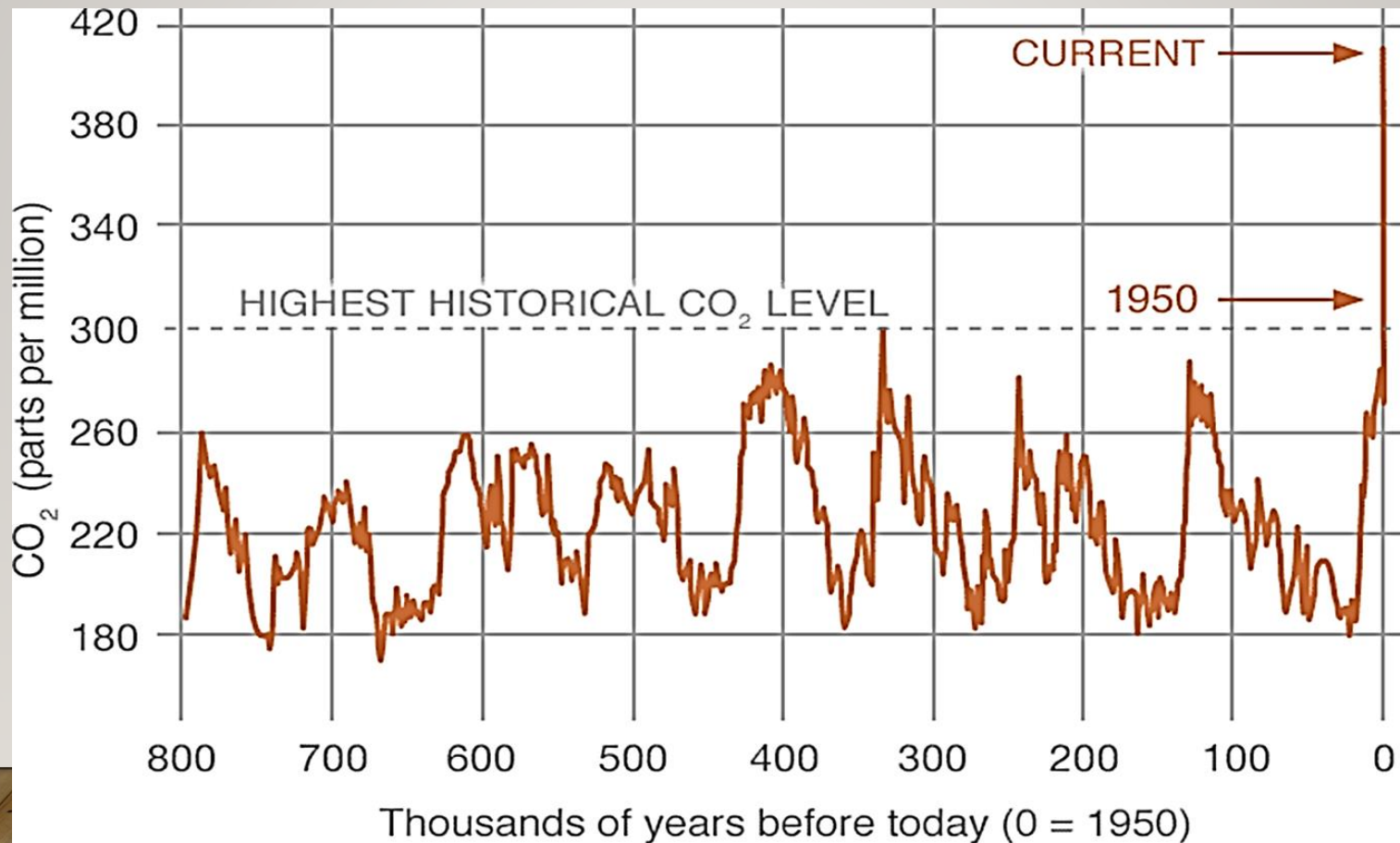

How to make your house carbon neutral, and why we need to.

Phil Hemsley

CEng FIMechE



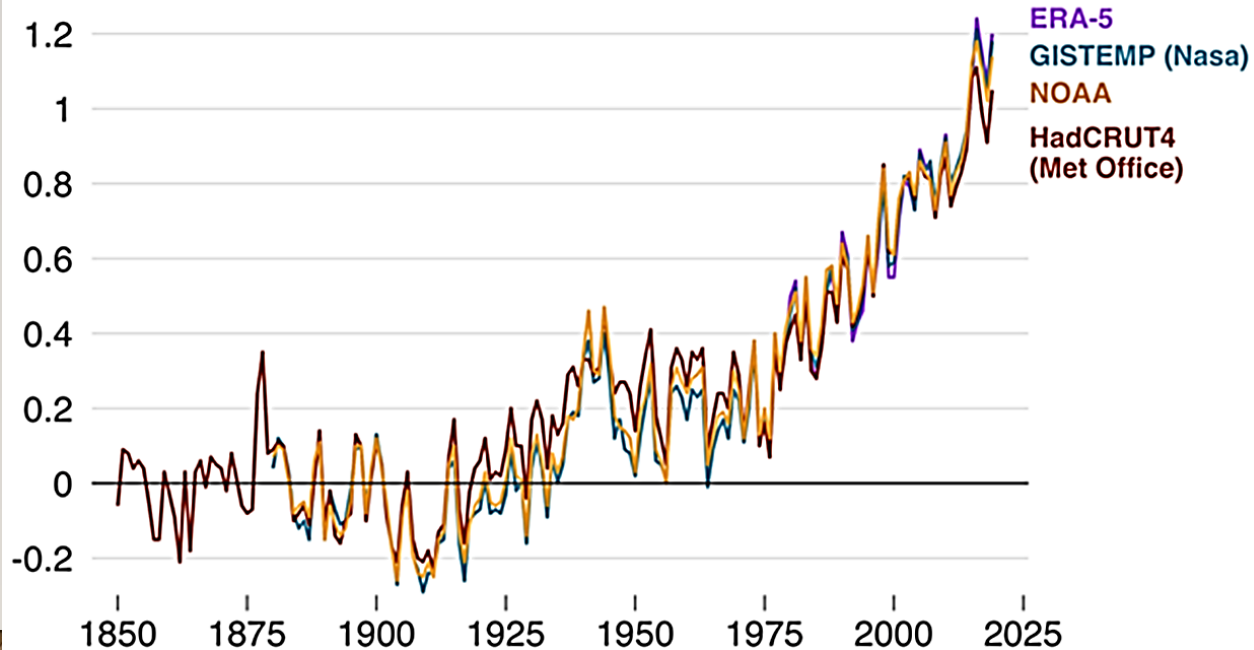
CO₂ concentration is at unseen levels



Global warming today is around 1.1 degrees

Temperature rise since 1850

Global mean temperature change from pre-industrial levels, °C



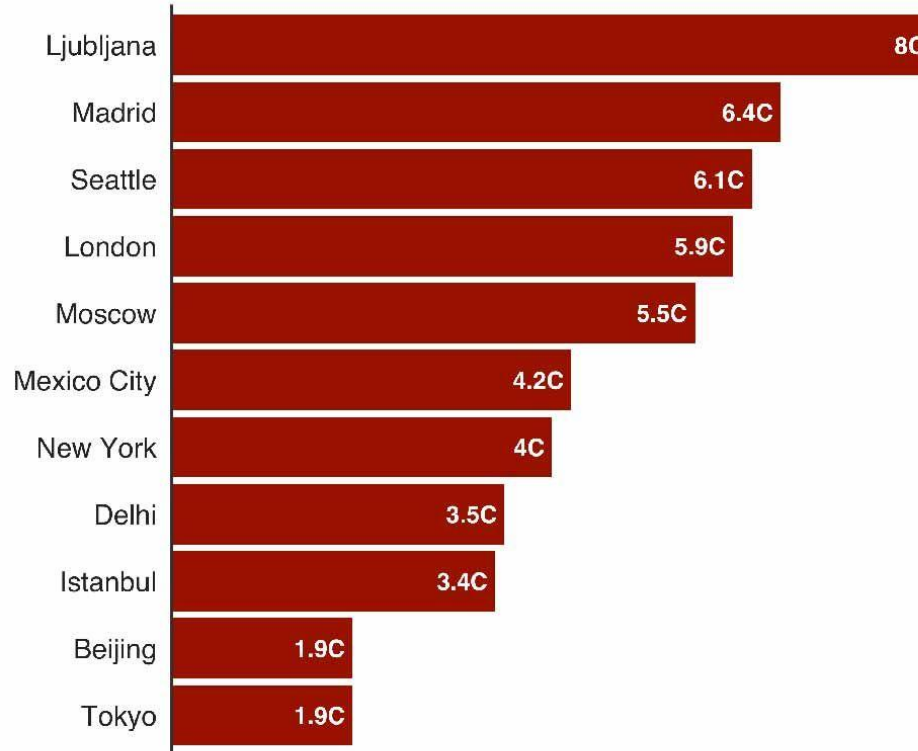
Source: Met Office

BBC

Projection made in 2019:

Expected temperature changes in 2050

Increase in temperature in warmest month



Hypothetical projection for 2050, made in 2020



To limit to 2.1°C we need 40% reduction by 2050

Annual global greenhouse gas emissions
in gigatonnes of carbon dioxide-equivalents

150 Gt

100 Gt

50 Gt

Greenhouse gas emissions
up to the present

0

1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

No climate policies

4.1 – 4.8 °C

→ expected emissions in a baseline scenario if countries had not implemented climate reduction policies.

Current policies

2.5 – 2.9 °C

→ emissions with current climate policies in place result in warming of 2.5 to 2.9°C by 2100.

Pledges & targets (2.1 °C)

→ emissions if all countries delivered on reduction pledges result in warming of 2.1°C by 2100.

2°C pathways
1.5°C pathways

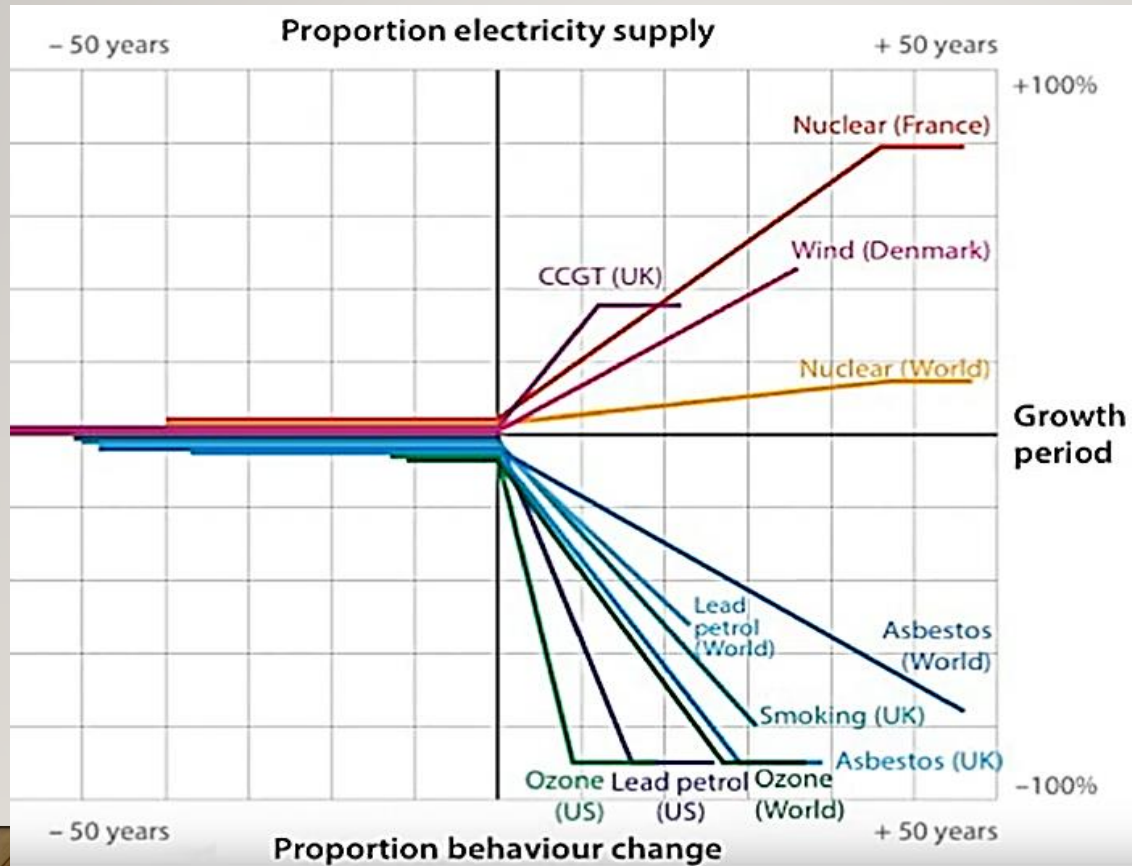
-40%

How to reach 40% reduction fairly

	CO2 emissions (billion t)	2020 population (millions)	2020 tonnes per person
International transport	0.9		
Oceanea	0.4	40	10.0
Asia (inc China and India)	20.5	4640	4.4
Africa	1.4	1340	1.0
South America	1.0	420	2.4
North America (inc USA)	5.9	590	10.0
Europe	4.9	750	6.5
Total / Average	35	7780	4.5

