ECOBERKO

How-to Guide for Insulating Your Home (& Ventilation)

In the first few months of 2022, we turbo-charged our insulation! These are the key things we learnt during the process which we think might be useful for you.

We have mentioned quite a few products and companies, on the basis that we did some research to find them, and they worked for us – they may not be the best available, and they may not work for your situation.

Our house: a medium-sized 1880s mid-terrace solid brick Victorian home, now 4 bedrooms via a loft conversion

Motivations

- We wanted to install an air source heat pump and the vital first step was to improve insulation to stop precious heat leaking out of our house
- We wanted to shrink our carbon footprint by reducing energy usage
- We wanted to save money on energy bills – some things have a quick pay-back, others will take longer.

Insulation to Prevent Heat Loss

Heat escapes from your house in two ways:

- Through walls, windows, into the loft voids, through the floor
- Via draughts around doors and windows, chimneys, between floorboards, through kitchen and bathroom vents, and air bricks direct into living spaces.

The loft space is a high priority to tackle as heat rises and a good layer of insulation will keep it in.

Our experience is that fixing draughts is easier and as important for comfort (and probably heat loss) as improving the heat resistance of the fabric of the building. A layer of loft insulation won't make your house much warmer if the windows don't close properly! You need to do both.

For a more technical explanation, see the appendix to this case history

Finding Those Heat Leaks and Draughts

We paid a local firm to do a thermal imaging survey of our house in 2022 to show up the places where we were losing heat, and to provide a report of costed recommendations plus a meeting to discuss. Cost of this varies by the size of your house, and you can just have the survey without the report. We paid £750 for the full report option.

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Berkhamsted Town Council now have a thermal imaging camera and provide free basic surveys over the winter months – see https://www.berkhamsted-tc.gov.uk/the-council/thermal-imaging-camera/

We already knew most of the places where we had cold draughts or which rooms were colder than others, but the thermal imaging camera revealed that our loft conversion in 1999/2000 had never had all the insulation installed that the architect had specified!

To better identify specific cold spots, we bought a little handheld infrared thermometer gun (the one we got is no longer available, but there are several similar around £20 on Amazon). Easy to use and accurate enough for the purpose. After our insulation work, we could then use it again to confirm the improvements we had made.

We tracked down draughts with a damp finger (it feels cold in a draught), or via little bits of tissue paper stuck in suspect areas on a windy day. Low tech but perfectly effective.

Insulation Actions

We decided to manage the work ourselves and researched the products and solutions our surveyor had suggested and some alternatives. We consulted the Energy Savings Trust website amongst others. https://energysavingtrust.org.uk/energy-at-home/reducing-home-heat-loss/.

Another useful website is https://www.gov.uk/improve-energy-efficiency .

Below we list all the changes we made, grouped into three lists by priority/cost benefit. Your list may well be different, depending on where your problem areas are. (We have updated prices except where stated.)

Top Wins against Draughts – Very Cheap and Very Effective

- Sellotape over the front door keyhole inside the house (the outside of ours has a metal cover)
- £29 on a letter box cover for *inside* the front door (replacing a set of brushes) – it is magnetic and stops all draughts while allowing the mail to fall through effectively https://www.magflap.co.uk/
- £7 on a can of "No Nonsense" expanding foam to fill in random holes in the brickwork in our mini-cellar
- Ordinary bathroom sealant to fill cracks between wooden boards in the mini-cellar
- £105 in 2022 on 2 chimney sheep(s) to stop draughts in 2 chimneys (but still allow movement of moisture – vital to stop condensation) https://www.chimneysheep.co.uk/
- Where a room is hard to insulate/draught-proof, it makes sense to shut the door and put a draught excluder "sausage", the softer the better, along the gap at the bottom – at least as a temporary measure.

Other low-cost ideas can be found here:

https://www.theguardian.com/money/2022/oct/06/heatproof-your-home-top-tips-for-energy-efficiency

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Vital Insulation – Pretty Cheap and Very Effective

The loft is a key area to work on because hot air rises and the temperature difference between the bedrooms and the loft void and with outside is therefore large. As the loft void is going to be very cold in winter, you need to minimise heat loss through the ceilings of the rooms below via rolls of loft insulation.

If you have a loft conversion, the walls of the attic room facing the loft void are equally important to insulate well (but are often overlooked).

