warmer homes

includes:

Case studies of typical and hard-to-treat houses in Slaithwaite & Marsden, West Yorkshire

Guidance on developing a 'whole house plan'

& much more!

making your home more comfortable and reducing energy bills

green building store®

Green Building Company

Environment conscious and energy efficient construction

in partnership with

Warmer Homes

MASTT

Connect housing

Where do I start?

It can be very confusing knowing what to do to **improve** the warmth and cosiness of our homes, especially if you live in one of the **'hard-to-treat' older properties** that are typical in this area of Yorkshire.

This booklet has been designed as part of the MASTT Warmer Homes project to help householders through this maze, so that you can make well-informed decisions based on best-practice building principles.

Green Building Store and Green Building Company have been at the forefront of low energy building in the UK. In the case studies on pages 6-9, we have applied our knowledge of low energy 'Passivhaus' approaches to two different house types to show the energy efficiency strategies available for typical Colne Valley homes.

We hope that this booklet will help you to develop a strategy for improving your home.

Passivhaus: The low energy standard

Developed in Germany in the 1990s, **Passivhaus** design can help create homes which use **90% less energy** than standard UK housing. Passivhaus design aims to wrap the house in a continuous 'blanket' of insulation, maximising the use of super insulation and stringent airtightness to create healthy and comfortable buildings that require minimal heating. For more information on Passivhaus, go to www.futurepassiv.co.uk

Thermafleece

Insulation, insulation, insulation (and airtightness!)

People often see **low carbon homes** purely in terms of bolt-on renewable technologies such as solar panels and wind turbines. Meanwhile **insulation** and good **airtightness** are ignored or forgotten, the invisible, unsung heroes of low energy refurbishment! It is now widely agreed that it is important to address the energy efficiency of the house **first** before looking to bolt-on solutions. Not only will this increase the comfort and warmth of your home (and save you money on bills) but it also offers a **robust long-term solution**, future-proofing your home for the years to come.

What is 'green'?

All too often supposedly 'green' homes have features which have the outward appearance of being **eco-friendly**, while actually being very energy inefficient. Good examples of this would be bare floorboards (very draughty), replacing gas boilers with wood-burning stoves (no net CO_2 reduction) or installing solar panels (without addressing insulation first). We need to bring the focus back to good insulation and airtightness strategies.

4 key principles for energy efficient refurbishments

Insulation

For walls, floors, roofs, lofts and windows, energy efficiency obviously depends on good levels of insulation.

Airtightness

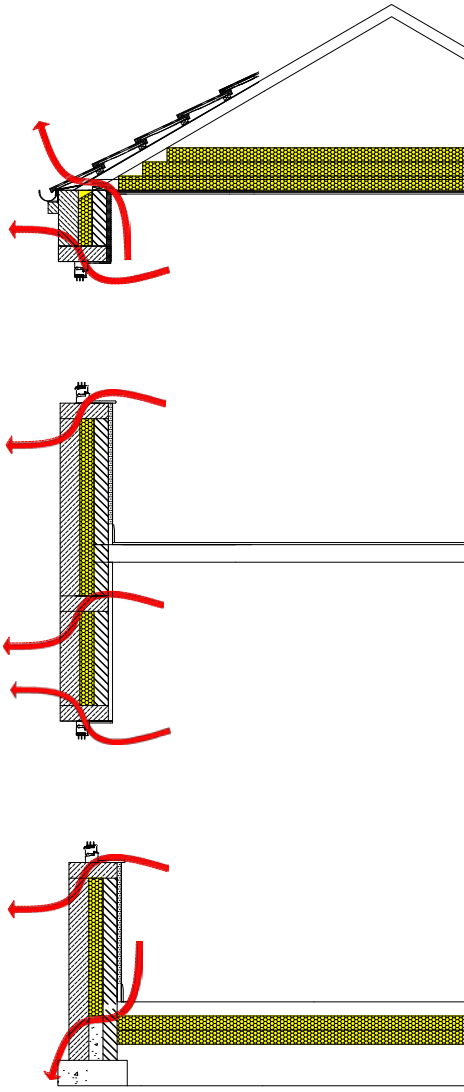
Airtightness (or reduction of draughts) is an often overlooked aspect of energy efficiency which can make a huge impact on the warmth and comfort of a home.

