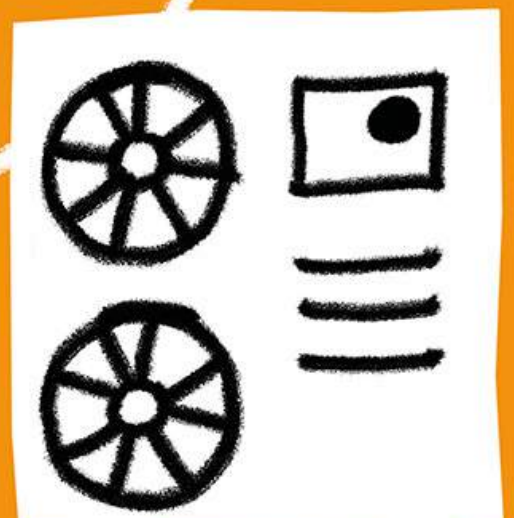
Transition Town Lewes presents

SHOULD I GET A HEAT PUMP?



Join an expert panel (plus homeowners who have got one) to explore this greener home heating solution.

Thursday 9 March

7.30pm (doors open 7.15pm)

The Elephant & Castle Pub
White Hill, Lewes, BN7 2DJ

FREE (donations welcome)

Transition Town LEWES

In partnership with

OVESCO
OUSE VALLEY ENERGY SERVICES COMPANY

COMMUNITY ENERGY SOUTH

DEEPER GREEN by design

Should I Get a Heat Pump?

Your NEW Climate Hub is opening at Lewes House!

GRAND OPENING

32 High Street, Lewes BN7 2LX

DISPLAYS MUSIC & POETRY

GROUPS & PROJECTS TO JOIN

OVESCO ENERGY ROOM

FAMILY ACTIVITIES AND LOTS MORE

SATURDAY 18 MARCH

11am – Procession from Linklater

Midday – Official opening

Plant a tree on the riverbank

Everyone welcome until 3pm

Usual opening hours: Wednesday – Saturday 11am-3pm

Putting climate action at the heart of our town

Lewes Climate Hub

COMMUNITY ENERGY SOUTH

OVESCO

Programme

Ian McKay

- What are heat pumps and how do they work?
- The benefits over other forms of heating
- How I would need to adapt my house
- The cost and the potential savings
- Do I need planning permission?
- Are air source heat pumps noisy?

Neil Williams

- What have been the experiences of homeowners who have got one - and what advice they would now give to others

Q&As

- Our speakers and a local installer will be happy to respond to questions you may have on the tonight's topic.

Introduction – Ian McKay

DEEPER GREEN by design

Should I Get a Heat Pump?

Introduction – Ian McKay

Image credit: Ian McKay

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Image credit: Ian McKay

AJ Retrofit AWARDS 2013 WINNER

Technology Strategy Board
Driving Innovation

Image credit: Ian McKay

Should I Get a Heat Pump?

Introduction – Ian McKay

Image credit: Ian McKay

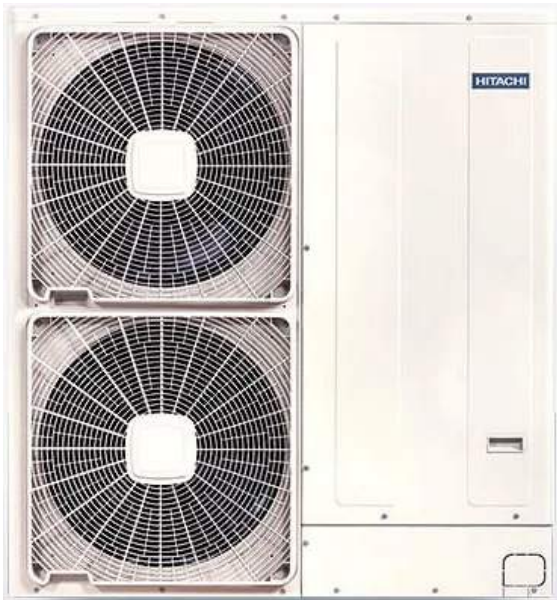
What are heat pumps and how do they work?

Did you know…?

The Royal Festival Hall (1951) was originally heated and cooled by heat pumps working with the water of the River Thames.

The compressors were powered by 2 Rolls Royce Merlin engines converted to run off the gas supply!

Why the fridge?



The magic bit…

A good air source heat pump installation is capable of around 300% efficiency or a coefficient of performance (CoP) of 3. Some claim higher than this.

A good ground source heat pump installation can have a CoP of over 4!

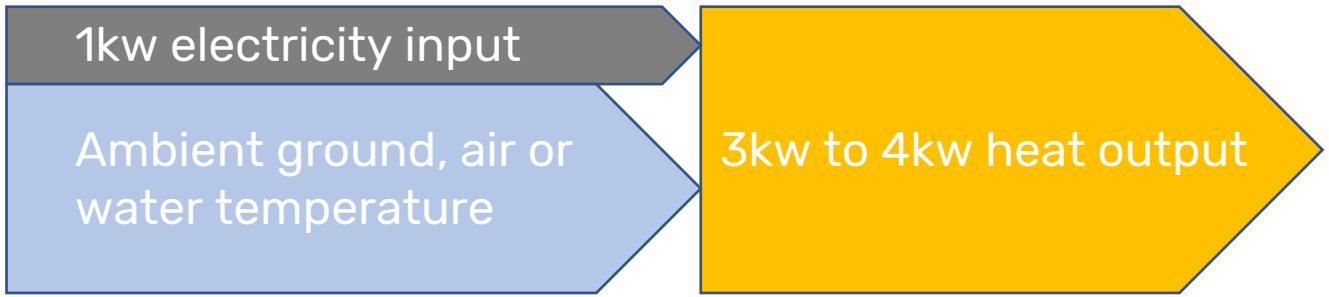
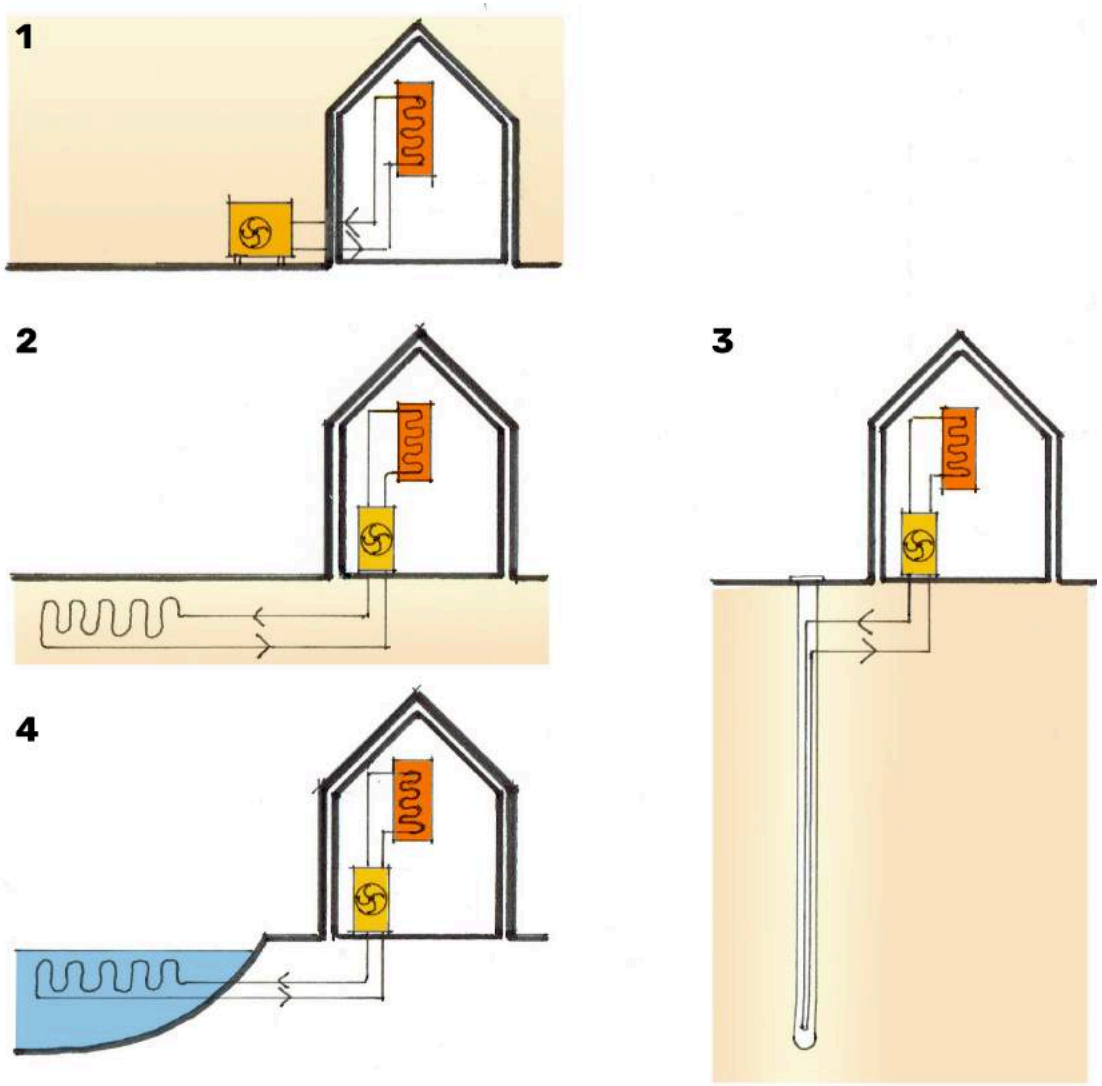


Image credit: Deeper Green

JARGON BUSTER

Coefficient of performance:
The rated efficiency of a heating appliance based on the heat output relative to the energy input.

