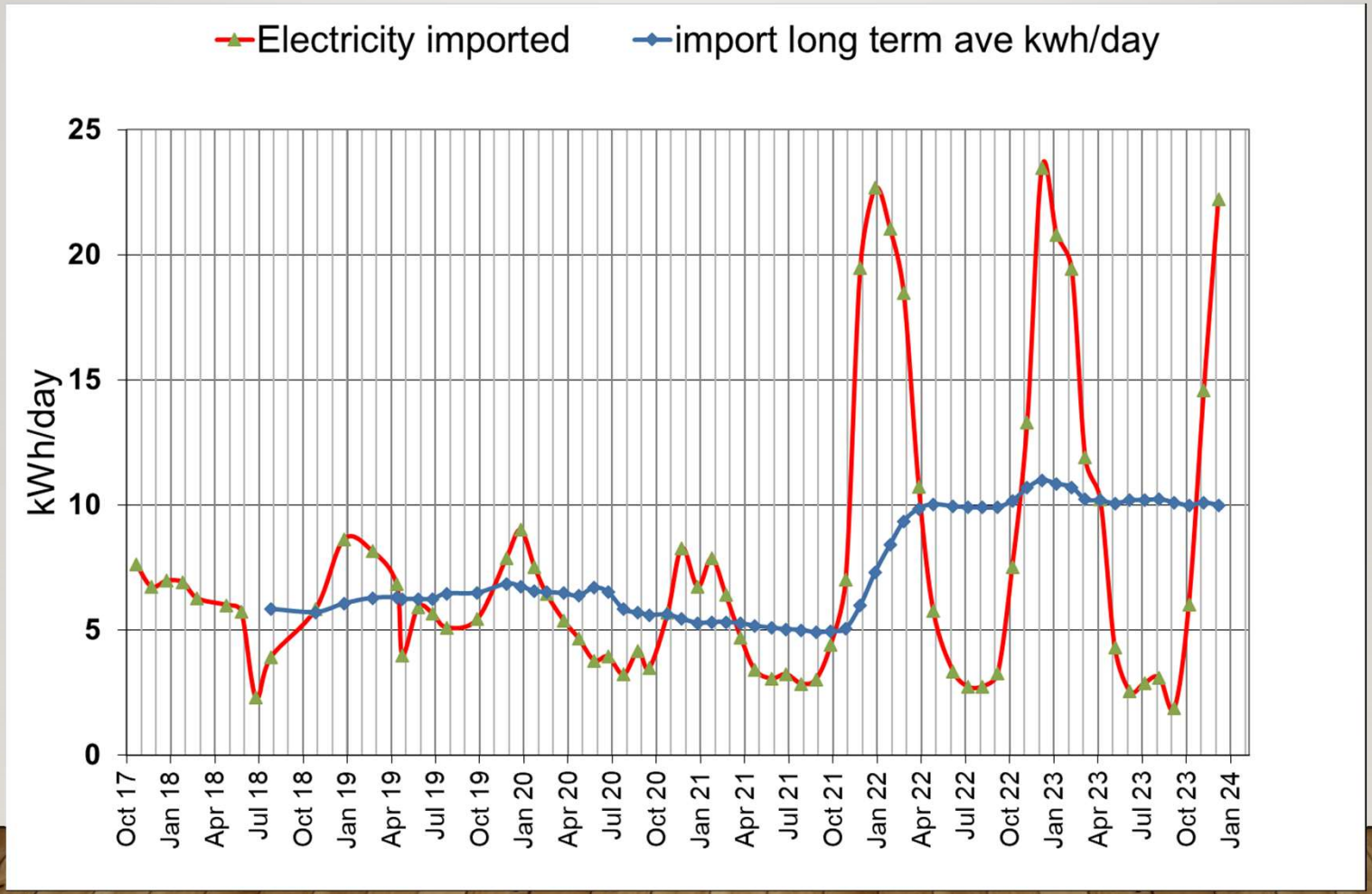
Proven energy savings from heat pump



How has our gas use changed?