Continuity of insulation (or minimising 'thermal bridging')

To work best, insulation needs to work in a continuous 'blanket' around the house, minimising any gaps in the insulation (known as 'thermal bridges'). Examples of 'thermal bridges include through stones through cavity walls or gaps in insulation where the wall meets the roof, which breaks the continuity of insulation and loses heat out of the building (see diagram on the right).
The importance of reducing 'thermal bridges' increases as the level of insulation increases.

Ventilation

As airtightness improves in a building, it is also vital that suitable approaches to ventilation are considered carefully, so that there is no impact on occupant health or building structure (see page 5).



Examples of 'thermal bridges'

All four principles need to be considered during a low energy refurbishment to avoid any '**unintended consequences**':

Action = Potential risks

(ignoring all the other principles) = Draughty & inefficient

(ignoring continuity of insulation and ventilation) = Condensation on surfaces, condensation on 'thermal bridges', mould, poor air quality

(ignoring ventilation) = Condensation on surfaces, mould, poor air quality

= Warm, comfortable home with good air quality

Think big!

The complex interaction of the **4 key principles** (insulation, airtightness, continuity of insulation, and ventilation) means that **the order in which home improvements are undertaken is very important**. It helps if you think of your home as a complex system which needs to be considered as a whole. Piecemeal improvements to a home, without fully considering the 4 principles, can result in **'unintended consequences'** (see page 3). To avoid this, it is very useful to think about a **'whole house plan'** before you begin any refurbishment work.

Getting advice

Houses can be very different. Assessing a house for a low energy refurbishment is both an art and a science and needs a good understanding of construction, local conditions and energy efficiency.
If you are considering getting an energy assessment of your home, be aware that quick, superficial energy assessments are unlikely to give specific enough advice for your home.
For **radical refurbishments** (eg Option C on pages 8-9), the Passivhaus methodology (using specialist PHPP software) offers **the most efficient and reliable approach** currently available for predicting energy use in very low energy homes.

EdenBloc[35]

What is a whole house plan?

A whole house plan is an energy efficiency improvement strategy for the entire house, ideally based on good or best practice approaches (eg Options B or C on pages 8-9). This is the plan that, if funds were allowing, you could undertake for your home to make it warm, comfortable and energy-efficient. If budgets are tight, there are smaller, easier stages that can be undertaken first (eg Option A on pages 6-7) but it is useful to keep your whole house strategy in mind when undertaking any improvement works on your home. For example, it is possible to implement internal wall insulation improvements on a room by room basis at the same time as when you are upgrading your kitchen/ bathroom etc. You could tackle the floor, walls, ceilings, windows within the room, taking into account the 4 principles. You would just need to think ahead and consider how the work would join up with the next room (eg ensuring continuity of insulation).

Joined up thinking

If you don't map out a 'whole house plan' there is a danger that you will undertake works on your home which would later need to be removed if you wanted to do further energy efficiency improvements. For example if a new kitchen is installed, without thinking about energy efficiency measures, it might close off the possibility of any further improvements to that room. Similarly, if you have installed a small amount of external wall insulation, you are unlikely to want to upgrade the external insulation to a greater thickness anytime soon.

Be the best you can

With your whole house plan in mind, you might, for example, decide to build a new extension or install triple glazed windows with higher energy efficiency standards than the rest of the house. This will obviously be dependent on budget (and projected budget into the future) but wherever possible we would urge you to 'be the best you can' with any home improvements.

Why is ventilation important?

Good air quality is essential to a healthy, comfortable home to reduce stuffiness and maintain the health of occupants. It is also essential to deal with excessive humidity, which, if not controlled, can lead to **condensation, damp, mould and health problems** (eg respiratory illnesses). Cooking, showering and drying clothes inside can all lead to a build up of humidity that needs to be removed.

Mould on wall

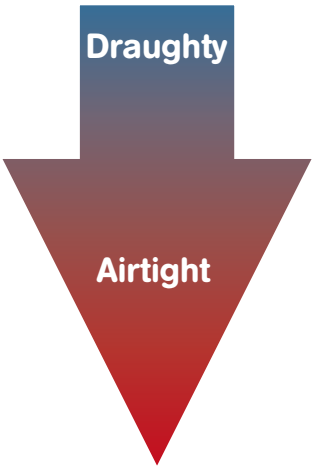
Draughty homes

Draughty homes have lots of air coming in, in an uncontrolled way. As well as making the home uncomfortable and cold, this wastes huge amounts of energy and is an inefficient form of ventilation.