Different types of heat pumps



Key:

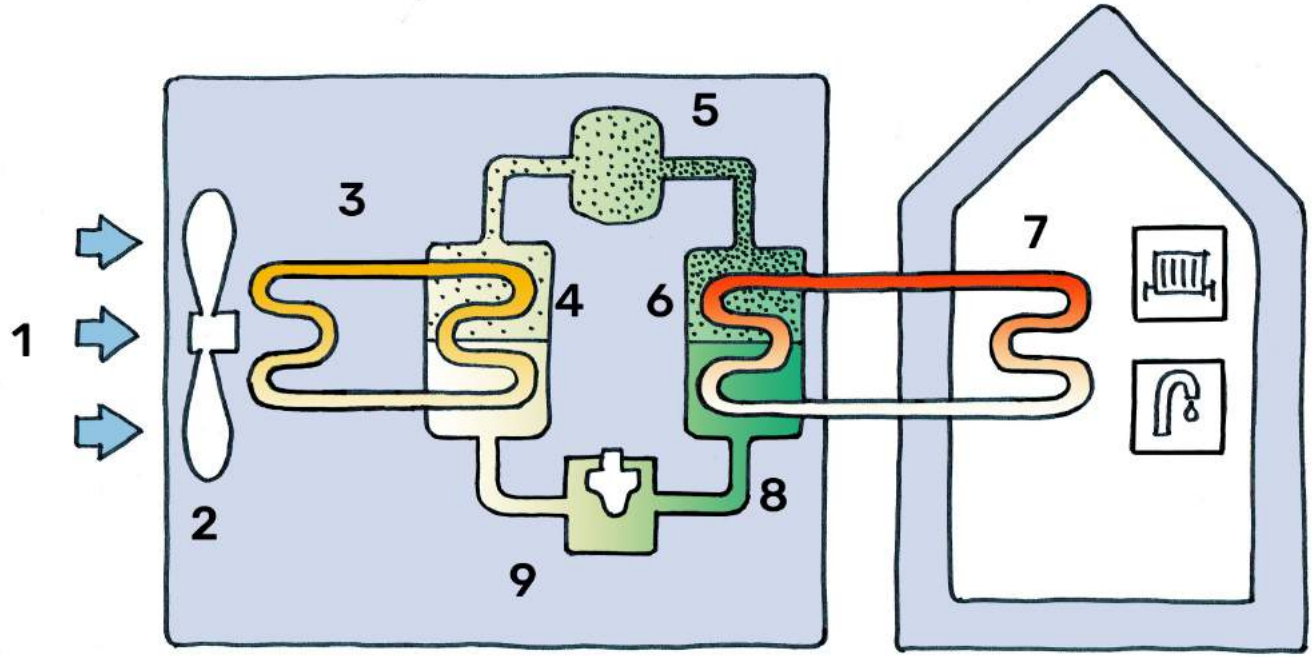
1. Air source heat pump
2. Ground source heat pump (horizontal)
3. Ground source heat pump (borehole)
4. Water source heat pump

Typical borehole depth is between 75m – 200m deep

Brighton's i360 is 162m high

Image credit: Deeper Green

How it works...



Heat pumps can extract heat from very cold air temperatures with some claiming to work down to -25°C.

Key:

1. Outside air blown over heat exchanger
2. Impeller (fan)
3. Antifreeze absorbs heat energy from outside air
4. Refrigerant evaporates at low temperatures
5. Condensor raises heat by pressurising the vapour
6. Another heat exchanger takes heat into the building
7. Heat utilised for space and/or domestic hot water
8. Regrigerant cools back into liquid
9. Expansion valve removes pressure and cools liquid

Image credit: Deeper Green

Should I Get a Heat Pump?
What are heat pumps and how do they work?

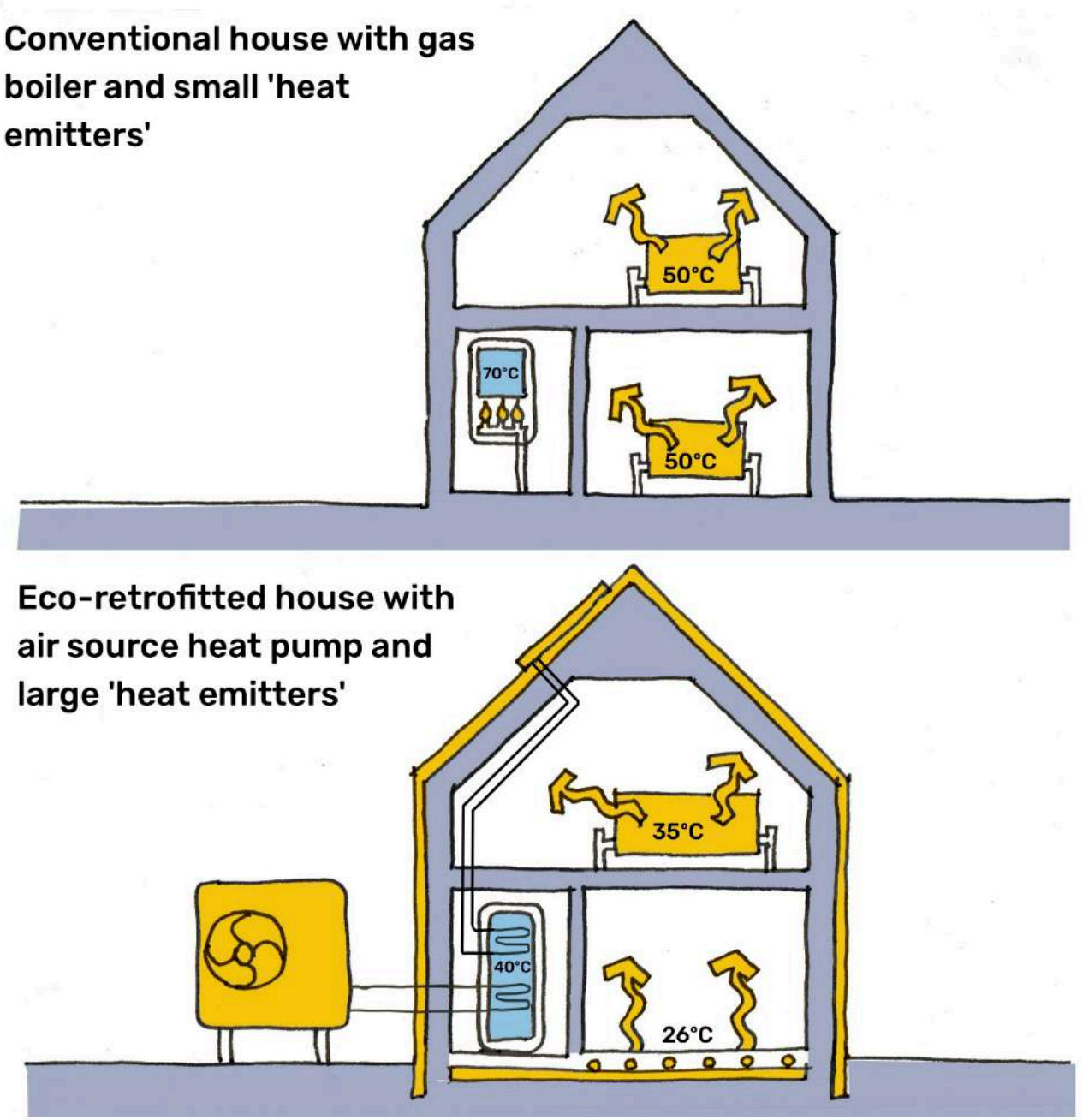
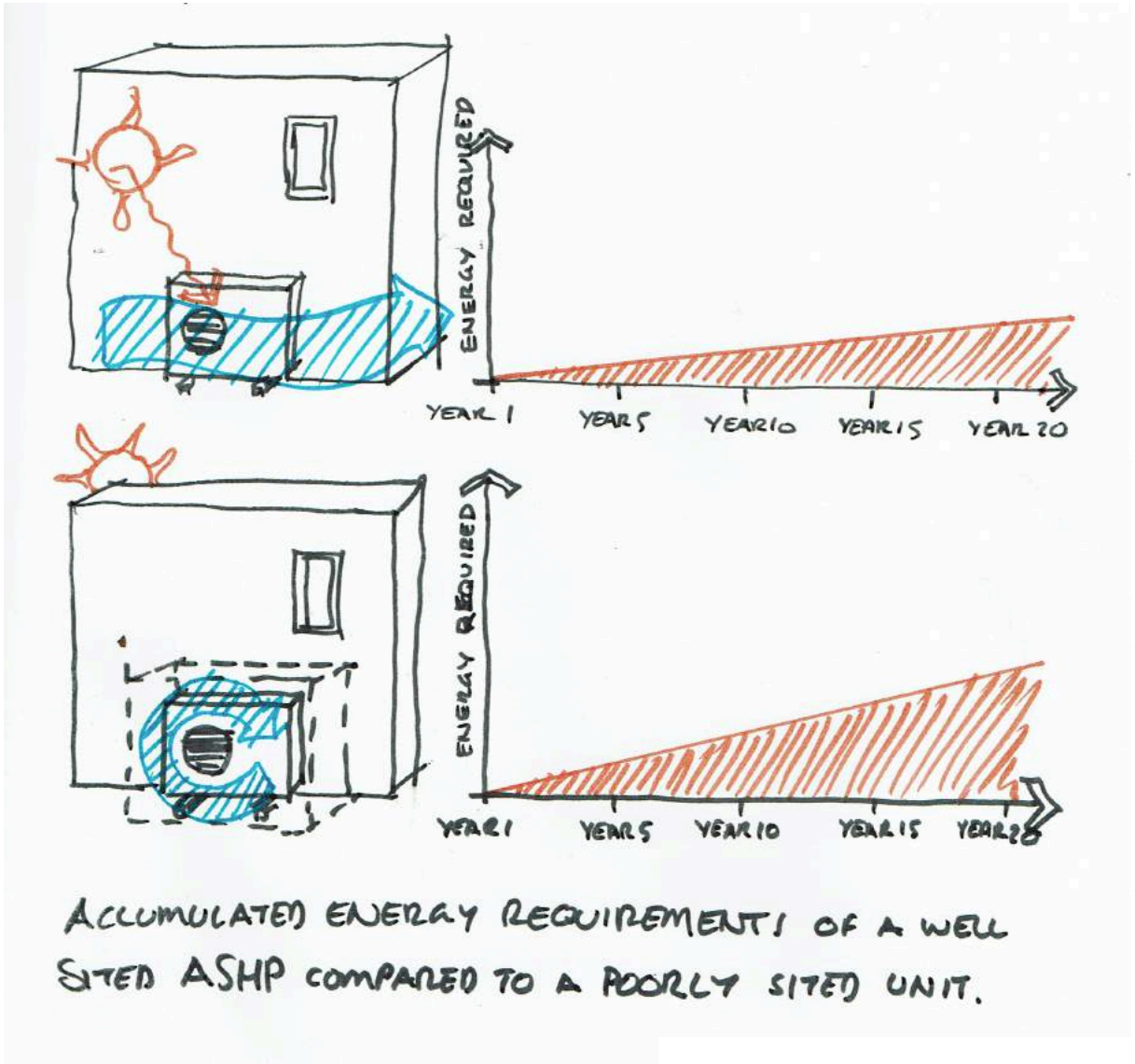


Image credit: Deeper Green

Should I Get a Heat Pump?
What are heat pumps and how do they work?