How has our electricity use changed



Annual energy cost pre heat pump

Gas

- 26.3 kWh/day average @ 5.9p/kWh x 365 days
- £566 per year

Electricity

- 5.0 kWh/day average @ 23.77p/kWh x 365 days
- £434 per year

Total = £1000

Annual energy cost post heat pump

Gas

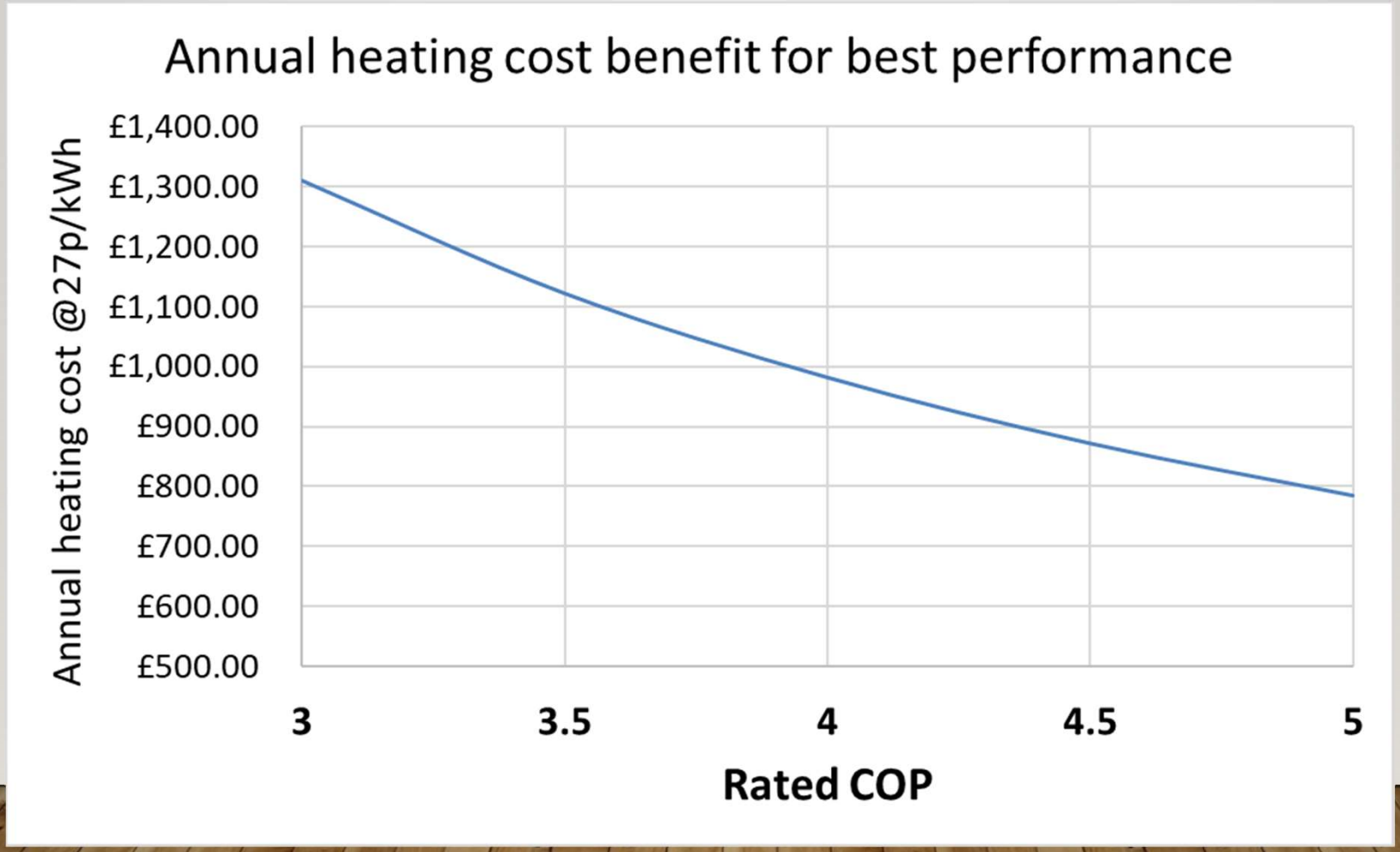
- 2.5 kWh/day average @ 5.9p/kWh x 365 days
- £54 per year