	2050 CO2 emissions (billion t)	2050 population (millions) UN projection	2050 tonnes per person (40% total reduction)	Tonnes per person % of today's value
International transport	0.5			
Oceanea	0.1	42	2.1	21%
Asia (inc China and India)	11.2	5290	2.1	48%
Africa	5.3	2480	2.1	203%
South America	1.0	480	2.1	89%
North America (inc USA)	1.5	690	2.1	21%
Europe	1.5	700	2.1	32%
Total / Average	21	9682	2.1	

We can't wait until new technologies arrive



We need to use
Current technology
+
Behaviour change

TECHNOLOGY

WHAT CAN WE
DO TODAY?



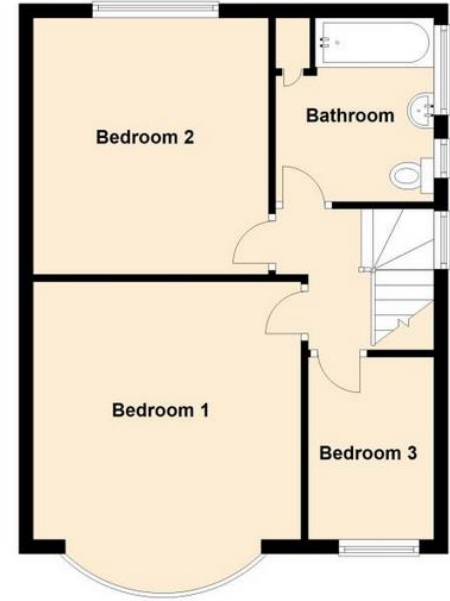
My experience: 1930s 3 bedroom semi



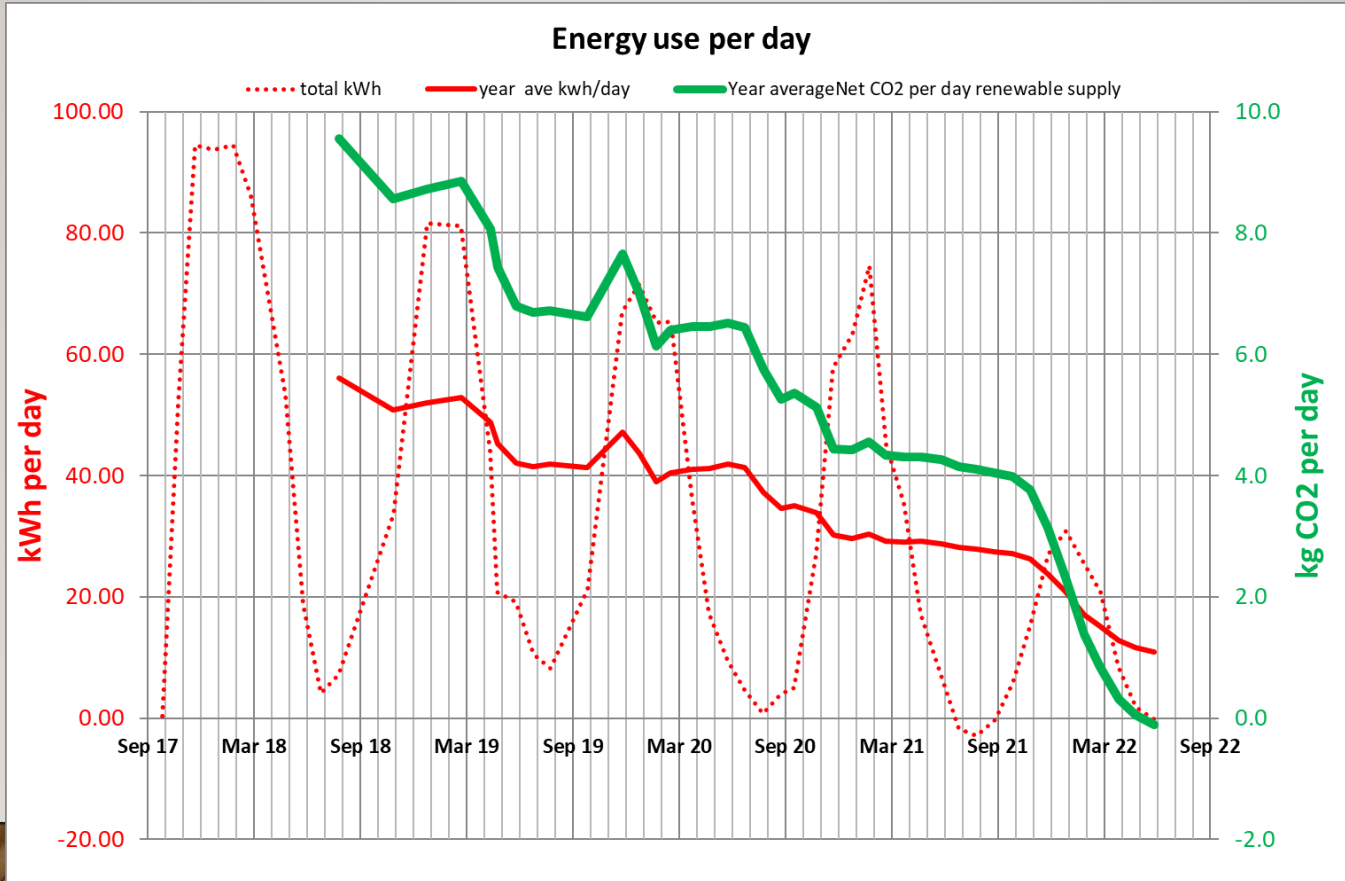
Ground Floor



First Floor



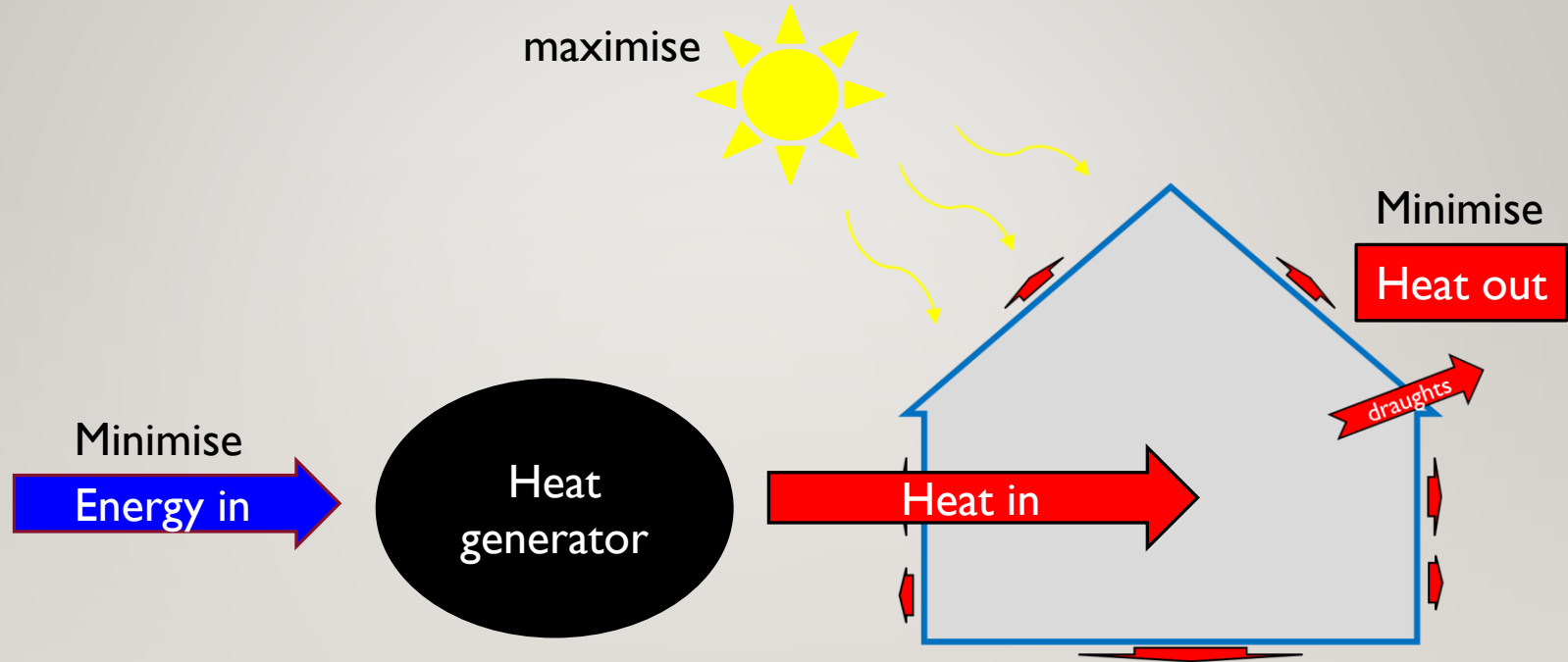
Progress so far... better than “net zero”



The rules

- Renewable electricity import tariff is carbon neutral
- Exported electricity displaces a gas fired power station

Biggest energy consumer: heating

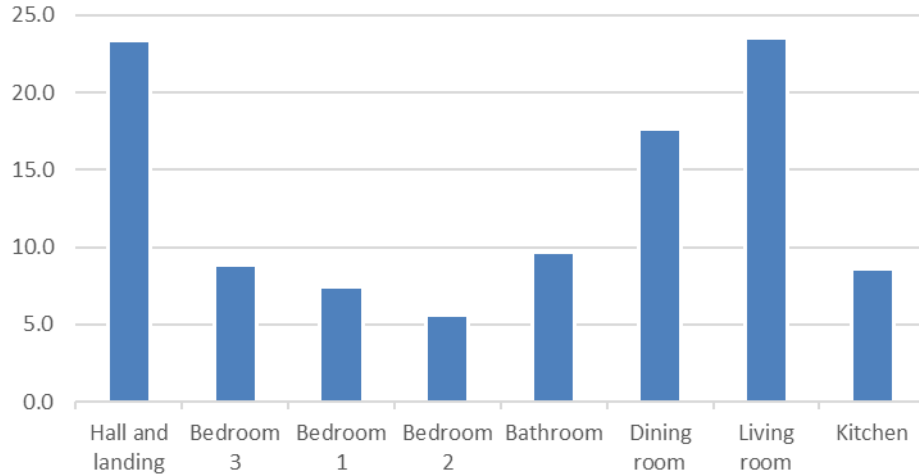


When we moved in:

- ✓ Loft insulation
- ✓ Double glazing

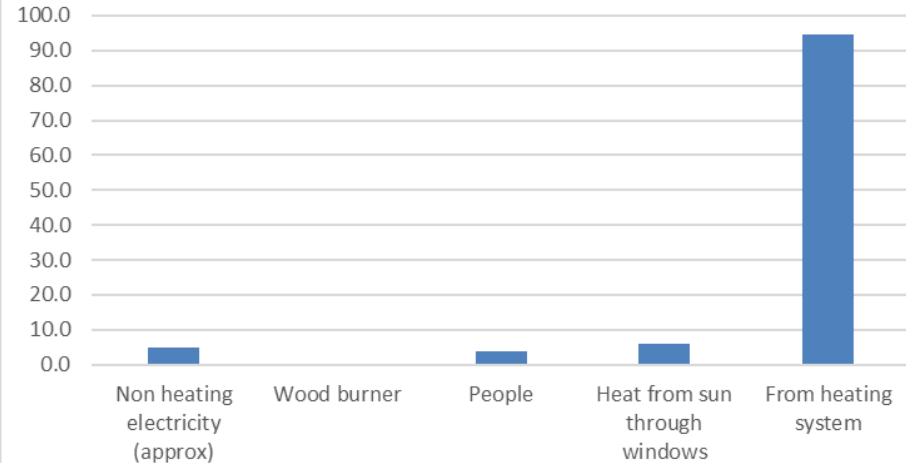
Where to start? Analyse the losses:

Heat required per day

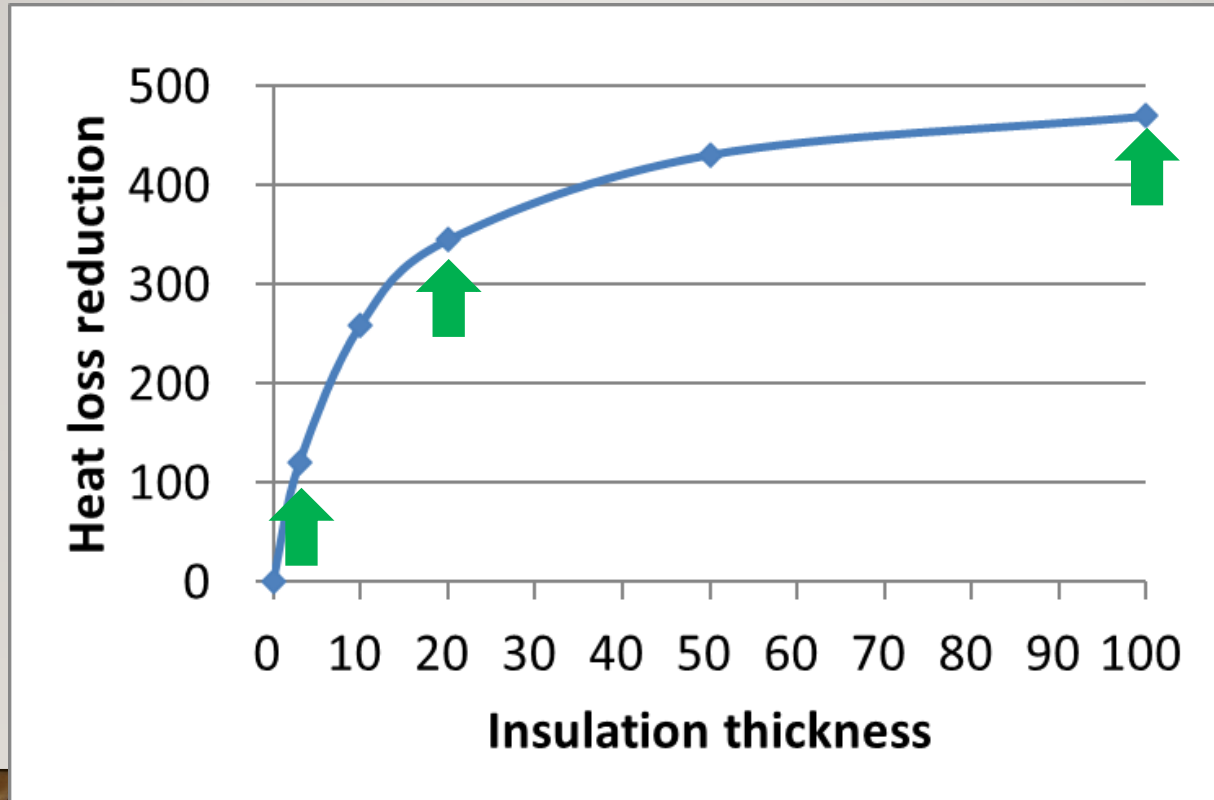


$$Q = U.A.dT$$

Heat provided by



Minimise heat loss: The benefit of insulation



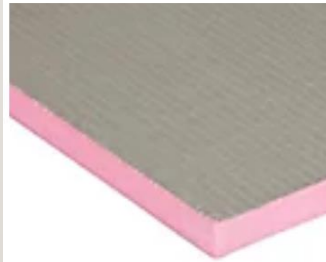
Simple internal wall insulation - 20mm tile backer board:



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

Cost ~£600 installed

Saving ~0.5kW



Qboard Backerboard (H)2400mm (W)600mm (T)20mm

Sold & shipped by B&Q

★★★★★ (4) [Write a review](#)

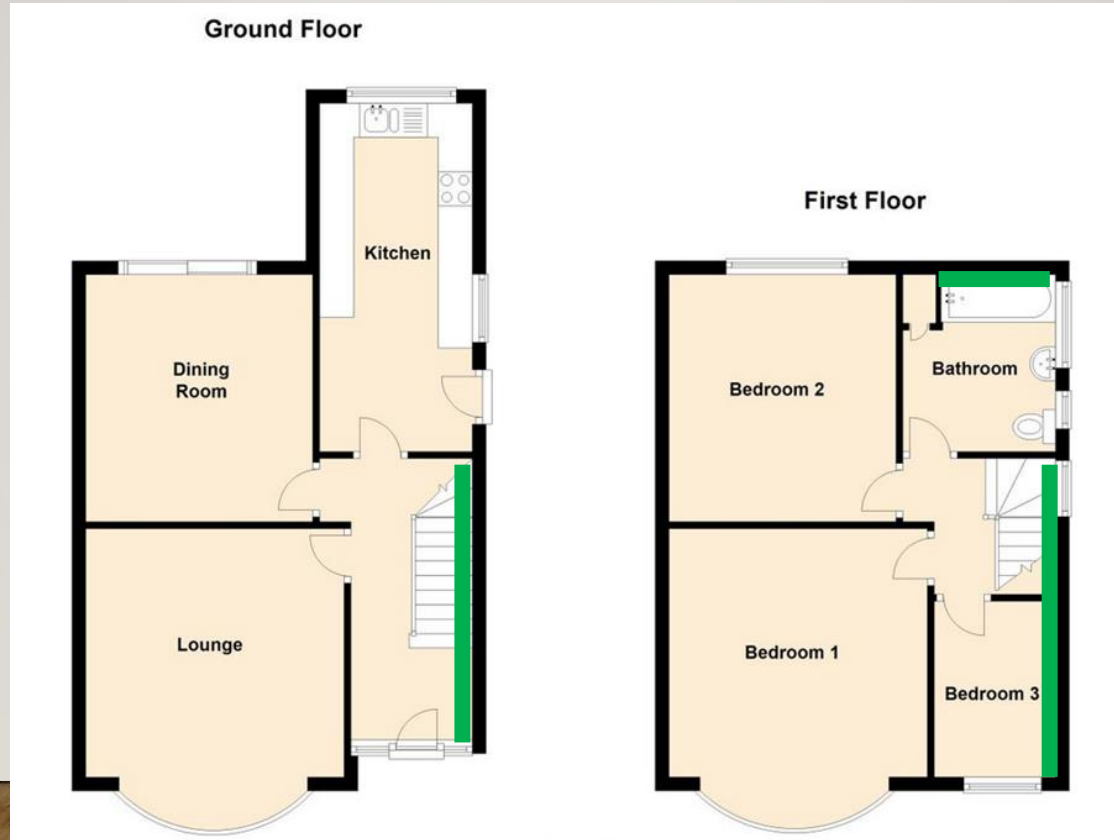
> **£22**

 Home Delivery

Available to CV227DS

[Change postcode](#)

Hall/landing, part of bathroom and small bedroom



Thermal lining paper

Graphite+ Insulating Lining Paper 7.5m x 50cm

By [Erfurt Mav](#) Product code: **19476** Pack size: **Each**

ERFURT MAV



£17.88

Exc. VAT £14.90



Quantity



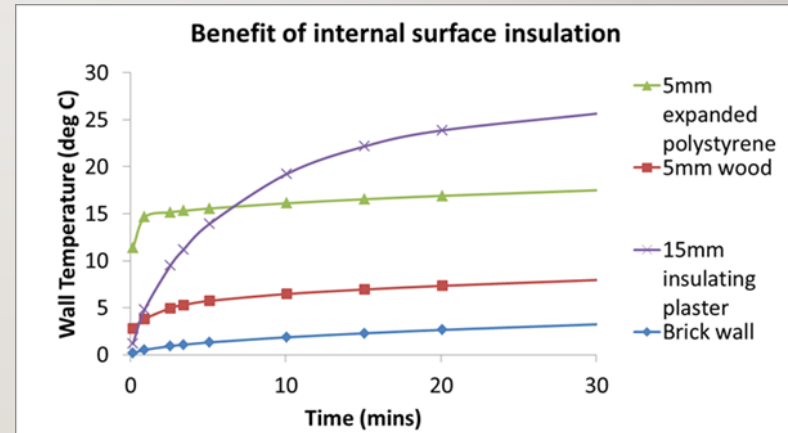
1 available Click & Collect

within 5 mins

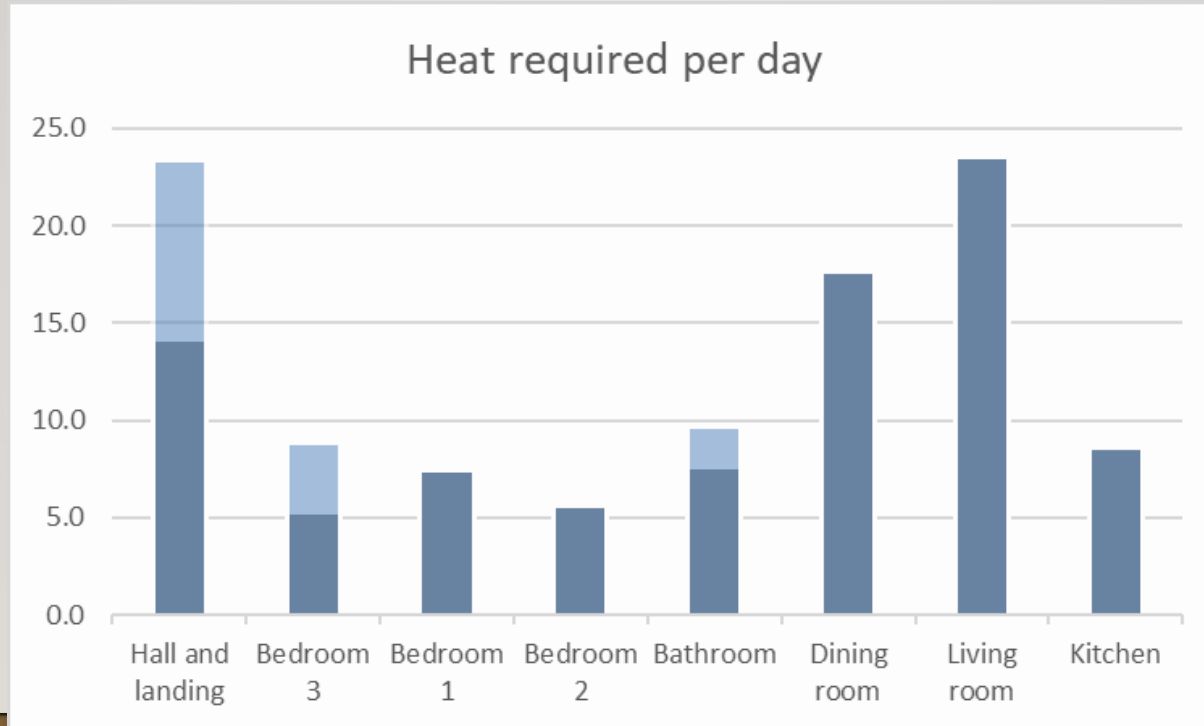
COLLECTION

Benefit of even thin insulation on the walls

- Faster warm-up of the surface
- Good to avoid condensation in bathrooms!