ACCUMULATED ENERGY REQUIREMENTS OF A WELL SITED ASHP COMPARED TO A POORLY SITED UNIT.

Image credit: Deeper Green

Should I Get a Heat Pump?
What are heat pumps and how do they work?

Image credit: Danfoss

Image credit: Daikin

Image credit: Samsung

Image credit: Viessmann

Image credit: Mitsubishi

The benefits over other forms of heating

Should I Get a Heat Pump?

The benefits over other forms of heating

Image credit: Deeper Green

Compared to gas

The cost and relative carbon intensity of gas versus electric forms of heating (air source heat pump)

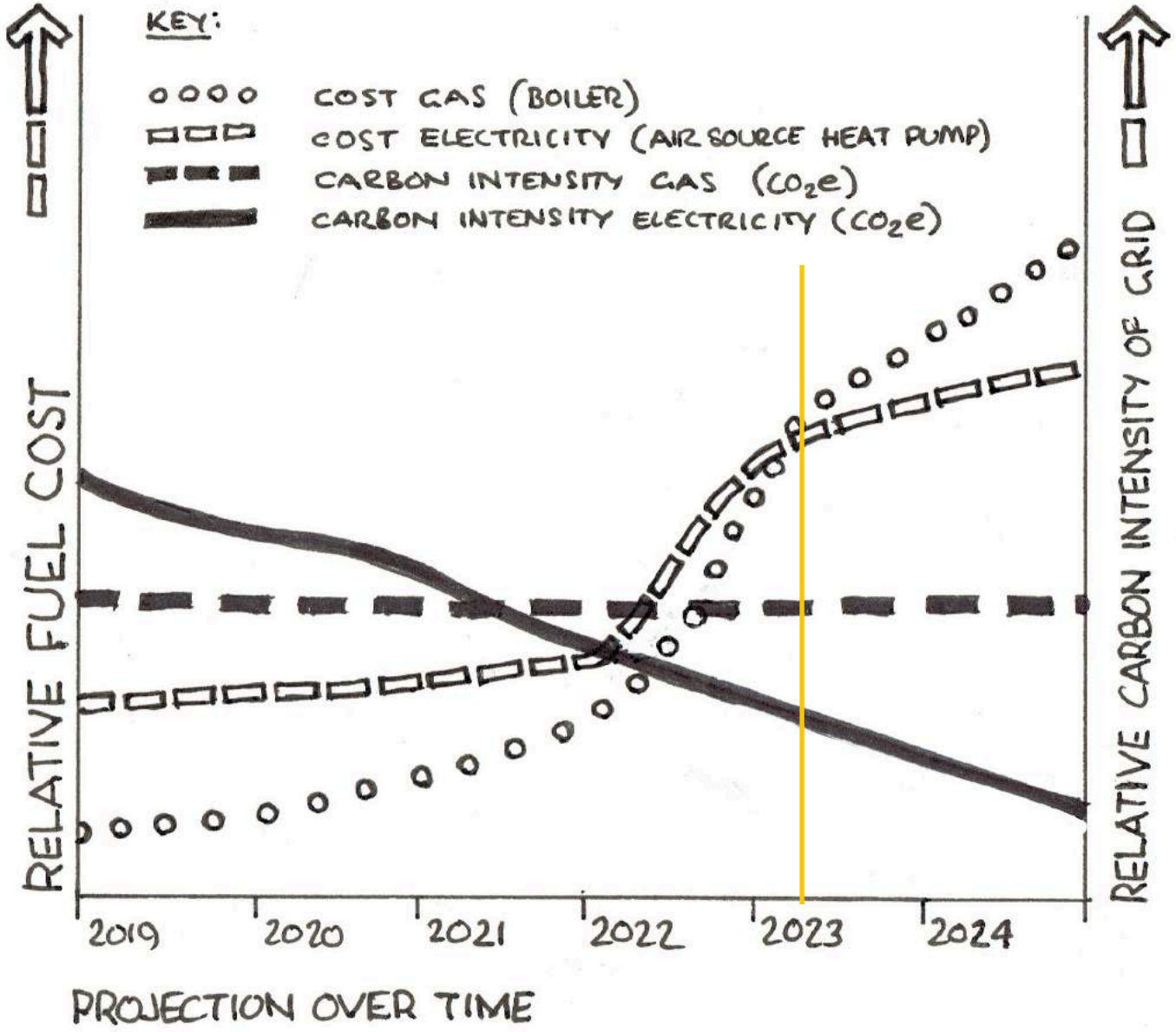


Image credit: Deeper Green

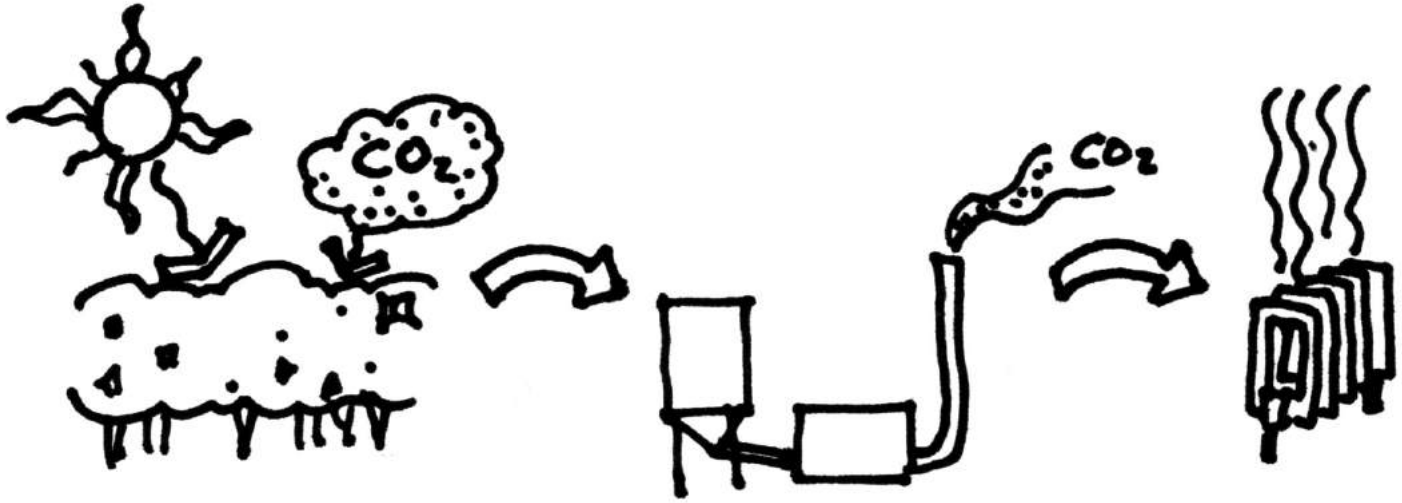
JARGON BUSTER

Carbon intensity: Pertaining to the global warming potential (usually expressed as CO_2e) of the energy supplied by the national grid energy network, ie. The mix of coal, bio-mass, gas, nuclear, solar and wind

Compared to bio-mass

- Far less particulate emissions
- Don't believe the hype, bio-mass heating is far from being carbon neutral

JARGON BUSTER
Bio-mass heating: Using grown material such as wood from trees to create thermal energy. Wrongly attributed (in my opinion) as carbon neutral form of heating as it takes many times longer to store the CO_2 than to release it through burning.



60 Years 60 Minutes

Therefore, it takes about 525,600 times longer to store the CO_2 than release it!

Image credit: Deeper Green

Should I Get a Heat Pump?
The benefits over other forms of heating

Compared to direct electric heating

- 1kw of input electricity produces around 1kw of heat energy with direct electric heating (ie. Something like a portable heater)
- 1kw of input electricity in a heat pump will typically give you around 3kw of heat output

Image credit: Daewoo

Should I Get a Heat Pump?
The benefits over other forms of heating

Compared to storage heaters

- Freeing up floor space and wall space where using underfloor heating
- Overall ASHP offers lower running costs
- More responsive to heating and cooling demand
- Over time there will be less need for Economy 7 tariff as there will be fewer power station turbines to keep going through the night

Image credit: Dimplex

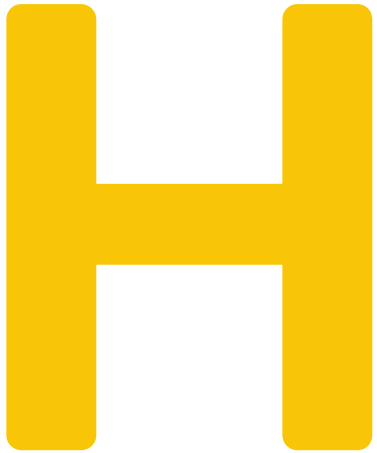
Compared to LPG and Oil

- Generally LPG is marginally more damaging to the environment than mains gas but oil is much worse
- Get rid of the ugly oil storage tank or gas cylinder (and the smell)
- ASHP and GSHP are excellent solutions for the rural context

Image credit: Total Tanks

What about ‘green’ hydrogen?