Electricity

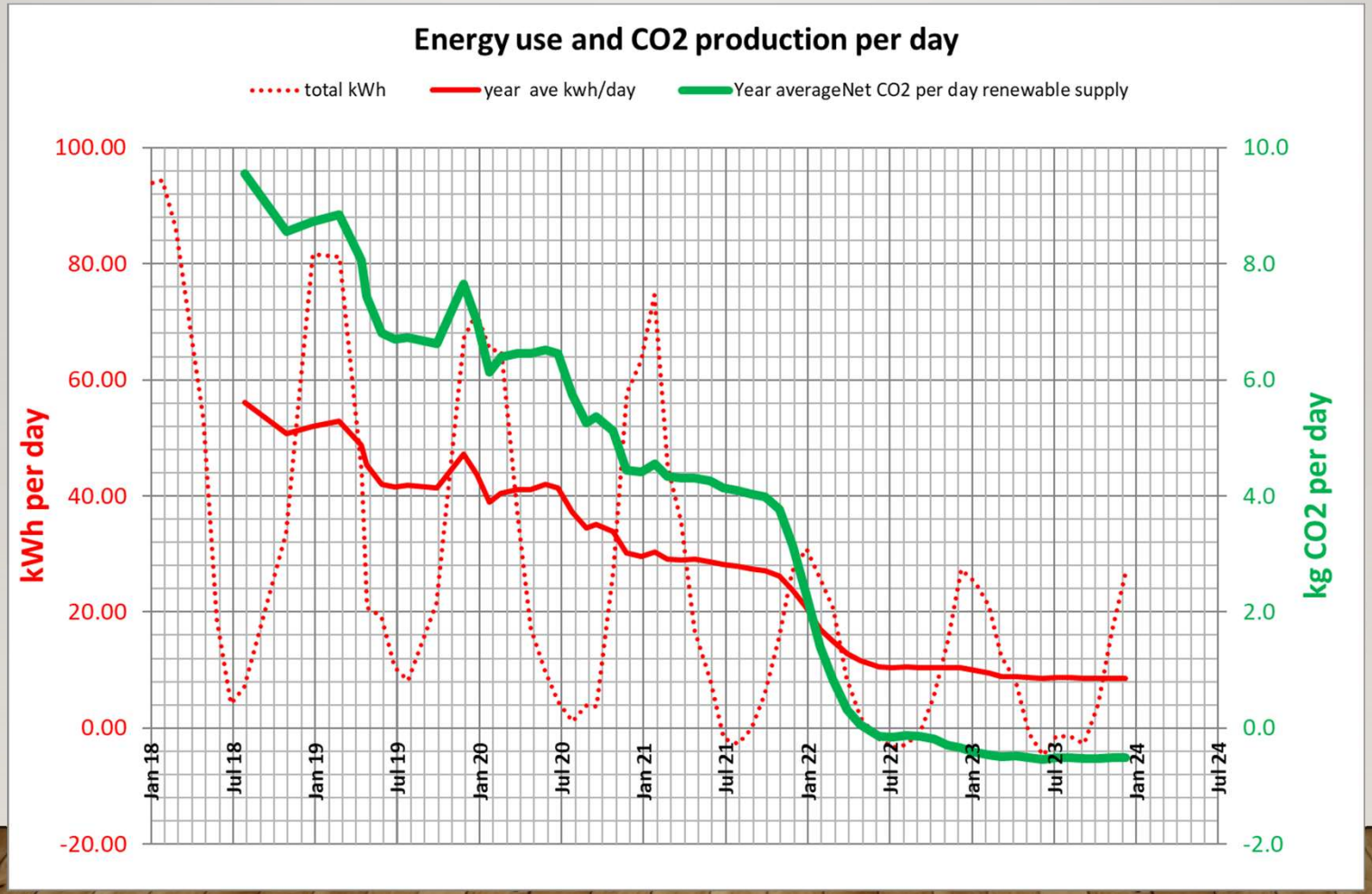
- 10 kWh/day average @ 23.77p/kWh x 365 days
- £868 per year