The current recommendation for depth of insulation is 270mm – just top up your existing layer of insulation to reach that depth or more, running perpendicular to existing insulation. No expertise is needed but be careful not to put any of your weight anywhere but the joists as you move around.

- Recycled glass insulation rolls for the loft floor – £35 per 5m^2 x 200mm roll of Knauf Eko Roll Loft Insulation
    - Much more pleasant to handle than the old mineral wool – still, mask and gloves recommended
    - Don't forget loft hatches or doors – use some of the tough polythene the roll comes in to enclose a big "pillow" of insulation, staple it to the back of the hatch, and put a rubber or brush seal around the rim of the hatch.
- Sheep's wool insulation for loft conversion walls, between the vertical studs (and any awkward spaces) – £135 per 7m^2 x 100mm roll
    - Benefits are: very pleasant to handle, eco solution, non-toxic; easy to cut to size; easy to ensure a good fit; easy to fit vertically, basically self-supporting with a couple of staples to be sure; better at allowing moisture to escape than conventional materials
    - (Make sure you buy wool that has been treated to avoid moths etc)
    - https://www.chimneysheep.co.uk/product-category/100-sheep-wool-insulation/.
- Multi-layer foil insulation for loft spaces – £138 per 12m^2 roll of YBS BreatherQuilt
    - Benefits are: thin but highly insulating; can be wrapped round beams, fitted into awkward roof spaces; easy to cut and use – no noxious chemicals/particles; allows moisture to escape
    - Conventionally used directly under the roof tiles, but we used it around the loft room walls on top of the sheep's wool and existing (rather poorly fitted) PIR board
    - Stapled to studs with 14mm staples (Arrow AT50 staple gun), not pulled tight, so the layers can separate, leaving internal air gaps
    - Taped for a complete air seal using Diall aluminium foil tape – quite difficult to get good adhesion everywhere
    - A lot of work in an uncomfortable confined space.

Very important! The loft void under the roof must have direct access to the outside air, with good circulation under the eaves, in order to ensure good ventilation and so avoid rot problems. (See the ventilation section below. This does not apply if you have an air exchange system.)

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Non-loft insulation:

- Heat-reflective foil to go behind radiators which are mounted on an external wall - £14 for 3 radiators.
- For insulating walls inside your house, foil-backed plasterboard plus extra layer of insulation
    - Back in 2013 when we had our kitchen renovated, we added this to make the kitchen warmer; it reduces the size of your room by 2 to 3cm but we found the trade-off worthwhile even in a narrow room
    - Newer, thinner, products are available now – e.g. silica aerogel panels.
- A Jumpax floating floor layer for insulating solid floors
    - Back in 2013 when we had our kitchen renovated, we added this to make the kitchen floor warmer as the floor tiles previously sat on top of concrete.
- Secondary glazing added to our front door – 2 inset windows and the window above the door £198 in 2022 from https://www.extraglaze.co.uk/
    - Not heavy glass, but a lightweight, very clear acrylic (clearer than glass)
    - Easy to fit
    - Held on by magnets so easy to remove for cleaning
    - Almost as effective as standard double glazing.
- Under-carpet insulation on the ground floor to stop a lot of cold air coming up between and through the floorboards
    - A local carpet-fitting company took up our carpets and put a special foil/foam insulation layer (held in place with metal tape) under new underlay and then put our carpets back. This has made a great difference in keeping our rooms warm on the ground floor.
    - EcoTec Floor-Foam Insulation £190 per 30m^2, plus replacement underlay and labour.

Important Insulation – Expensive but Very Effective

- Double-glazed the 5 windows which weren't Victorian sash windows – we did this back in 2009, and it made a huge difference to those rooms – £2,850 in 2009.
- Replaced the thin wooden back door, which had single-paned glass in it, with a much thicker composite door with a double-glazed window – it made a huge difference to our kitchen – £500 in 2013 (plus labour cost to fit it).
- Added brush seals around our sash windows in 2006
    - This acts like magic to stop draughts, stop heat loss, and cut out noise; the thermal imaging camera showed no heat loss from the edges of our sash windows
    - Ventrolla says it effectively makes your sash windows 70% as good as a double-glazed window (as you still lose heat through the single panes of glass)
    - Cost £1,135 in 2006 for 7 windows
    - https://www.ventrolla.co.uk/the-ventrolla-perimeter-sealing-system-vpss
        - Alternatively, you can buy the equivalent brushes and get them fitted.
- Replaced all our original Victorian sash windows in 2022 with double-glazed sash windows
    - Our road is in a conservation area and so the windows had to be like-for-like, and go through Dacorum planning approval