- There are suggestions that ’green hydrogen’ could be used in the existing gas supply network and used in existing boilers
- Unfortunately, it seems unlikely that green hydrogen will be available at any appreciable scale in the near term, it is likely to be expensive when it is and some suggest the aviation industry will be first in-line to use what capacity we maybe able to produce



Increasing human activity = decreasing ecological capacity

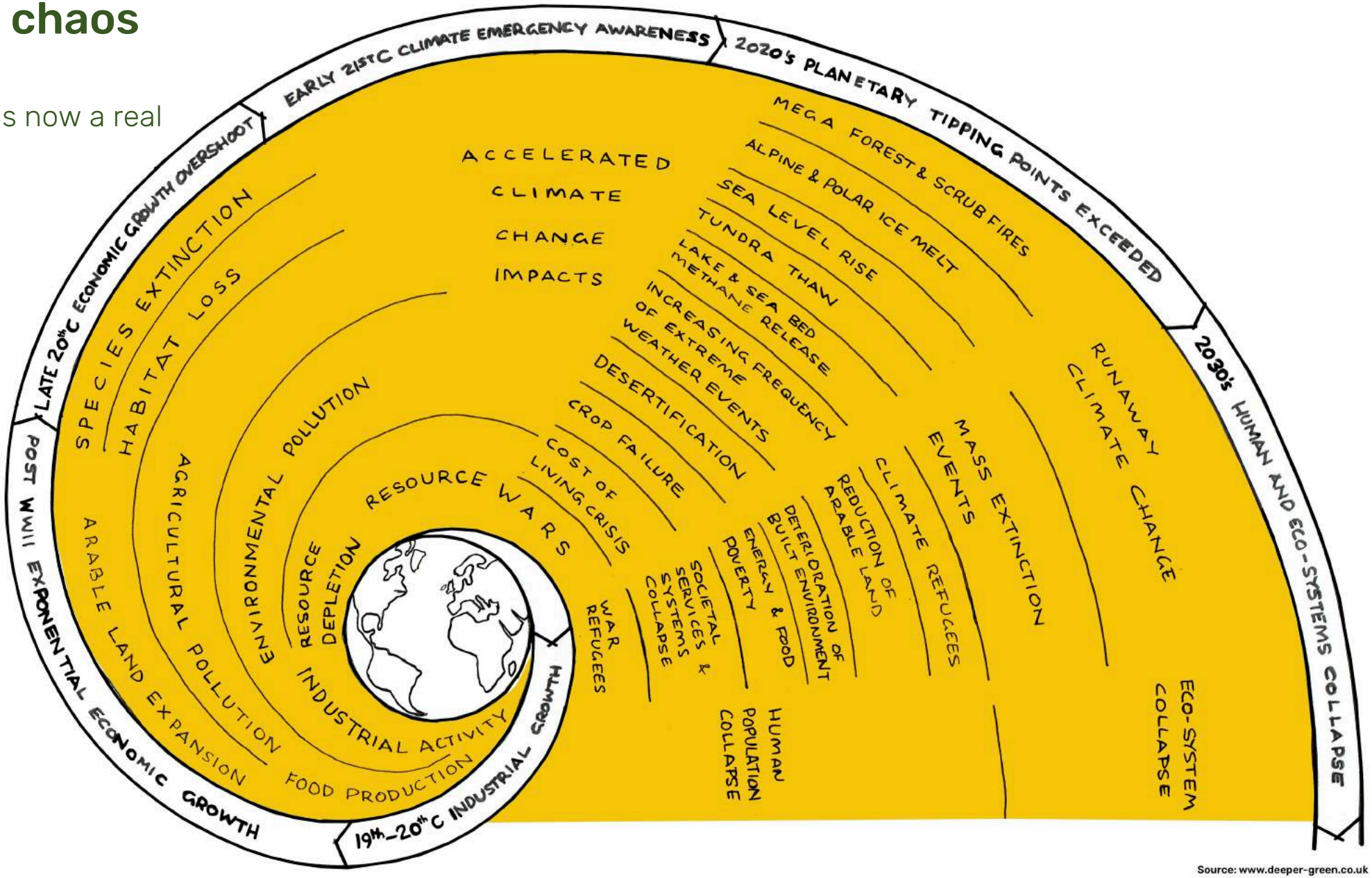
We have to stop burning stuff as we are already CRITICALLY degrading the ability of the planet to support life