Wall insulation (hall, bathroom, and bedroom 3)



Small Defra approved wood burning stove

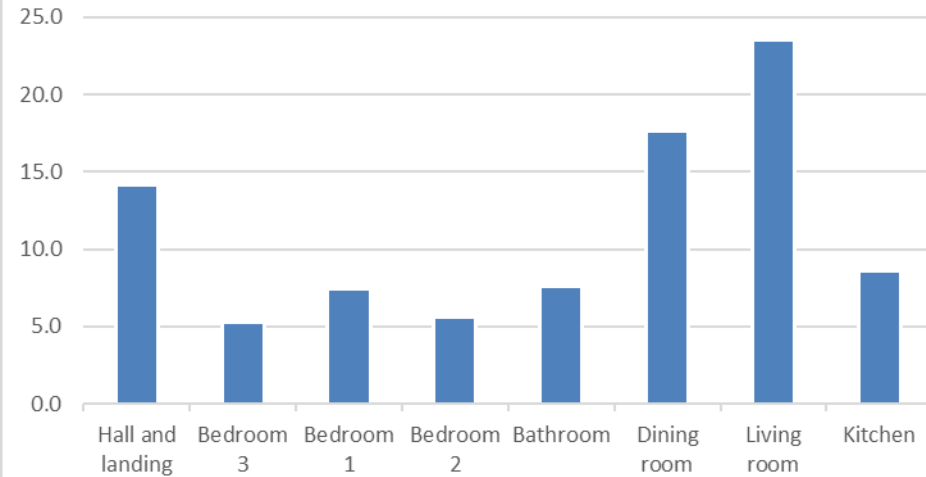


Cost ~£1000 installed
Up to 3kW
Renewable energy

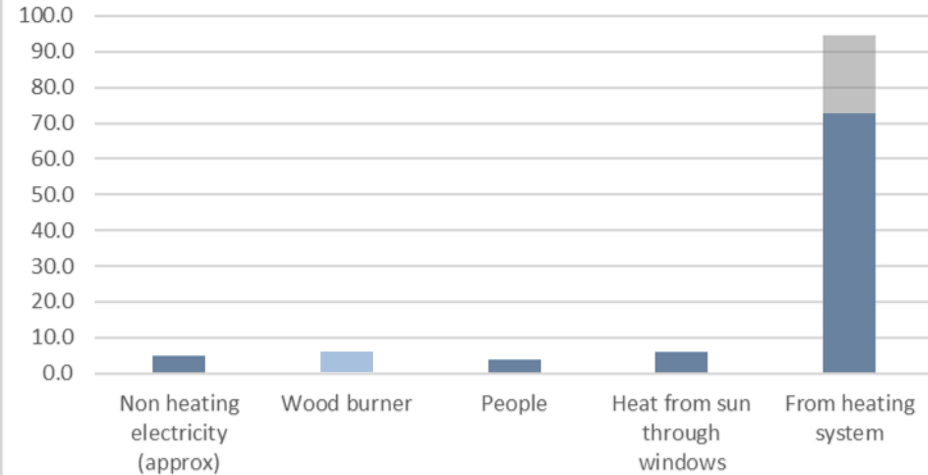


Wall insulation (hall, bathroom, and bedroom 3) + wood burner

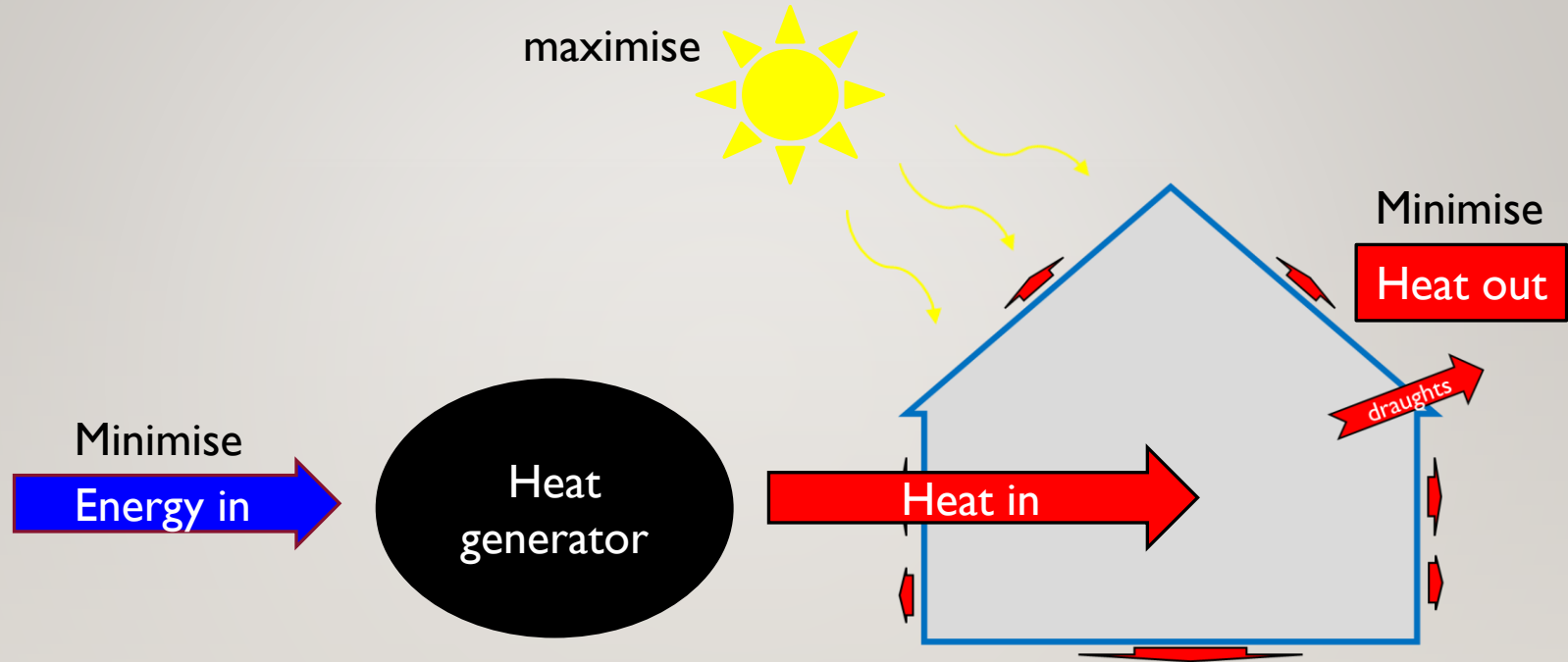
Heat required per day



Heat provided by



How to minimise the energy in per unit of heat in?



Traditional UK solution – gas boiler and water filled radiators

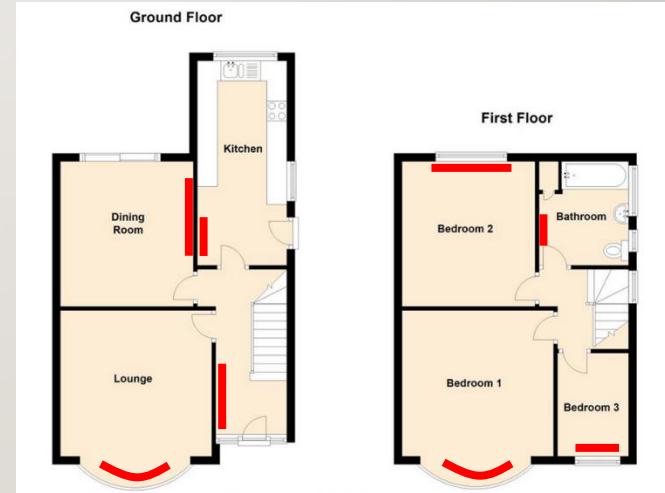
☹️ Condensing gas combi boiler + radiators

☹️ Non-renewable energy source

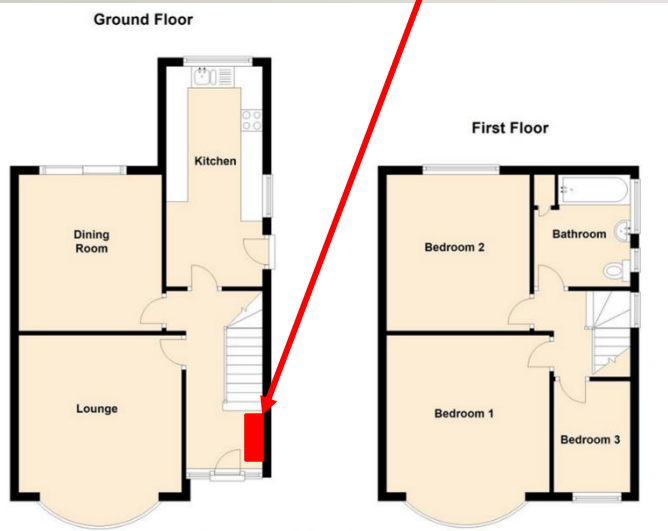
☹️ At best ~95% efficiency

☹️ Heat up radiators before
heat up rooms – slow and
inefficient

☹️ Heat lost to walls



Air to air heat pump

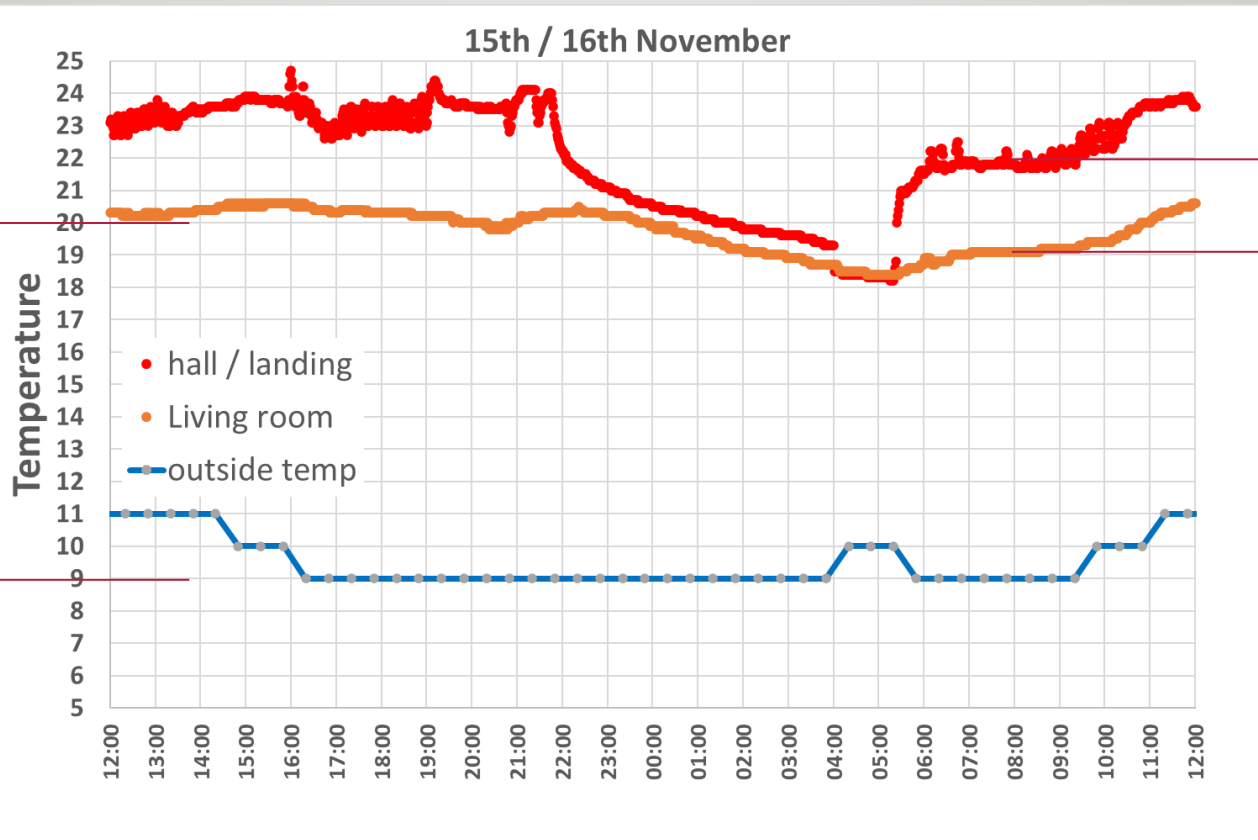


- ☺ Renewable energy source - electricity
- ☺ Typically 400% 'efficiency'
- ☺ Fast heat up
- ☺ No radiated heat lost to walls
- ☺ Cooling in summer