Total = £922 (8% saving compared with £1000)

It is worth getting the most efficient unit



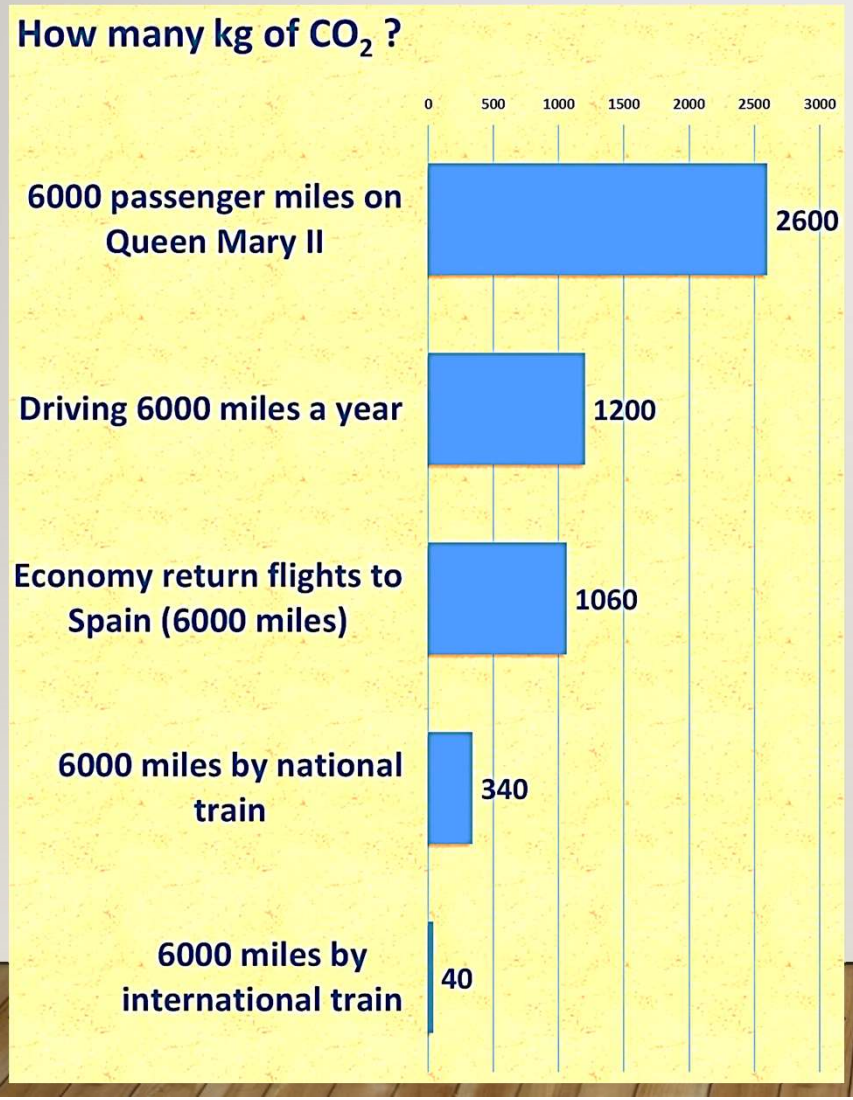
With renewable electricity supply we reach net zero