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    - So, they were sash windows, made of timber, and had proper glazing bars (not stick-on "bars" to make it *look* like 4 or 6 panes of glass)
    - If you weren't in a conservation area, you could opt for much cheaper (though less beautiful) UPVC windows, or secondary glazing in order to keep your sash windows
    - Ventrolla make conservation area compliant timber sash windows to match the shape of your original windows – cost £11,000 for 7 windows which included the brush seals again
    - A thinner double-glazing gap than usual to fit within the sash, but filled with krypton (not the standard argon) to bring the insulation performance back up
    - https://www.ventrolla.co.uk/windows-doors/windows/timber/sash-windows.
- Put in brush seals round our front door – £300 with Ventrolla in 2022
    - We wanted to keep our wooden front door with its stained glass – an alternative would be to replace it with a composite double-glazed front door.
- "Painted" our exterior brickwork on the front and back of the house with a silicone product called StormDry https://www.safeguardeurope.com/products/stormdry-system/stormdry-masonry-protection-cream
    - Benefits are – it acts like a waterproof breathable coat, stopping the bricks getting wet in the winter, but allowing moisture out of the house. Victorian bricks lose even more heat when they are wet.
    - It is easy to put on and dries clear in a day; within a month it is fully protective and invisible
    - It has been tested and approved by the Energy Savings Trust
    - Cost of product £330 for our house (15 litres), plus labour and scaffolding at £1,175 in 2022.
- Still to do: Add exterior insulation to an outside wall – our alleyway wall is only 1 brick thick and so the front room and dining room are noticeably colder than other rooms
    - Possible option – insulating wood fibreboard with a lime plaster render
    - As alleyway is narrow, and shared with our neighbour, it can't be a thick layer of insulation
    - (An alternative is to insulate the wall on the inside, as we did in our kitchen.)
- [We have solid brick walls, but if you have unfilled cavity walls, then you will almost certainly benefit from filling them. There have been problems in the past, but technology and installation standards have improved.]

Extra tip to save on heating bills

Fit thermostatic valves to all your radiators (c £15 each). You can then control the heating level in each individual room.

Remember! Keep all your invoices, receipts and guarantees of all your insulation materials and work. This will be needed for your next EPC rating.

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Ventilation/Avoiding Damp Problems – Important

A lot of moisture is released into a house from the people inside it, and from cooking and washing. Assuming you don't have a problem with either rising damp from the ground or penetrating damp through the walls or roof, you still have to deal with the dampness generated by the inhabitants.

You can generally assume that the air inside your house carries more moisture than air outside. (Outside air may have higher relative humidity, but that is because it is colder, and cold air cannot carry as much water vapour.)

If you improve the insulation of your home without taking account of this, there is a risk you will end up with condensation and damp trapped inside, which can cause all sorts of problems, especially in older homes which need to "breathe".

The best way to be sure that you haven't caused a problem is to buy a humidity sensor (hygrometer). There are many available, e.g. Eve which links to smart home features. We chose a combined room temperature and humidity level meter £15: https://www.tester.co.uk/eti-810-130-therma-hygrometer.

The relative humidity level in your house should stay below 60% for comfort and should not stay above 70% for extended periods.

Actions to avoid damp:

- Use fans in the bathroom and kitchen, and/or a cooker hood (one that removes the steam to vent outside the house)
- Open a window occasionally
- Use the trickle vents on your windows
- Install more advanced types of ventilation – see the technical appendix
- Never block up air bricks which go into the space underneath your house
- Never block up the vents in the eaves in your loft space. Ensure adequate airflow.

The Insulation Success Story

- Some of this insulation work was done back in 2006, 2009 and 2013 and so we have reaped the benefits in terms of a warmer, less draughty and quieter house for some while.
- As of 2022, by upgrading the insulation, adding the double-glazing and tackling all those draughts, we have a much cosier house. I no longer sit at my desk with freezing cold draughts coming in all round the door from the hallway, chimneys and the mini-cellar.
- As a great bonus, during the extraordinary summer heatwave, our house has been much cooler thanks to the double-glazed windows and extra insulation. In particular, the hallway was kept cool because of the secondary glazing over the front door windows. (For intense heatwaves, external blinds, awnings or shutters are also going to be needed for our houses in future.)
- All this saved us money on our heating bills and reduced our carbon footprint.