Heat dissipates through house: Hall to living room data

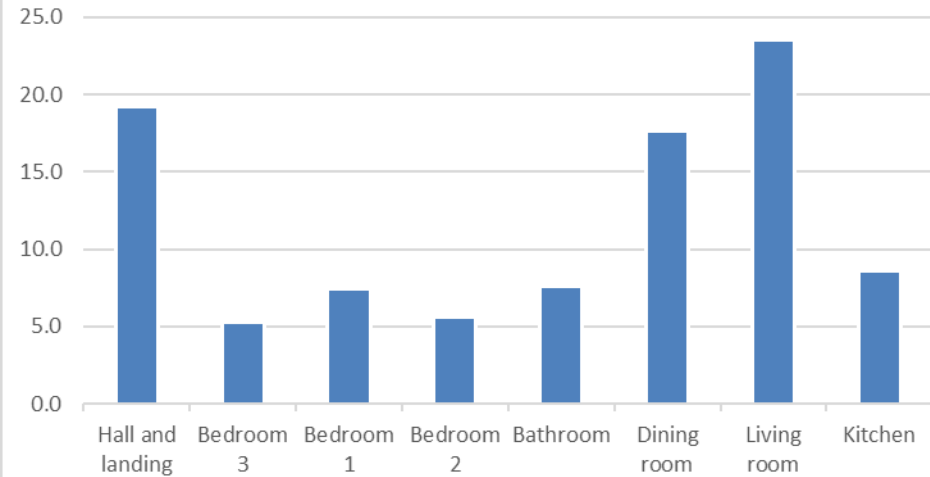
~900W
heat loss



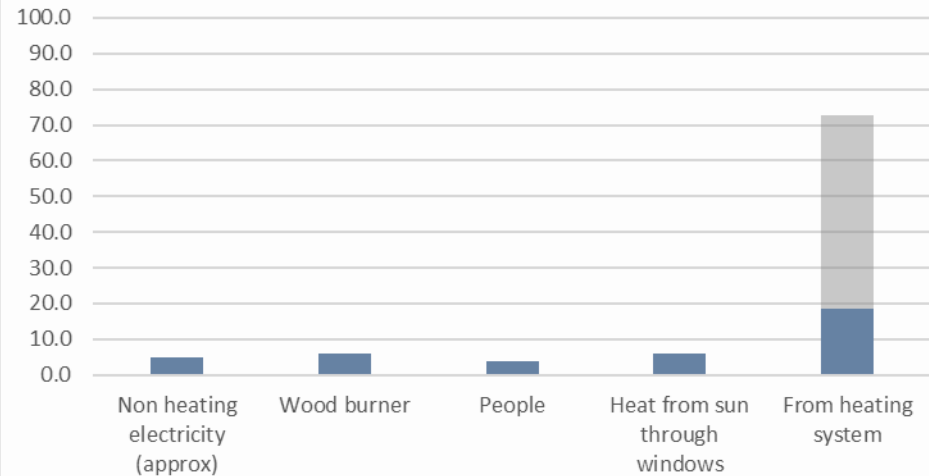
Hall needs
to be
warmer to
heat living
room