Image credit: Deeper Green

Image credit: Deeper Green

Exponential growth = exponential chaos

Resource security is now a real concern for many sovereign states



Source: www.deeper-green.co.uk

Should I Get a Heat Pump?
The benefits over other forms of heating

Humankind is not good at responding to slow moving existential threats

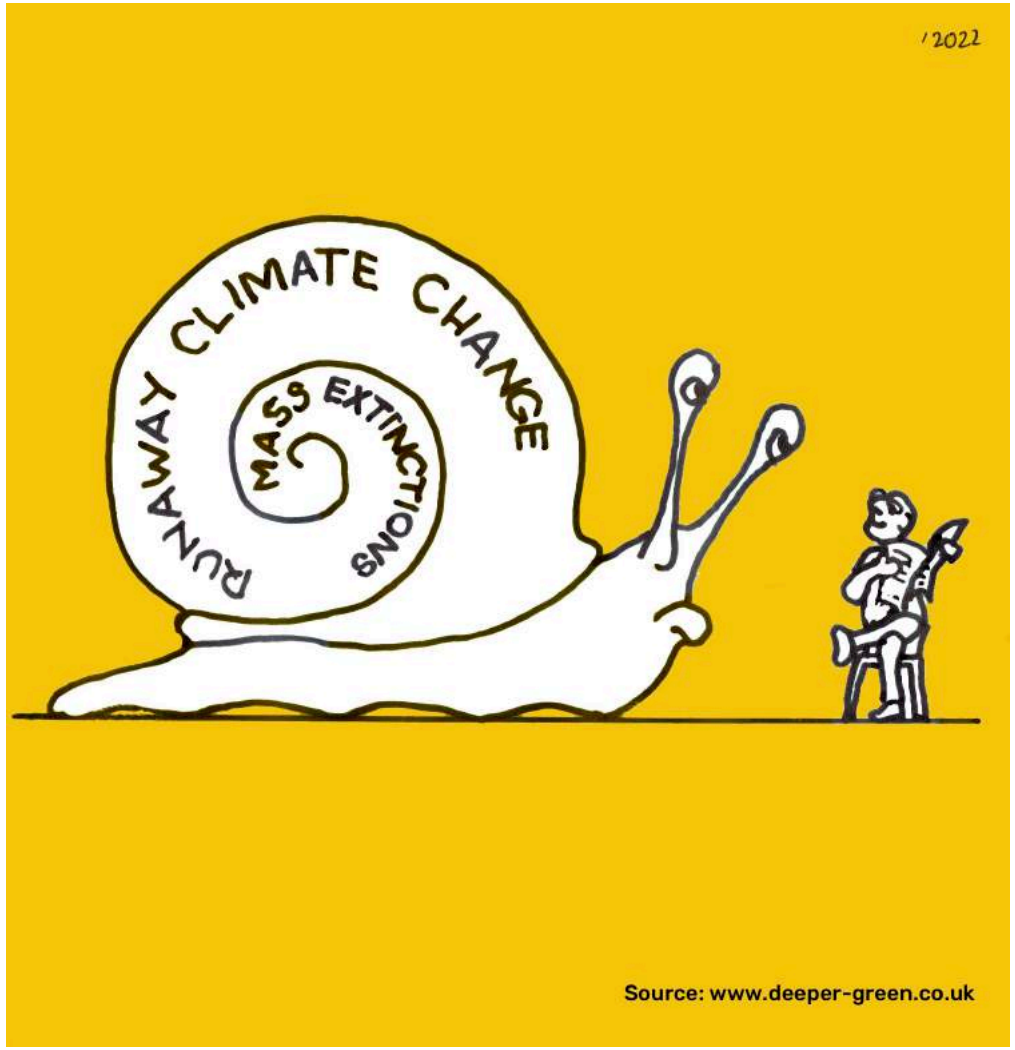


Image credit: Deeper Green

Many of us chose to ignore the consequences of over-consumption

Image credit: Deeper Green

How I would need to adapt my house

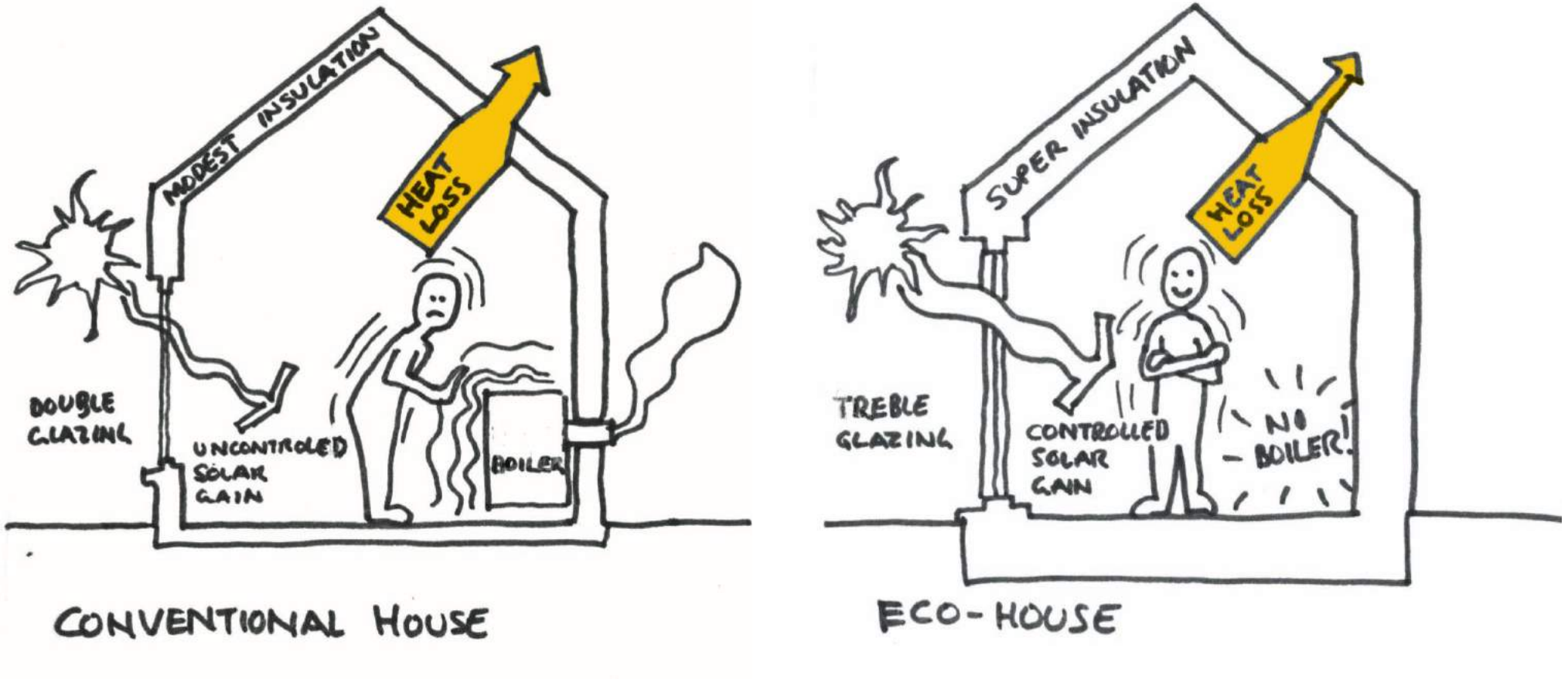


Image credit: Deeper Green

The importance of slowing down the rate of heat loss

The importance of slowing down the rate of heat loss

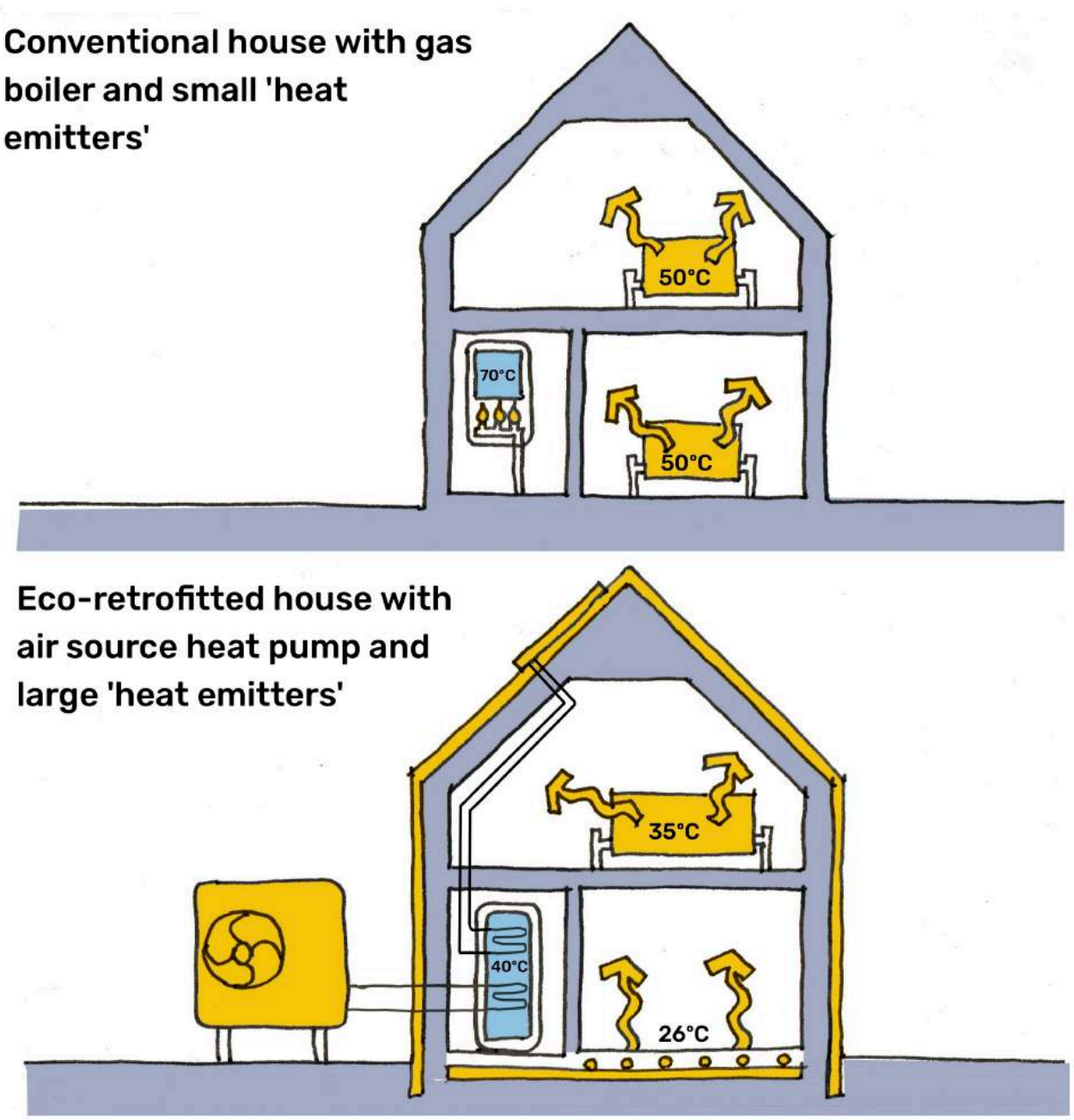


Image credit: Deeper Green

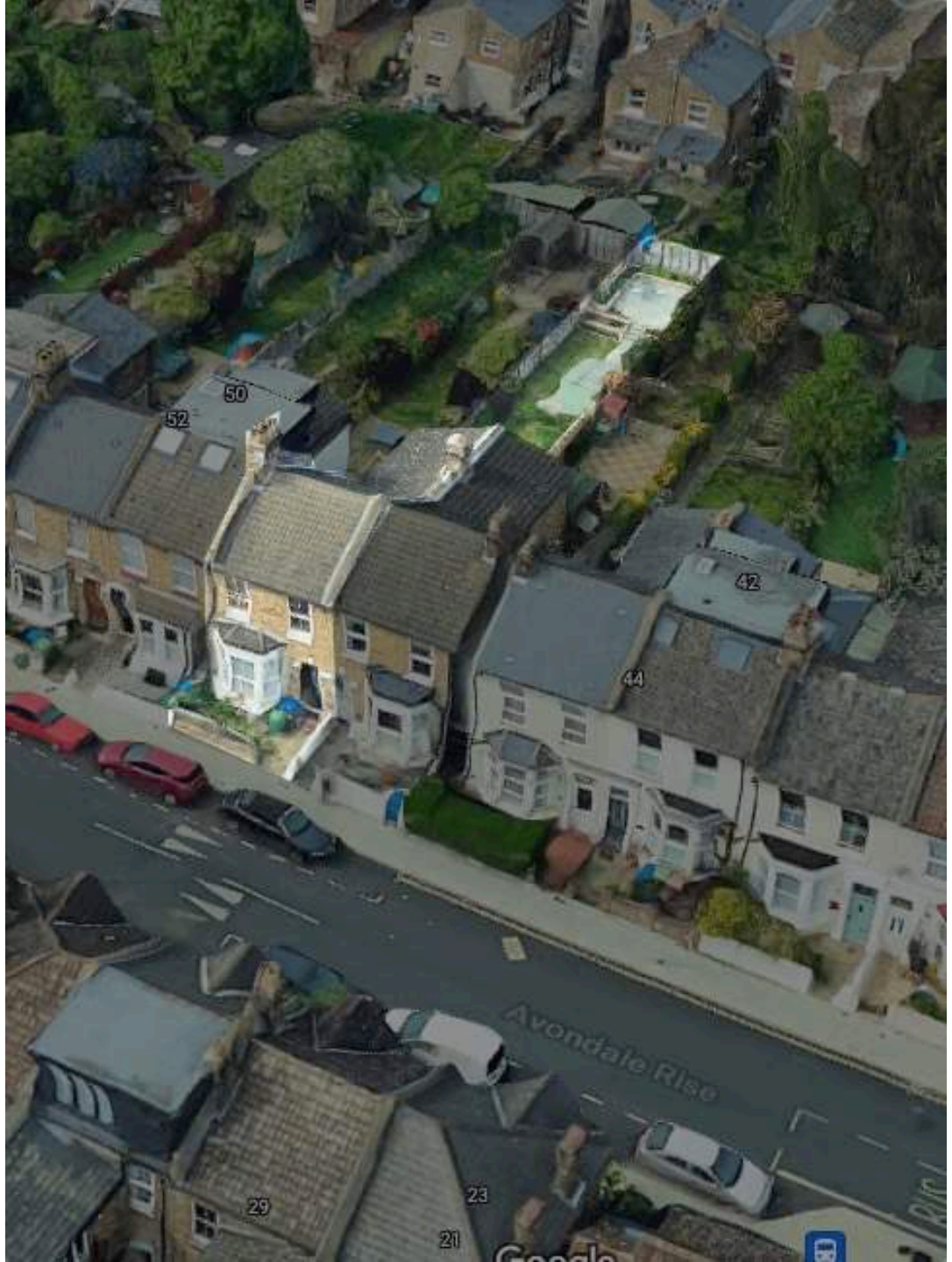
Light
Eco-
Retrofit
£

Medium
Eco-
Retrofit
££

Deep
Eco-
Retrofit
£££

JARGON BUSTER
Eco-retrofit: Installations applied to an existing building to reduce the energy demand in operation

Should I Get a Heat Pump?
How I would need to adapt my house



What Deeper Green do:
Appraise the heat loss of the existing building's external envelope

Image credit: Deeper Green

What Deeper Green do:

Measure the areas of the 'thermal envelope' by construction type

JARGON BUSTER

Thermal envelope: The enclosure of the building which is treated as the insulating boundary to the interior and/or the heated and ventilated (conditioned) spaces. ie. External walls, roofs, ground floor, windows etc.