Airtight homes

Creating airtight homes by eliminating draughts is an important part of creating warm and comfortable homes. However, we also need to make sure we have adequate ventilation to reduce stuffiness and remove humidity. As the airtightness in our homes improves, we need to look carefully at ventilation to maintain good air quality.

Solutions



- Opening windows during/after showering & cooking
- Using extractor fans for cooking and showering and trickle vents on windows
- Mechanical extract ventilation (MEV) – constant low level extraction from bathroom and kitchen combined with trickle vents in windows in living rooms and bedrooms. Can be boosted at times when cooking or showering.
- Mechanical ventilation with heat recovery (MVHR) – essential for homes with very high levels of airtightness and energy efficiency. Has the added advantage of recovering heat from the air that is being extracted.

MVHR unit

More information on these solutions is available at: www.retrofitventilation.co.uk

Safety first

Any change to the **airtightness** of your building might have implications for any 'open-flued' appliances (gas, oil, solid fuel). **If in doubt, consult a suitably qualified professional.** For safety's sake, in any home – leaky or airtight – remember to put carbon monoxide monitors near any open flued gas boilers, cooking appliances or fires! These are often supplied free of charge by utility companies etc.

Victorian mid-terrace house

Marsden

Typical **3-bed terraced** **Victorian stone and brick house** of 66m², with minimal loft insulation (100mm) and older double glazed windows.

Much more efficient than end-terrace positions (due to fewer exposed walls)

No potential for insulation in cavity wall or externally, due to construction type

Option A:
Low-cost improvements

heating costs

down **9%**

draughts

down **11%**

200mm insulation added to loft (topped up to 300mm).

Draught-proofing measures on doors, loft hatch etc.

Continuity of insulation is not relevant at this level of insulation!

Ventilated with plenty of fresh air, due to leaky building!

Option A suggests some of the least disruptive, easy win options for dealing with hard-to-treat properties like this one. This includes topping up the **loft insulation** and **basic airtightness** measures.

Would it make sense to improve the windows at this stage?

If the windows & doors in the property needed replacing anyway (eg if frames are rotting or degrading or the glazing is steaming up), then it would make sense to replace windows with the most **efficient windows & doors** you can (looking out for low **U values**). **Windows & doors should last at least 30+ years** in a building, so it makes sense to upgrade to the most efficient you can, as the rest of the house will hopefully later catch up. If you are planning future wall insulation measures as part of your **whole house plan** (see page 4), you will just need to think ahead as to the best position for the windows to be installed.

Estimates for 'heating cost' reductions are calculated using comparisons of kWh/m²/year for the different options (modelled in PHPP) and are based on reduction in space heating need. Actual cost reductions will depend on individual utility company tariffs etc.

1940s semi-detached house

Slaithwaite

Typical **3-bed semi-detached brick house** of 80m², with minimal loft insulation (100mm) and older double glazed windows.

Has the potential for cavity wall and external wall insulation

Because it has more exposed walls, it is less efficient than the mid-terrace.

Option A: Low-cost improvements

heating costs

down **38%**

draughts

down **11%**

Loft: 200mm insulation added to existing 100mm; Cavity wall: filled with insulation

Draught-proofing measures on doors, loft hatch etc.

Continuity of insulation is not relevant at this level of insulation.

Ventilated with plenty of fresh air, due to leaky building!

Option A outlines some of the least disruptive, easy win options for dealing with properties like this. This includes, topping up the **loft insulation** and getting the **cavity wall insulated** - with impressive results.

What are U values?

A U value is a measure of how much heat is transferred through a particular section of construction – eg wall, window. **The lower the U value the better the insulating effect** and the better it will keep heat inside a building on a cold day.

Cavity walls

If your house was built **after 1930** it is likely that it has a cavity which might be suitable for insulation. Specialist cavity wall installers can inspect the cavity to see whether cavity wall insulation is suitable.

Cavities **not suitable** for insulation:

- Too narrow/irregular-shaped
- Filled with rubble
- No cavity trays
- With through tie-stones

Improving heating & lighting efficiency

See page 11 for other quick-fix solutions to help keep fuel bills down.