With heat pump

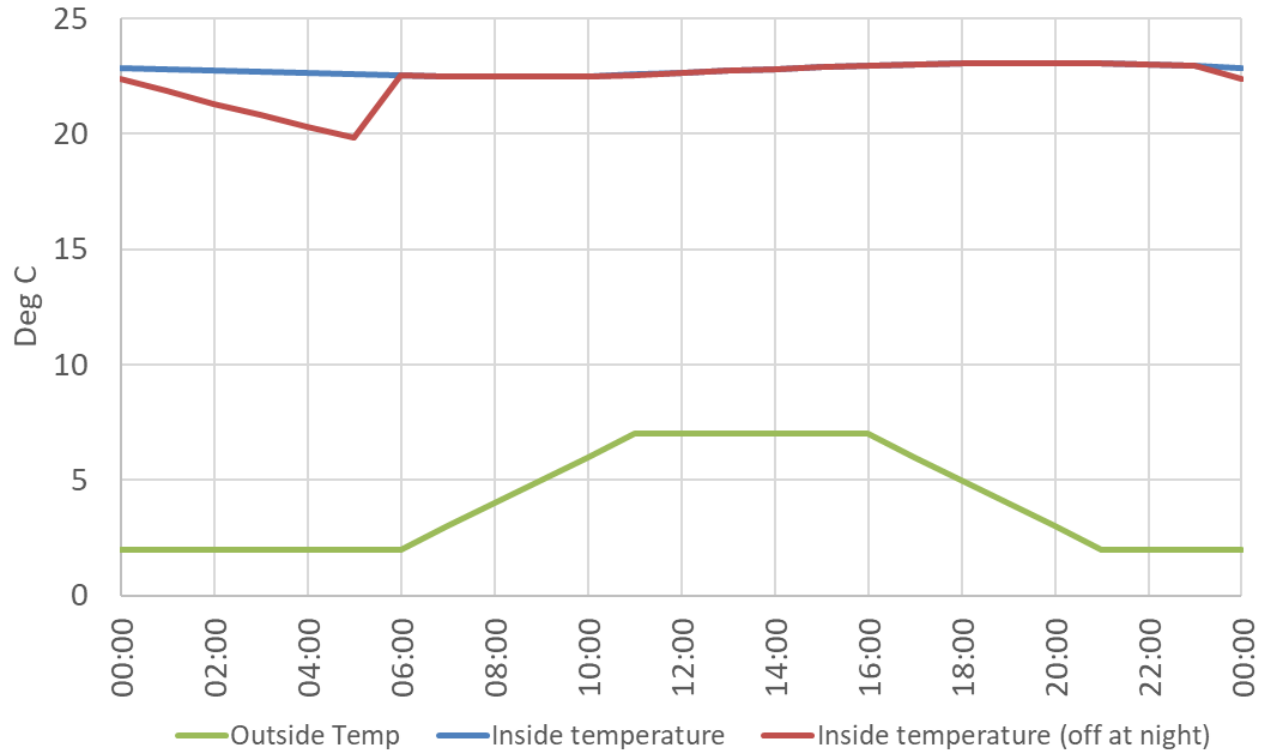
Heat required per day



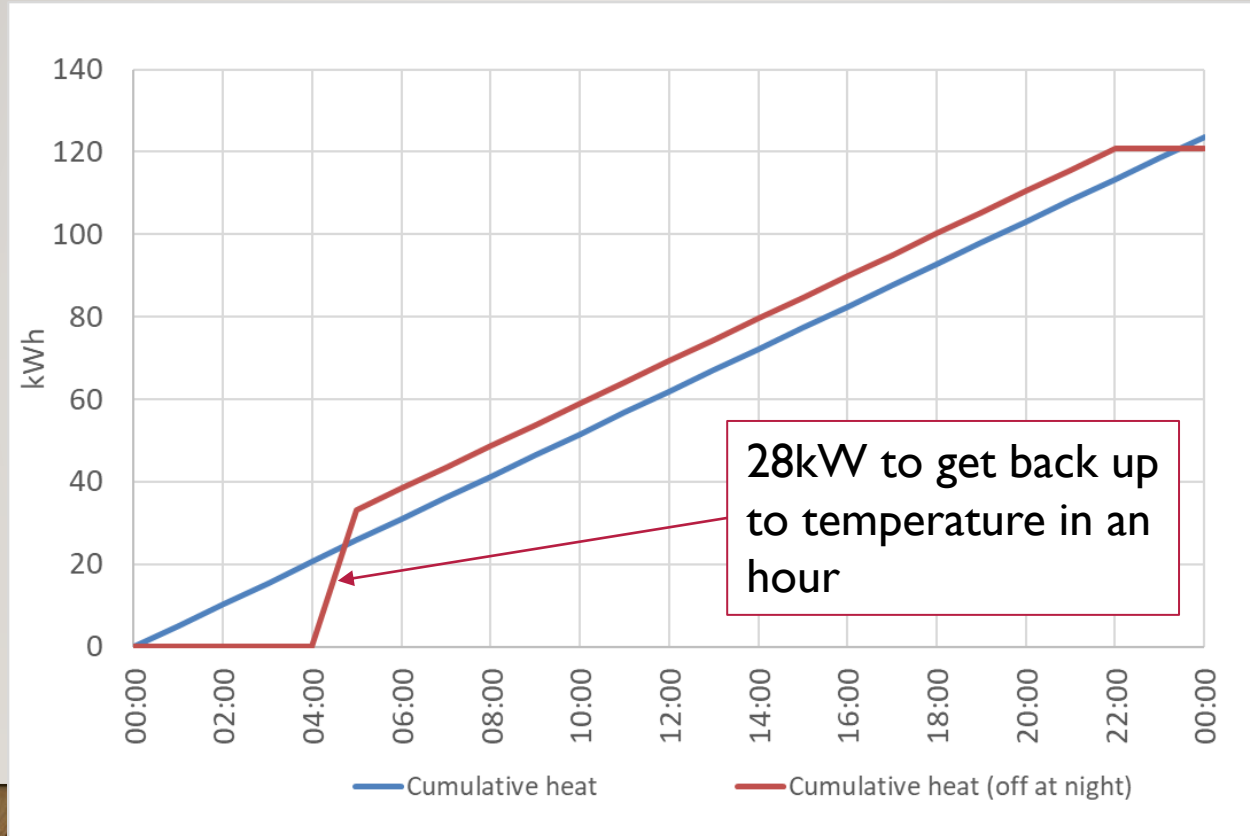
Heat provided by



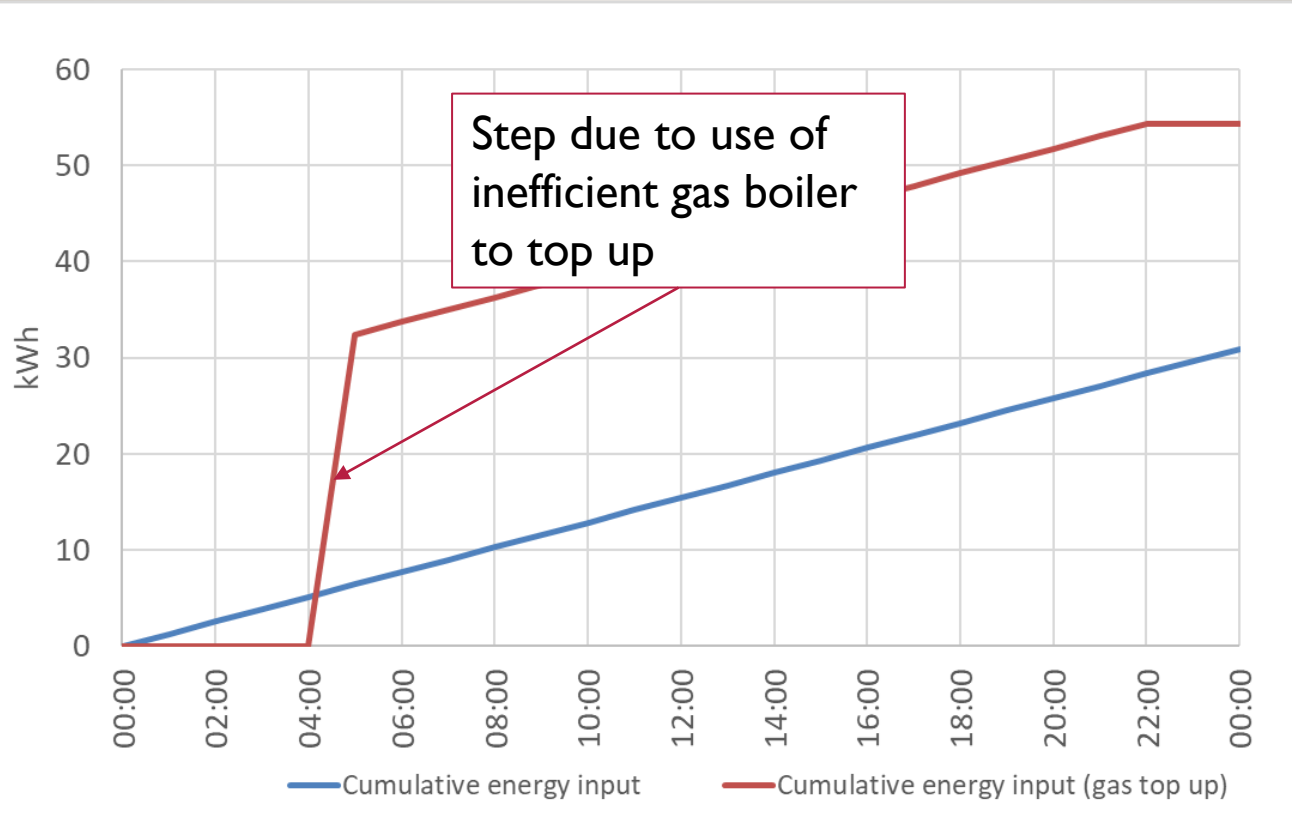
Turn heat off at night?



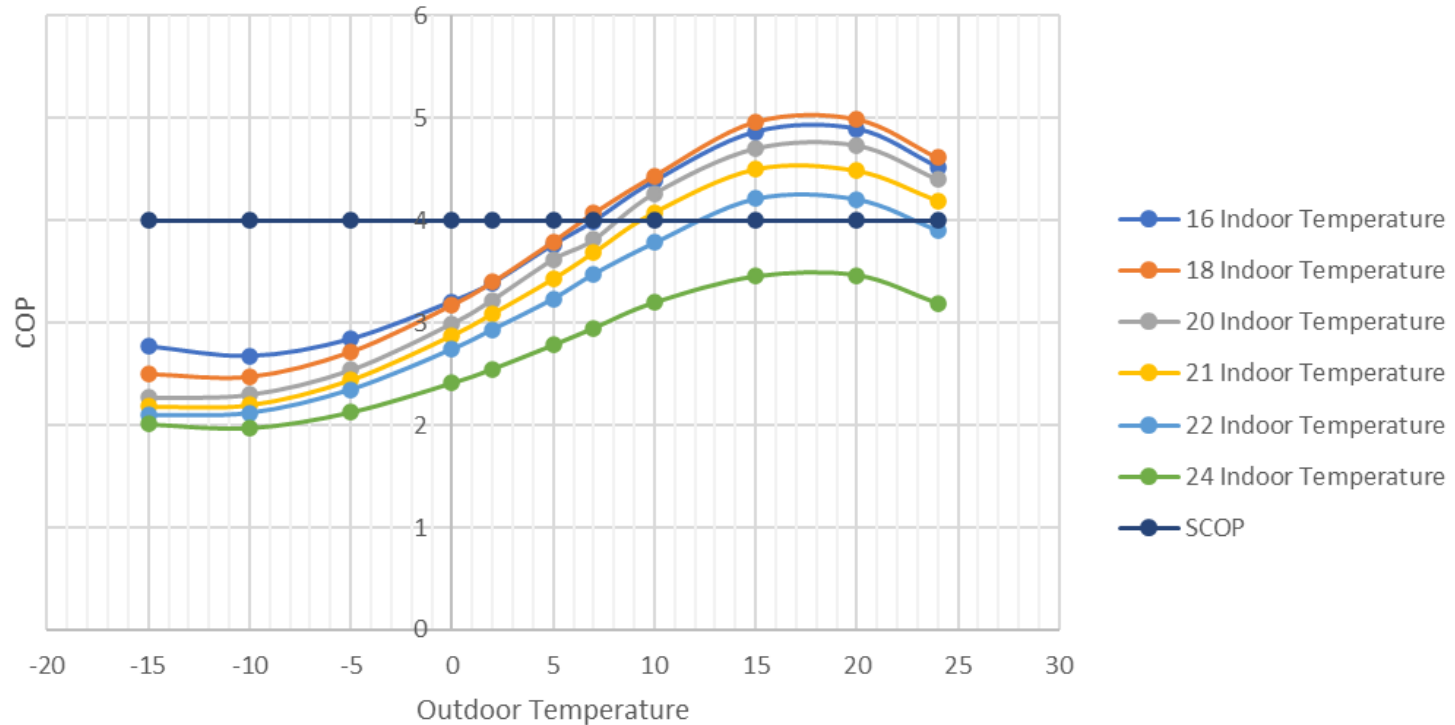
2.5% heat energy saving if heating is turned off for 6 hours



Much less energy if heat pump left on continuously instead of topping up with gas boiler

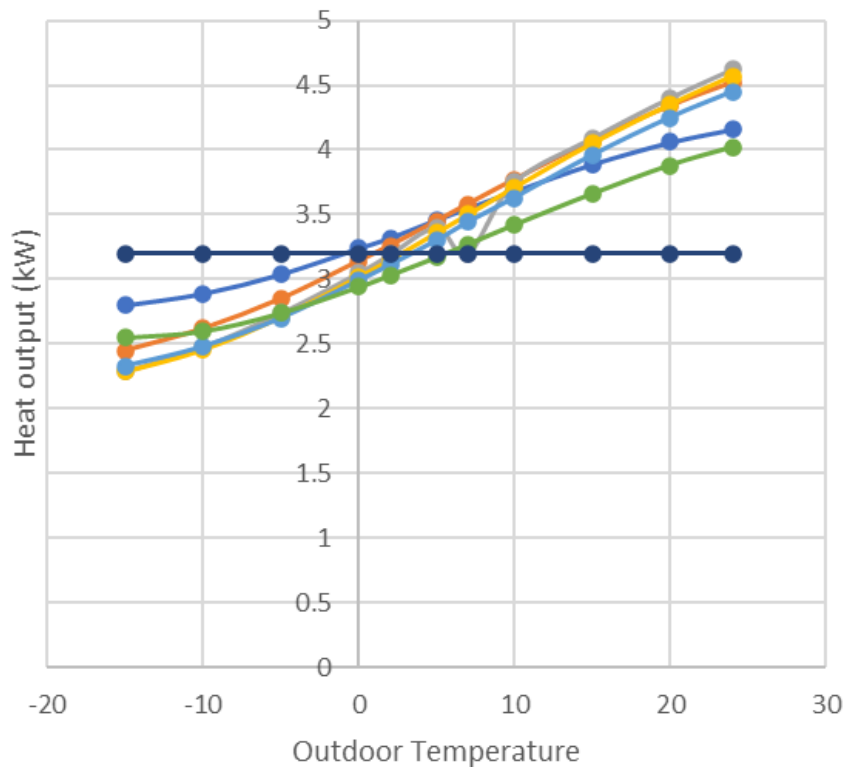


Coefficient of performance: (Samsung example data)



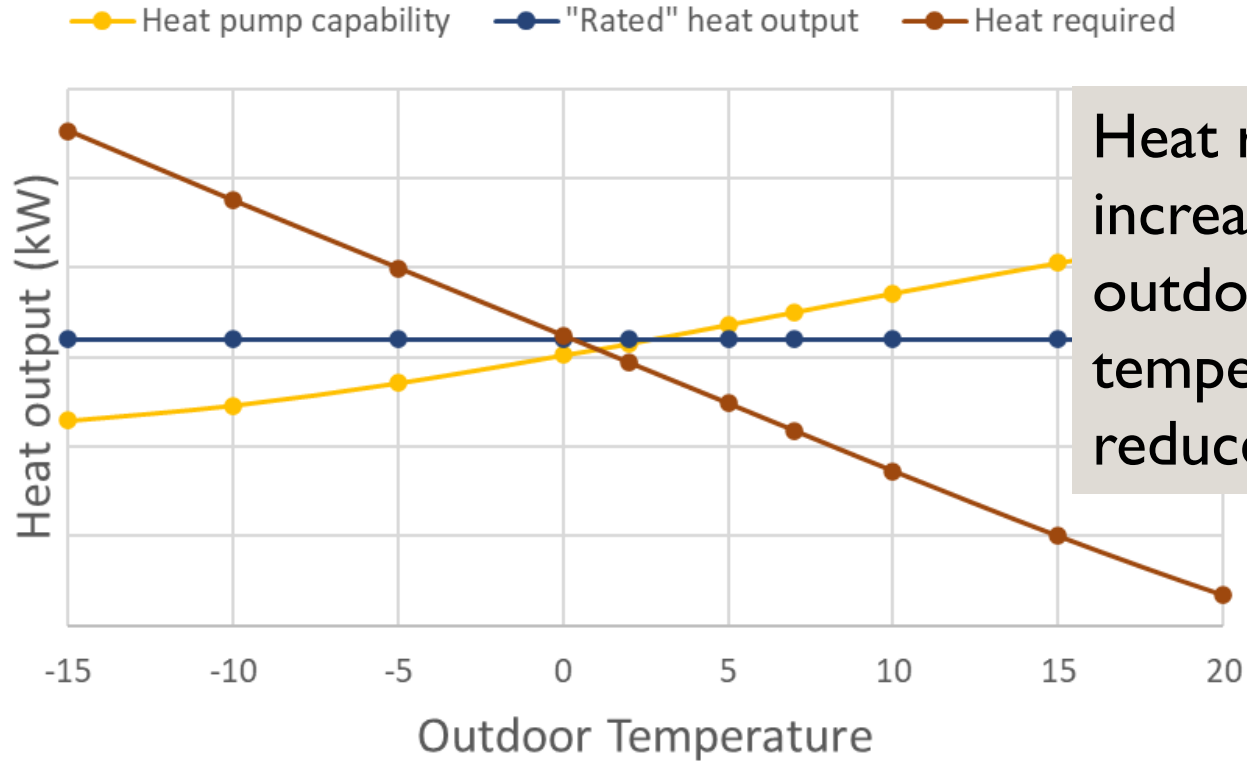
<https://dkc-klima.dk/professionel/wp-content/uploads/sites/4/2021/06/TDB-Datablad-RAC-Komplet-Lineup-R32-2020-compressed.pdf>

How big to make the heat pump?



Heat output reduces as outdoor temperature reduces.

How big to make the heat pump?



Heat require increases as outdoor temperature reduces.