DEEPER GREEN

Should I Get a Heat Pump?
How I would need to adapt my house

Existing dwelling heat loss calculation

Fabric heat losses

	Area (m²)	U	kWh a x U x degree days	Proportion of whole	
Ground floor	53.30	0.84	1,740.74	19.9%	
Walls (street)	22.00	1.82	1,556.76	17.8%	
Walls (rear)	42.00	1.82	2,971.99	34.0%	
Loft floor	37.90	0.18	265.24	3.0%	
Loft boarded f	13.20	0.90	461.89	5.3%	
Bay window roofs	3.20	1.00	124.42	1.4%	
Loft Hatch	0.70	4.00	108.86	1.2%	
Windows	24.00	1.40	1,306.37	14.9%	
Front door	1.80	3.00	209.95	2.4%	**8,746.21** kWh

Ventilation heat losses

	Area (m²)	Height	Volume (m3)	Assumed air changes / hour	kWh x degree days	
L0 front	33.1	2.79	92.349	9	444.33	
L+1 front	33.1	2.70	89.37	9	429.99	
L0 rear	20.2	2.13	43.026	9	207.02	
L+1 rear	20.2	2.38	48.076	9	231.31	**1,312.65**

heating demanc

Annualised heat demand:	**10,058.86**	kWh	£3,420.01
Peak heating demand:	**6.2**	kW	

Image credit: Deeper Green

What Deeper Green do:

Assign U-values to each thermal element and estimate the ventilation heat losses of the existing building

JARGON BUSTER

U-value: The measure of heat transfer (thermal transmittance) through a portion of external building fabric expressed as W/m²K. The lower the figure the more efficient the build-up is.

Should I Get a Heat Pump?
How I would need to adapt my house

DEEPER GREEN

Proposed dwelling heat loss calculation - Deep Eco-Retrofit

Fabric heat losses

	Area (m²)	U	a x U	heat loss reduction	Proportion of whole	% reduction	£ guesstimate	heat loss reduction/ £1K	
Ground floor	53.30	0.18	373.01	1367.72	12.88%	79%	£10,000.00	137	*
Walls (street)	22.00	0.35	299.38	1257.38	10.33%	81%	£19,000.00	66	
Walls (rear)	42.00	0.18	293.93	2678.05	10.15%	90%	£19,000.00	141	
Loft floor	37.90	0.18	265.24	0.00	9.16%	0%	£0.00		
Loft boarded f	13.20	0.18	92.38	369.52	3.19%	80%	£2,000.00	185	
Bay window roofs	3.20	0.28	34.84	89.58	1.20%	72%	£4,000.00	22	
Loft Hatch	0.70	0.80	21.77	87.09	0.75%	80%	£1,000.00	87	
Windows	24.00	1.40	1,306.37	0.00	45.10%	0%	£0.00		
Front door	1.80	3.00	209.95	0.00	7.25%	0%	£0.00		**2896.9** kWh
				5849.34			£55,000.00		

* possibly highest cost benefit of all as it also significantly reduces ventilation heat losses

Ventilation heat losses

	Area (m²)	Height	Volume (m3)	Assumed air changes / hour	kWh x degree days
L0 front	53.3	2.39	127.387	4	272.40
L+1 front	53.3	3.10	165.23	4	353.33
L0 rear	53.3	2.81	149.773	4	320.27
L+1 rear	53.3	2.32	123.656	4	264.43

heating demanc

	1210.4	
Annualised heat demand:	**4107.3**	kWh
Peak heating demand:	**2.5**	kW
Approximate demand reduction:	**59.2%**	

Image credit: Deeper Green

What Deeper Green do:

Assign U-values to each proposed thermal element along with an estimation of cost to derive a comparison of carbon saving versus cost benefit

Also estimate any improvements to the ventilation heat losses

JARGON BUSTER

Ventilation heat losses: The amount of airborne heat energy escaping the conditioned interior space through replacement fresh air ventilation.

DEEPER GREEN

Proposed dwelling heat loss calculation - Light Eco-Retrofit

Fabric heat losses

	Area (m²)	U	a x U	heat loss reduction	Proportion of whole	% reduction	£ guesstimate	heat loss reduction/ £1K	
Ground floor	53.30	0.18	373.01	1367.72	8.98%	79%	£10,000.00	137	*
Walls (street)	22.00	1.82	1,556.76	0.00	37.47%	0%	£0.00		
Walls (rear)	42.00	0.18	293.93	2678.05	7.08%	90%	£19,000.00	141	
Loft floor	37.90	0.18	265.24	0.00	6.38%	0%	£0.00		
Loft boarded f	13.20	0.18	92.38	369.52	2.22%	80%	£2,000.00	185	
Bay window roofs	3.20	0.28	34.84	89.58	0.84%	72%	£0.00		
Loft Hatch	0.70	0.80	21.77	87.09	0.52%	80%	£1,000.00	87	
Windows	24.00	1.40	1,306.37	0.00	31.45%	0%	£0.00		
Front door	1.80	3.00	209.95	0.00	5.05%	0%	£0.00		**4154.3**
				4591.96			£32,000.00		

* possibly highest cost benefit of all as it also significantly reduces ventilation heat losses

Ventilation heat losses

	Area (m²)	Height	Volume (m3)	Assumed air changes / hour	kWh x degree days
L0 front	53.3	2.39	127.387	7	476.71
L+1 front	53.3	3.10	165.23	7	618.32
L0 rear	53.3	2.81	149.773	7	560.48
L+1 rear	53.3	2.32	123.656	7	462.75

	2118.3
Annualised heat demand:	**6272.5**
Peak heating demand:	**3.9**
Approximate demand reduction:	**37.6%**

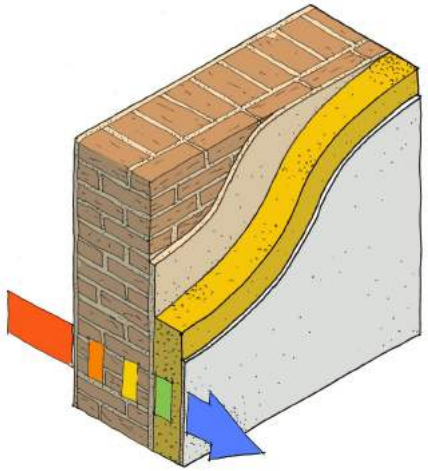
Image credit: Deeper Green

What Deeper Green do:

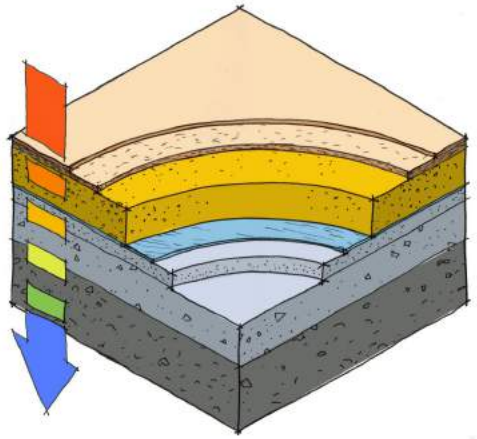
Prepare a ‘light eco-retrofit’ option which concentrates on the most beneficial range of measures

– the ‘low hanging fruit’

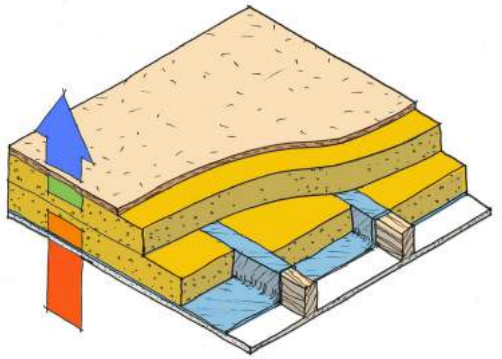
Should I Get a Heat Pump?
How I would need to adapt my house