LIFESTYLE CHOICES

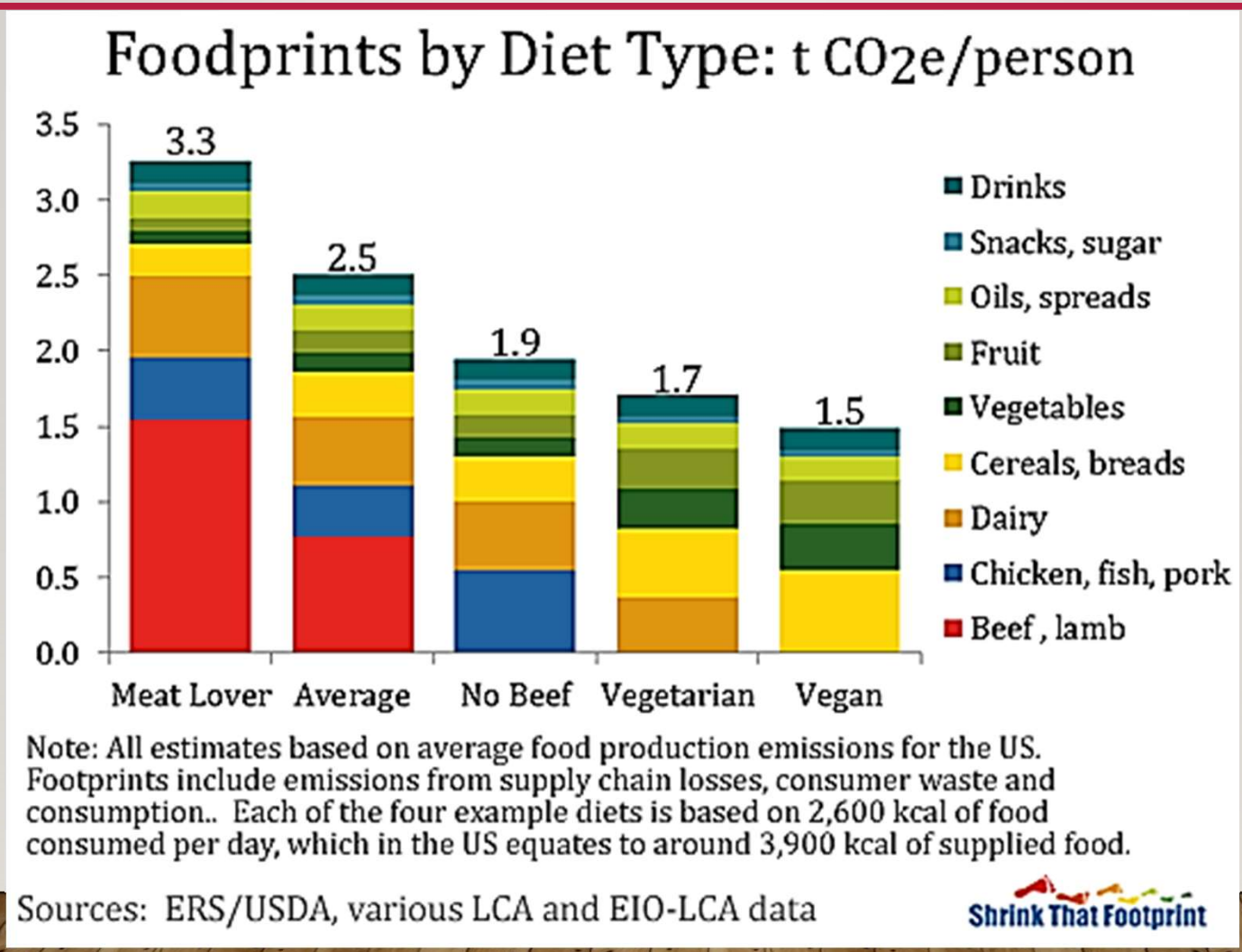
WHAT ELSE CAN WE DO TODAY?

How we travel:



Note: typical 3 bed semi energy consumption might be around 3 tonnes per year

What we eat:



Note: typical 3 bed semi energy consumption might be around 3 tonnes per year

https://www.greeneatz.com/foods-carbon-footprint.html

How we deal with the impact of our lifestyle:

To donate:

Account Name:	**1 JOHN 3 BEIRA**
Sort Code:	**08-92-99**
Account Number:	**67198719**