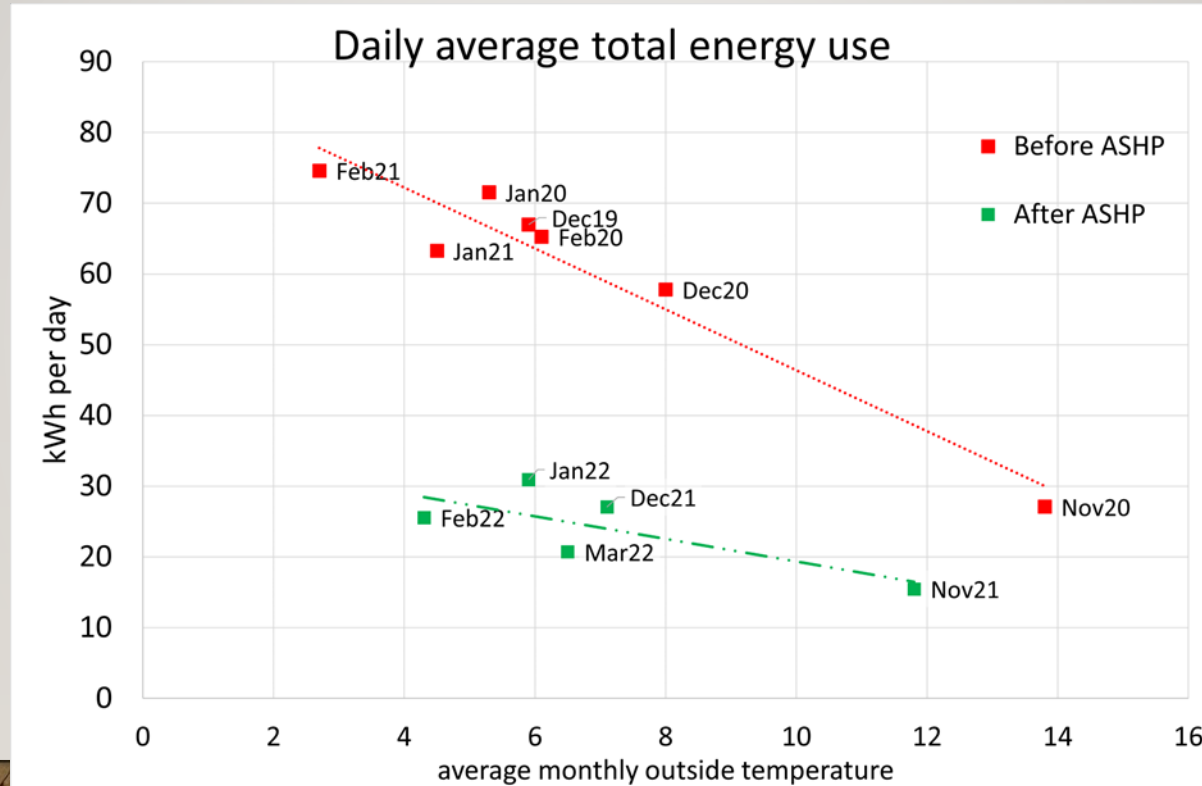
What to do if there is not enough heat in?

- Shut off rooms to reduce heat loss
- Accept lower temperature (put a woolly on!)
- Wood burning stove

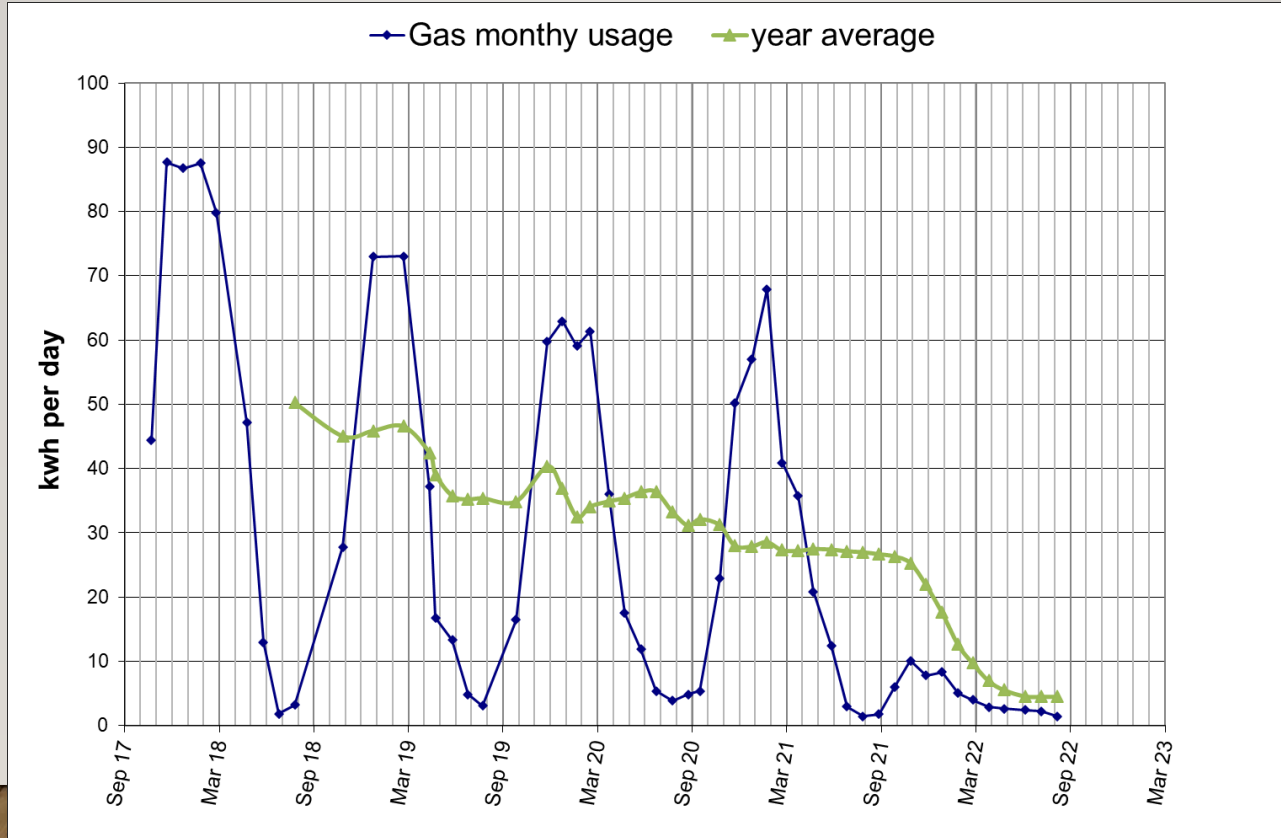
Gas boiler still in place! *(until you decide you don't need it)*



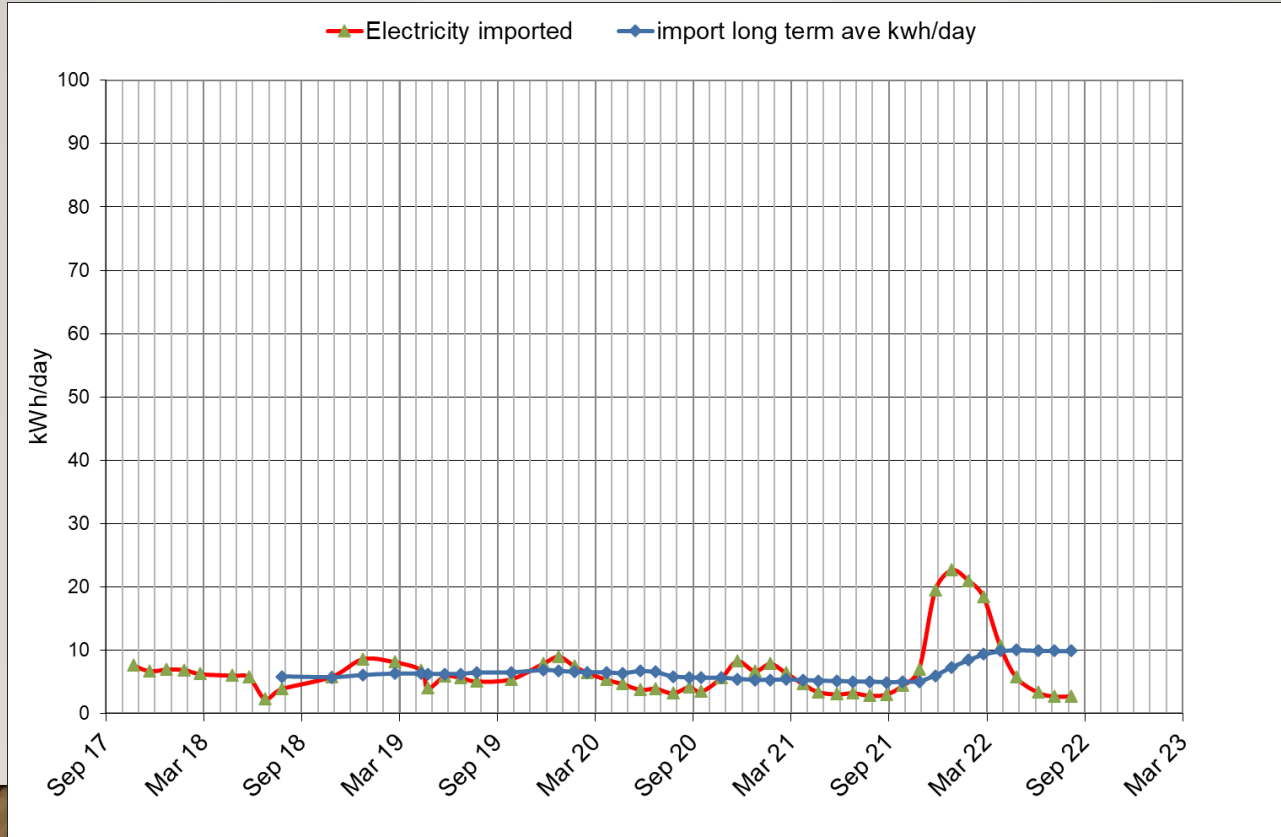
Proven energy savings from heat pump



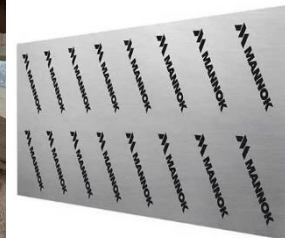
How has our gas use changed?