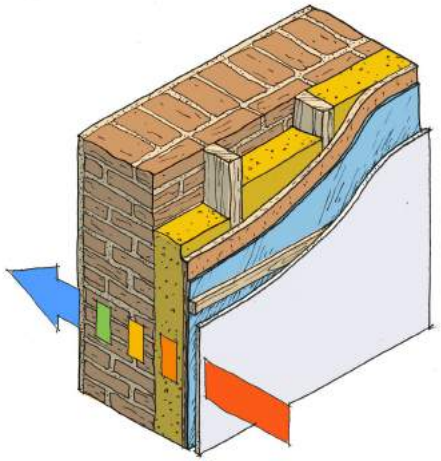
External wall
- External insulation



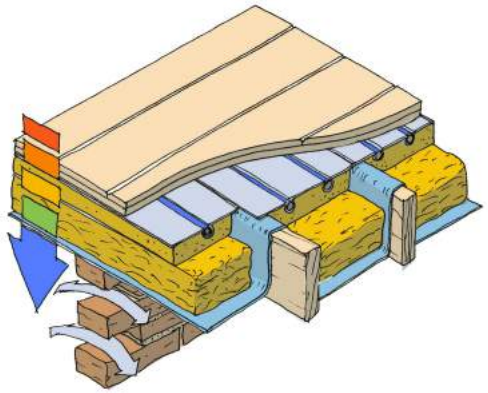
Ground floor
- Ground bearing slab



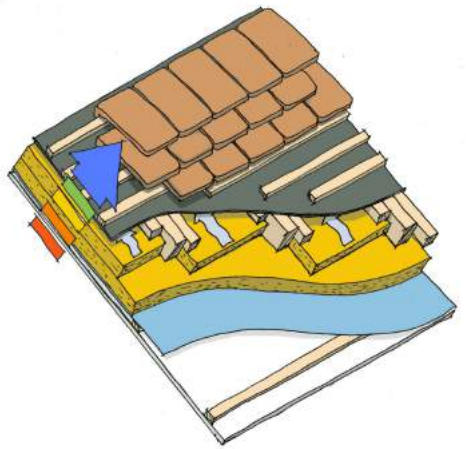
Loft floor



External wall
- Internal insulation



Ground floor
- Suspended floor

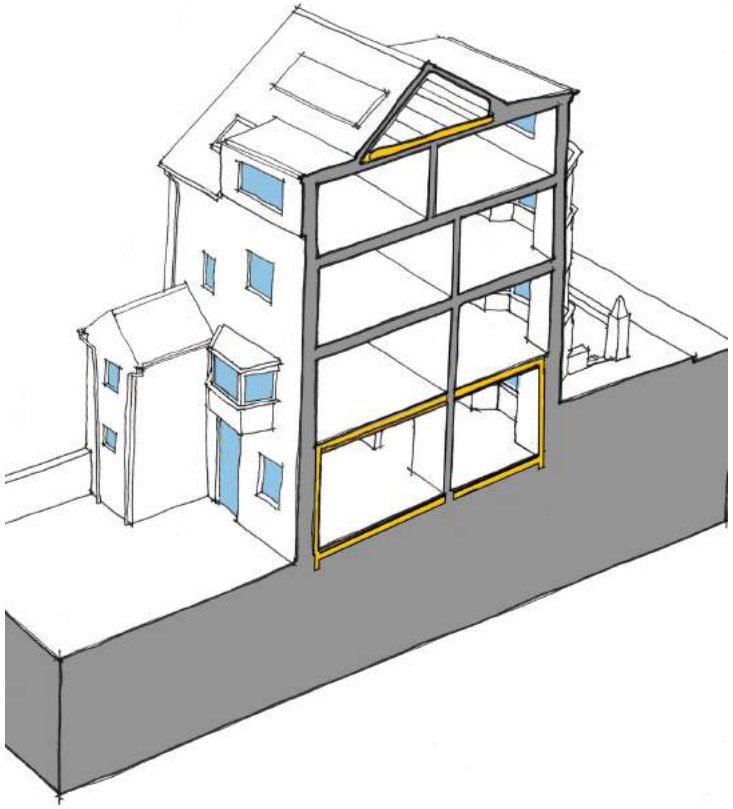


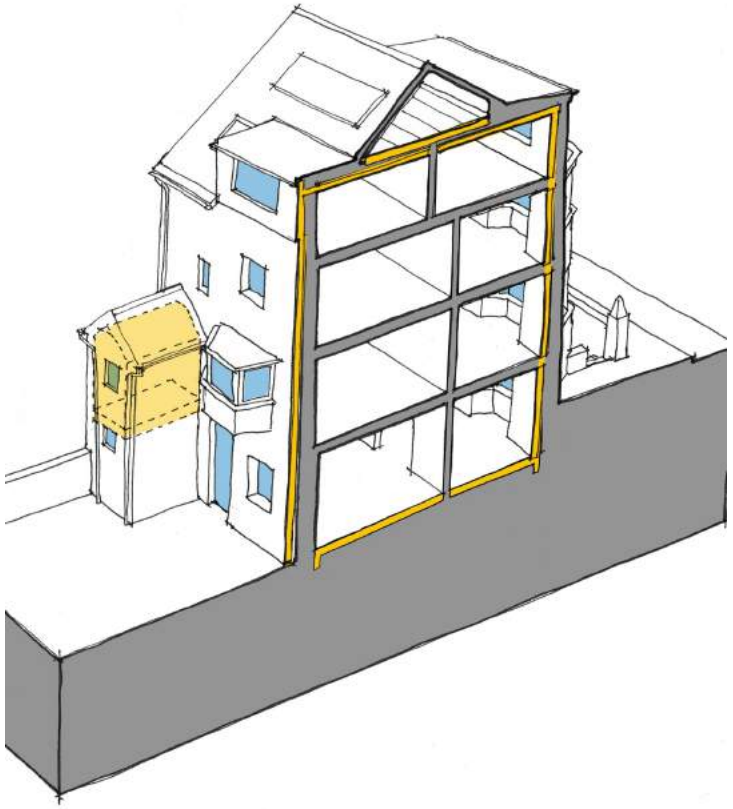
Pitched roof

Image credit: Deeper Green

What Deeper Green do:

Evaluate which technical solutions offer the best strategies for the context of the project





What Deeper Green do:

Finish up with a preferred strategy of eco-retrofit for the client to take forward to detail design, obtaining relevant permissions and organizing the construction phase

££

££££

Image credit: Deeper Green

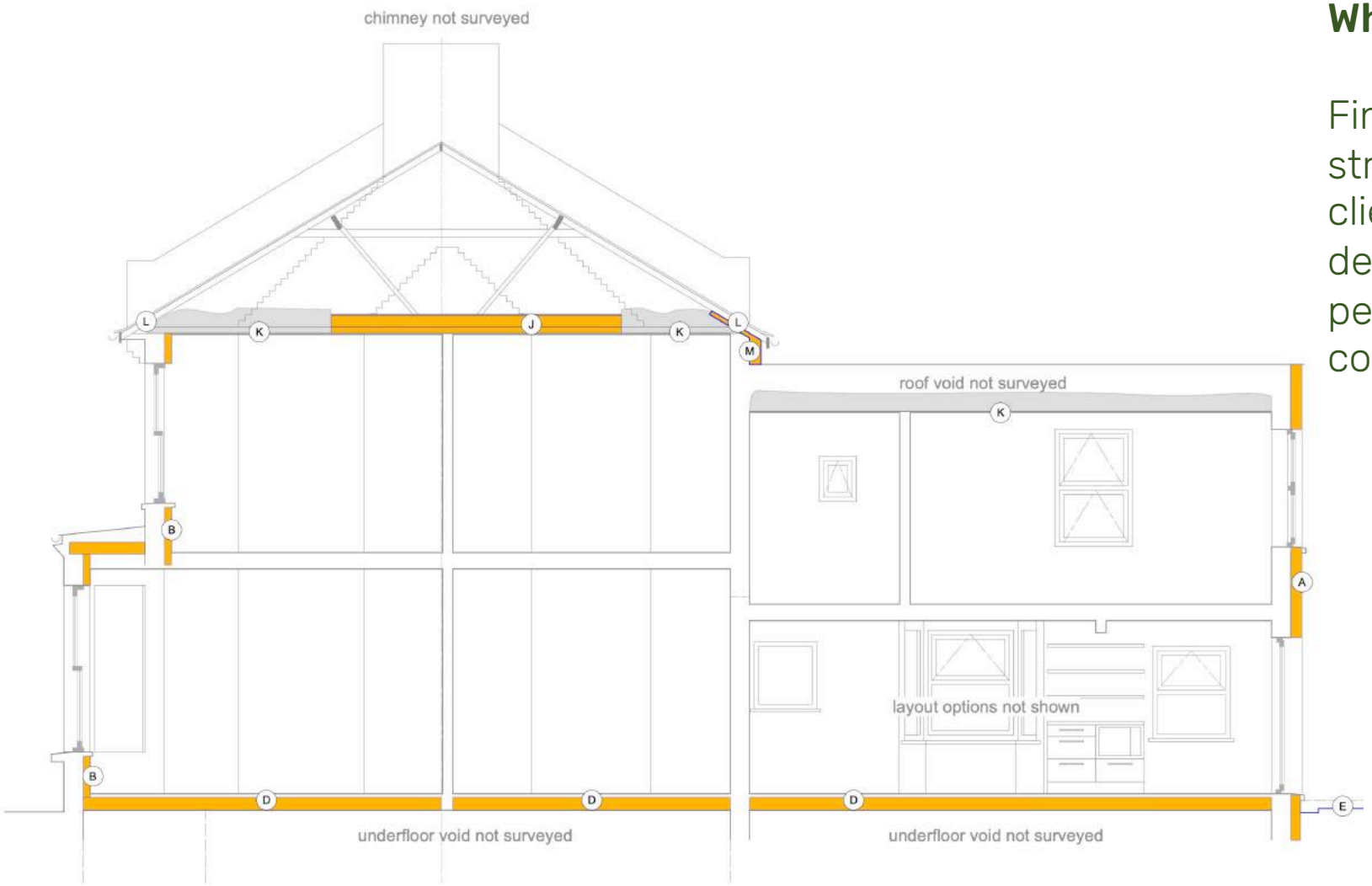


Image credit: Deeper Green

What Deeper Green do:

Finish up with a preferred strategy of eco-retrofit for the client to take forward to detail design, obtaining relevant permissions and organizing the construction phase

"So, the key message is – if you do nothing else, make enough fabric improvements to switch to a heat pump and avoid putting in fossil-fuel systems at all costs."

LETI, LETI Climate Emergency Retrofit Guide, October 2021. Pg. 9

"There is no property type or architectural era that is unsuitable for a heat pump – the Government-funded Electrification of Heat project has demonstrated."

"Energy efficiency upgrades were only made for 15% of properties where a heat pump was installed – in most cases this was loft insulation."

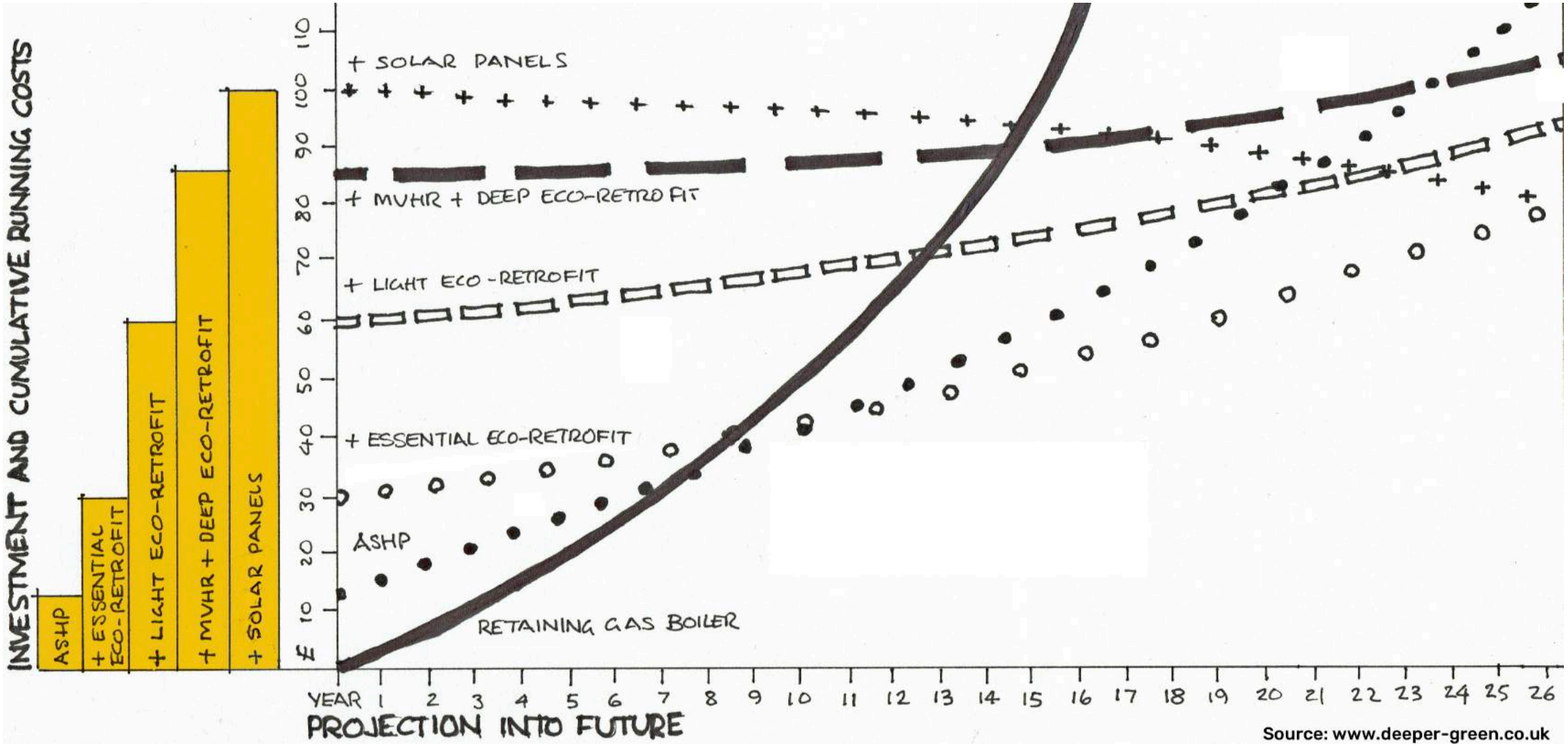
The Electrification of Heat (EoH) demonstration project