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Technical Appendix:

Insulation Principles

Heat escapes your house in two fundamental ways: by conduction through the fabric of the building (through walls, windows, into the loft voids, through the floor), and by the movement of air, otherwise known as draughts or "uncontrolled ventilation" (around doors and windows, chimneys, between floorboards, via kitchen and bathroom vents, and air bricks direct into living spaces).

The rate of heat loss through a solid material depends on the temperature difference between inside and outside, the thickness of the layer, and the thermal conductivity (or lambda) of the material. Thermal conductivity varies hugely – for example, a 230mm solid Victorian brick wall plus a layer of Victorian plaster is likely to be less insulating than a 4mm layer of silica aerogel.

Air gaps also have a big effect, because heat does not move easily from air to solid or solid to air. Almost all of the insulating effect of glass in a window is a result of the two surfaces (front and back). Double glazing largely works by making that four surfaces.

Of course, a bigger area loses more heat than a smaller area, other things being equal, so think about the big surfaces first.

You will often see references to U-value – this is the rate of heat loss (Watts) through a layer or multiple layers of insulation, per temperature difference (°C), per area (m^2). The smaller, the better. You can combine U-values if you are putting layers on top of each other, but not by simple addition. Inverse U-values can be added together to give the combined inverse U-value. There are plenty of resources online if you want to dig into all the technical details.

The rate of heat loss through draughts just depends on the temperature difference and the air flow rate, which will vary according to the weather, whether the gaps are in sheltered areas, and how big they are. So, even small gaps can have a large effect on your comfort and heat loss, e.g. your front door keyhole and letterbox.

See the Centre for Alternative Technology's guide to retro-fitting your house:

https://cat.org.uk/info-resources/free-information-service/eco-renovation/eco-retrofit/

Ventilation Explanations and Avoiding Damp Problems

Voids Outside the Living Area

There are two critical areas: in the roof, and under the ground floor. The air in the roof void must be able to flow unobstructed under the eaves to the outside. It is tempting to put the roll of insulation right up to the edge of the loft space, against the rafters, but **don't** do this. If you do, moisture will get into the void from within the house, be trapped, condense on the rafters since they are cold, and cause rot. Leave a few inches gap, and the flow of air will keep everything dry.

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Most houses built up until mid-20th century have suspended wooden floors. Below the joists holding up the floorboards there is a void, and underneath this void, quite likely nothing but earth. To keep those joists and floorboards from getting moisture condensing on them and rotting, airflow is provided by airbricks placed regularly around the perimeter of the house. You must **never** block those airbricks, and you should check they are not clogged up with weeds or debris from time to time.

If you have cold air coming up through the carpet via cracks in the floorboards, then the underlay solution mentioned above is safe – the timber underneath continues to be kept dry by airflow. It is possible to insulate from underneath with spray foam if the void is deep enough, but that is a job for professionals, because of the risk of trapping moisture.

External Insulation

Check the breathability of any insulation material you use, especially where the insulation is outside the original building fabric, because in that case damp may get trapped inside that original fabric. Beware of "cold-bridging", where the insulation fixing going into your wall is cold, so moisture will condense on it inside your wall, causing rot.

If the insulation is inside the original building fabric, then any moisture can move around the building and find another way out.

Extracting Moisture

You should already have (and use!) extractor fans in shower rooms and the kitchen, but do check the effective rate of change of air. A typical rate is 5 litres per second. Our tiny shower room has a volume of 6,000 litres ($6m^3$), so the fan needs to run for 20 minutes to change the air once.

If your extractor fan allows a draught through when not running, then you might want to upgrade to a more modern fan that seals effectively when not in use.

If the humidity level in your house is consistently high, then check first for rising or penetrating damp. Then think about fitting improved extractor fans or trickle vents. The sophisticated, expensive solution is powered air exchangers (mechanical heat recovery units) which swap the air while keeping most of the heat within the building – but you probably only need that if you have sealed the building envelope to excellent Passivhaus standards.

Between a standard extractor fan and these costly MHVR units, there is this option – https://xpress.nuaire.co.uk/. These have built-in humidity sensors and will boost activity when the humidity goes over 60%.

Portable dehumidifiers are another solution to damp issues.

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