How has our electricity use changed (same scale)



Completed this summer: under floor insulation



Rigid PIR Insulation
Board 2400 x 1200
x 100mm

SKU: 10002182

£56.88

VAT Included

Mannok Therm Roof / MR PIR insulation is high performance, fibre free board, with a rigid thermoset insulation core faced on [Read more](#)

Quantity

1

ADD TO BASKET

BUY NOW

Just completed: under floor insulation



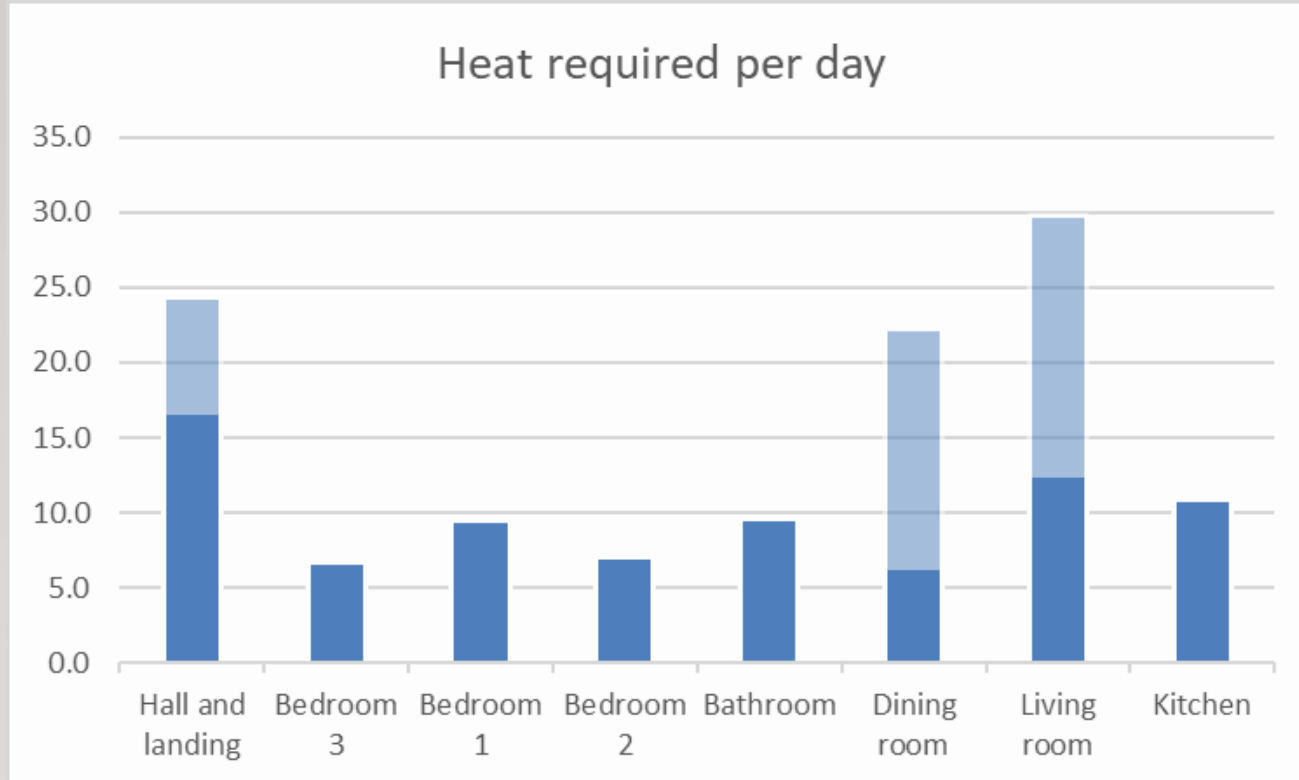
Living room: 15m²

Cost ~£150 for insulation and membrane

No labour cost (DIY)

Saving ~0.6kW

With underfloor insulation



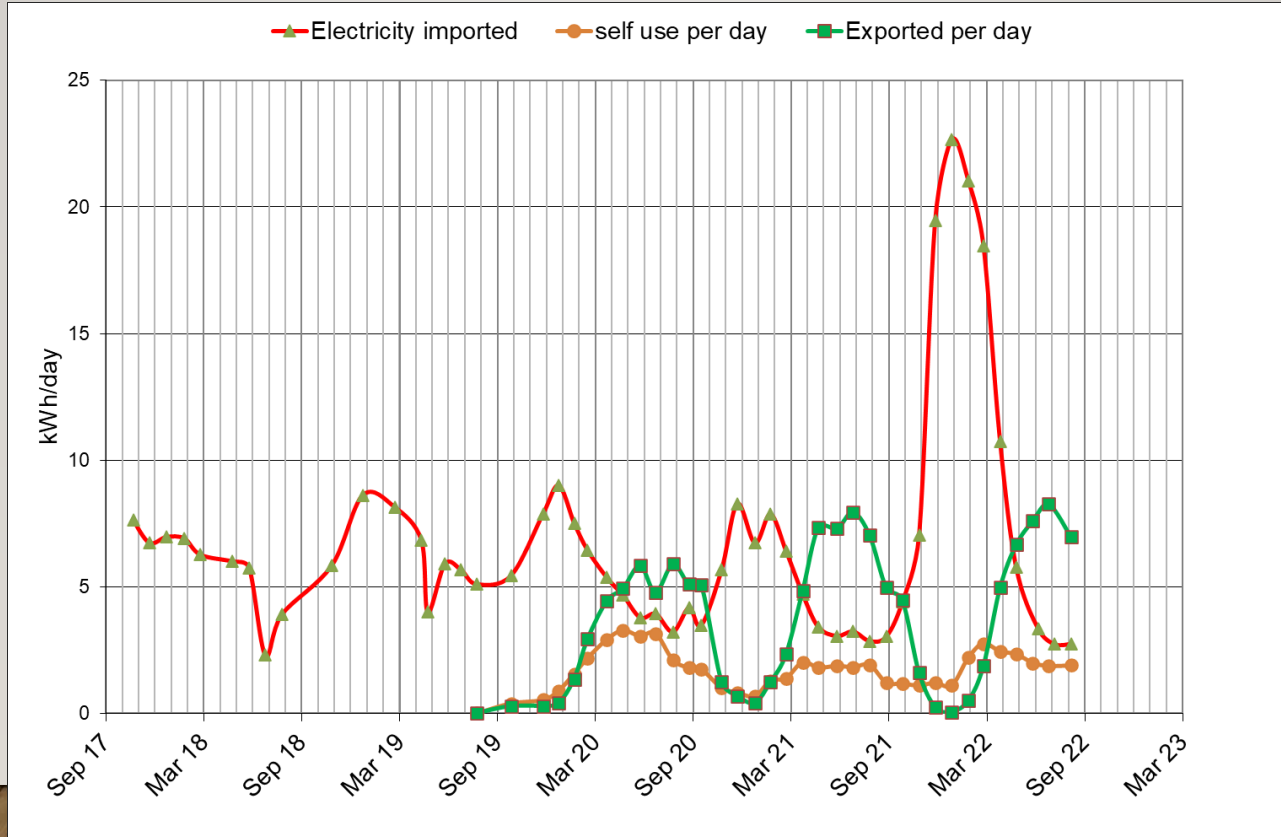
Solar energy

9 Solar panels

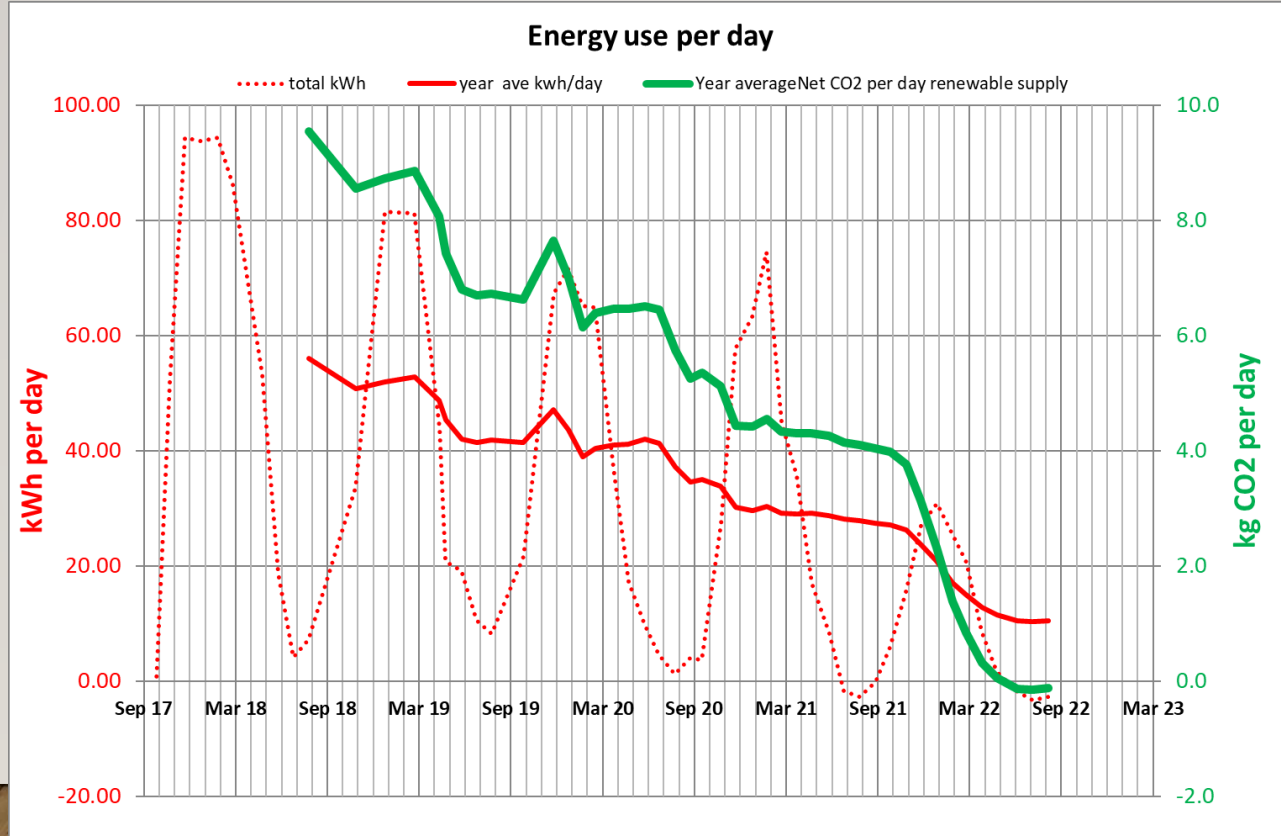
Conservatory



Electricity use profile



With renewable electricity supply we reach net zero



LIFESTYLE CHOICES

WHAT CAN WE
DO TODAY?



Lifestyle habits

- Dress more warmly and keep room temperature down
 - Try heated cushions and heated jackets
- Don't heat empty rooms, and shut the door to them.
- With gas ... don't leave the heating on all night, or when nobody is at home.
- Turn boiler temperature down.

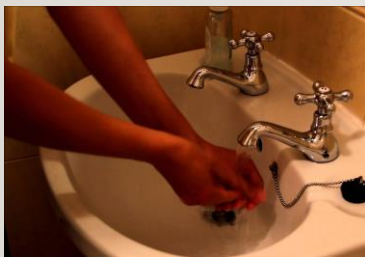


Lifestyle habits

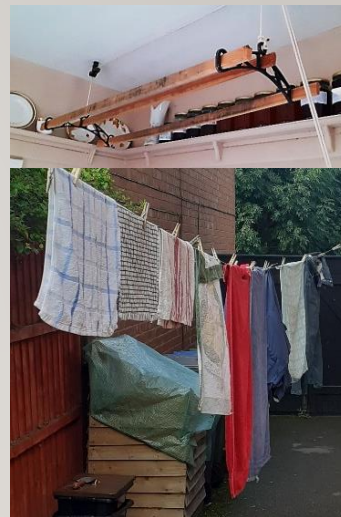


Saving excess boiled water in a thermos saves 0.1kWh per litre

Washing hands in cold water can save 0.5kWh per day



Air drying instead of tumble drying can save around 4 kWh / load



Turning electrical items off at the plug instead of standby can save 0.5kWh per day

Lifestyle habits

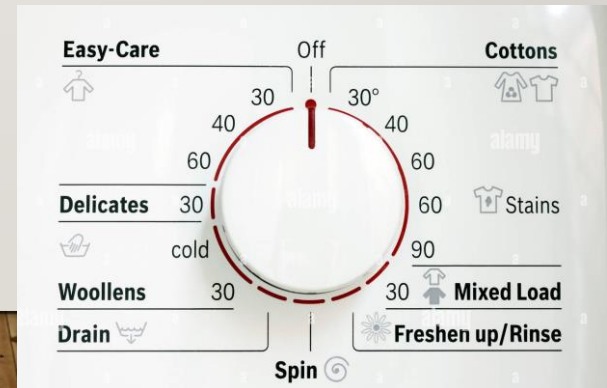


Limiting your top speed to 60mph can save 10% fuel consumption



Skipping a shower can save 1.5kWh or more.

Washing at 30C instead of 40C saves 40% energy. 0.4kWh per wash



Other lifestyle choices

How many kg of CO₂ do different activities produce?



Our legacy?