The project had a target to install heat pumps in up to 750 homes across Great Britain in a representative range of housing typologies, with the majority on the gas grid.

Image credit: https://es.catapult.org.uk

The cost and the potential savings

Should I Get a Heat Pump?
The cost and potential savings



Relative costs of eco-retrofit investment with running costs over time

Lower heating bills

According to Biosun Energy (Supplier based in Hartfield):

Based on a well-insulated 200m² home a heat pump could cost you:

- 70% less than electric heating
- 54% less than an oil boiler
- 29% less than a gas boiler

https://www.biosunenergy.co.uk/heat-pumps/air-source-heat-pumps

The typical installation cost

For a private residential project, the cost of an installed air source heat pump (ASHP) might be in the region of £10K to £14K

Octopus Energy are offering an ASHP installation for as little as £2,500.00 – the SAME price as a gas boiler and British Gas have also been recently driving down installation costs

The cost of a ground source heat pump (GSHP) is typically between £25k - £40K depending on the size and type of installation.

A good time to install might be if your boiler is towards the end of its service life and then you can offset the cost of the ASHP against that of a gas boiler.

As of February 2023 (and according to the www.gov.uk):

Through the Government's **Boiler Upgrade Scheme** you can get one grant per property.

Launched on 1st April 2022 the Boiler Upgrade Scheme is targeting 600,000 installations over next 5 years

Grants are available for:

- £5,000 towards an air source heat pump
- £6,000 towards a ground source heat pump (including water source heat pumps and those on shared ground loops)
- £5,000 towards a biomass boiler

Boiler Upgrade Scheme – CHECK THE SMALL PRINT (selected highlights):

- The installer must be registered on the **Microgeneration Certification Scheme** (MCS)
- You must have an Energy Performance Certificate and you must not have any outstanding recommendations for cavity or loft insulation
- Reversible heat pump installations (which can also do comfort cooling) are not eligible.
- You cannot get a grant for a hybrid heat pump system (for example a combination of gas boiler and air source heat pump).
- The system you install must meet certain standards, such as minimum efficiency levels (your installer can advise you on these).
- The system's maximum capacity must be less than 45kWh - anything over is not eligible.

Installers:

- In addition to ensuring they are MCS accredited, do some research to into the installer to satisfy yourself of their level of experience (you ought to avoid an installer being on a learning curve on your job)
- Make sure the heating engineer does a thorough and accurate heat loss calculation.
- At the moment, there are only around 3000 accredited heat pump installers whereas there are upwards of 130,000 gas heating engineers
- Training for heat pump installers is also being subsidised
- Currently there is no single clear route to qualify as an installer

Do I need planning permission?

As of February 2023 (and according to the www.planningportal.co.uk):

From 1 December 2011 the installation of an air source heat pump on domestic premises is considered to be permitted development, not needing an application for planning permission, provided ALL the limits and conditions listed below are met (selected highlights):

- The volume of the air source heat pump's outdoor compressor unit (including housing) must not exceed 0.6 cubic metres
- All parts of the air source heat pump must be at least one metre from the property boundary
- Permitted development rights do not apply for installations within the curtilage of a Listed Building or within a site designated as a Scheduled Monument
- On land within a Conservation Area or World Heritage Site the air source heat pump must not be installed on a wall or roof which fronts a highway or be nearer to any highway which bounds the property than any part of the building

Should I Get a Heat Pump?

Do I need planning permission?

Image credits: Deeper Green

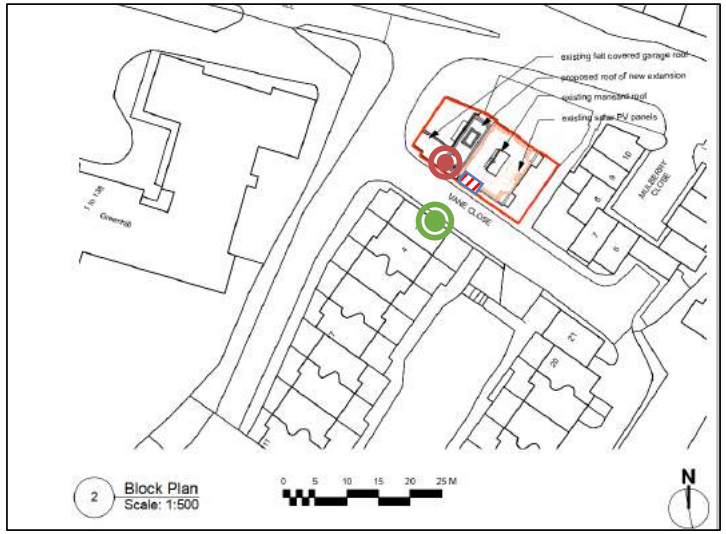


Figure 2.2 Site measurement position, identified receiver and proposed plant unit installation

(Drawing source: Source: Deeper Green)

Figure 2.3 Identified receiver and proposed plant unit installation

Period	Assessment Location	Rating Level Acceptability Range		
		Green: noise is considered to be at an acceptable level	**Amber:** noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development	**Red:** noise is observed to have a significant adverse effect.
Daytime (7:00-23:00)	Garden used for main amenity (free field) and Outside living or dining or Bedroom window (façade)	10dB below background	9 dB below and 5dB above background	5dB above background
Night-time (23:00-7:00)	Outside bedroom window (façade)	10dB below background and no events exceeding 57dB L_{Amax}	9db below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	5dB above background and/or events exceeding 88dB L_{Amax}

Table 4.1 Camden noise criteria for plant and machinery

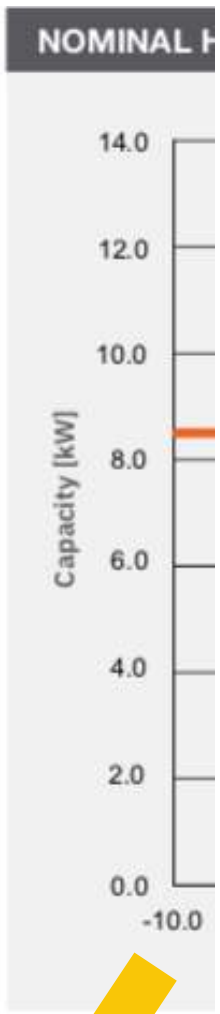
Should I Get a Heat Pump?
Do I need planning permission?

Image credits: KP Acoustics

Should I Get a Heat Pump?
Do I need planning permission?

OUTDOOR UNIT		PUZ-WM85VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	139%
	SCOP (MCS)	3.47
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	193%
	SCOP (MCS)	4.79
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	8.5
	Power Input (kW)	3.27
	COP	2.60
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	58
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	24
	Water Pressure Drop (kPa)	15.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		98
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	9.1 [22]
	Fuse Rating - MCB Sizes (A)*6	25
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

Notes:
*1 Combination with E*PT20X Cylinder
*2 Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.



Above: Noise attenuation enclosure – ugly but it also permanently lowers the unit's operating efficiency.

Left: Noise criteria of a typical heat pump as declared on product information sheet.

Requiring individual noise assessments is going to be an impediment to ASHP rollout. Don't forget fan assisted balanced flues also make noise!

Are air source heat pumps noisy?

no

(not really)

Thank you for listening.

Ian McKay
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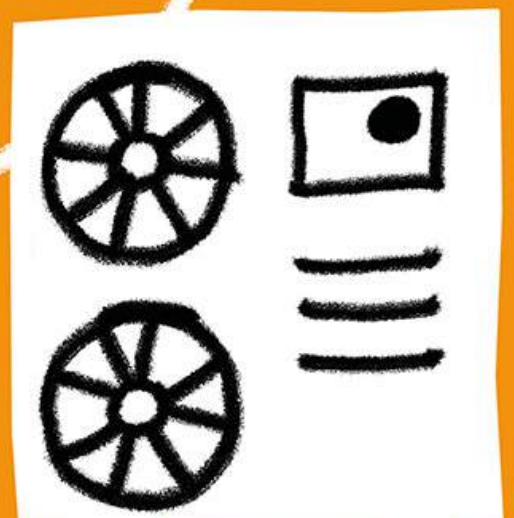
www.deeper-green.co.uk

Transition Town Lewes presents

SHOULD I GET A HEAT PUMP?



Join an expert panel (plus homeowners who have got one) to explore this greener home heating solution.

Thursday 9 March

7.30pm (doors open 7.15pm)

The Elephant & Castle Pub
White Hill, Lewes, BN7 2DJ

FREE (donations welcome)

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