Radical improvements

For both house types we have put forward two options to make **greater energy savings**. Both options would **require significant building work**. Which route you decide to go down will probably be largely dependent on budget but once you choose one option it may be difficult to later change to the

Victorian mid-terrace house
Marsden

£ £

Option B: Good practice

heating costs

down 53%

draughts

down 70%

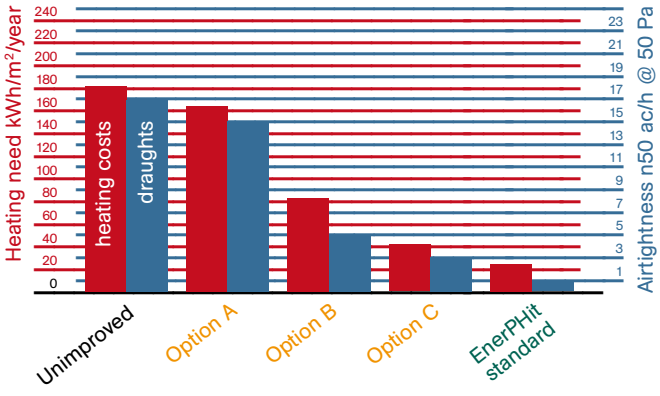
Option B involves adding **insulation to internal walls & floors** and **improving airtightness** around leaky 'junctions'.

Loft: 300mm insulation; Internal faces of exterior walls: 65mm polyurethane-backed plasterboard applied; First floor: Insulation cut around floor joists at junction with external wall; Suspended timber ground floor: 150mm mineral wool between timber joists.

Use of airtightness tapes and grommets around pipework coming in from outside; 'Parging' of walls around floor joists; Double-boarding first floor ceiling.

Attention paid to making insulation continuous eg insulated plasterboard around window reveals.

Use of mechanical extract ventilation (see page 5).



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Option C: Best practice

heating costs

down 77%

draughts

down 82%

Option C involves adding **insulation to internal walls & floors** and extra **high levels of airtightness** around leaky 'junctions'. It also includes **triple glazed windows & doors** and **MVHR** ventilation. Detailed diagrams of junctions for this option appear on page 10.

Insulation approach as for Option B. Windows: Triple glazed (U value 0.9 W/m²K).

Higher attention to detail at all junctions eg all measures as for Option B plus taping around floor joist ends to wall; 'Parging' of all walls before insulation applied.

Attention paid to ensuring continuous insulation at various junctions eg window reveals, wall to ceiling and around first floor.

Use of MVHR (mechanical ventilation with heat recovery) system (see page 5).

In advanced retrofits using internal insulation, it may be necessary to model moisture movement in walls to prevent 'interstitial condensation' (eg condensation behind the insulation).

alternative option. Many of the actions presented in each option can be broken down into **smaller, more manageable and affordable steps** (see page 4 for more on 'whole house plan').

1940s semi-detached house

Slaithwaite

£ £

Option B: Good practice

heating costs down **59%**

draughts down **70%**

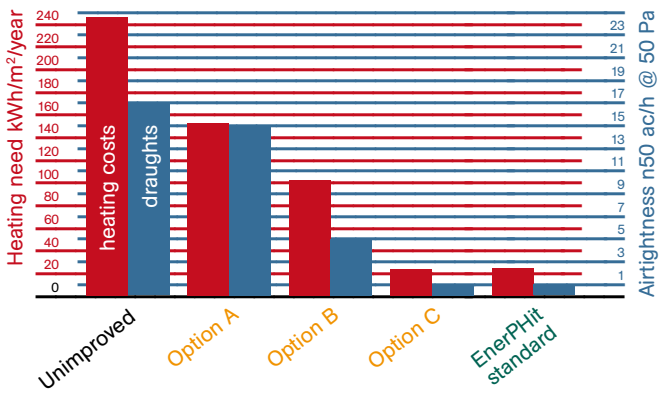
Option B involves applying **insulation to internal walls & floors** and **improving airtightness** around leaky 'junctions'.

Cavity wall insulation: as per Option A; Loft: 300mm insulation; Internal faces of exterior walls: 65mm polyurethane-backed plasterboard applied; First floor: Insulation cut around floor joists at external wall junction.

Use of airtightness tapes and grommets around pipework eg bath, sink and toilet; 'Parging' of walls around floor joists; Double-boarding first floor ceiling.

Attention paid to making insulation continuous at various junctions eg windows, wall to loft and around first floor/ wall junction.

Use of mechanical extract ventilation (see page 5).



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Option C: Best practice

heating costs down **90%**

draughts down **94%**

Option C takes the energy saving refurbishment of the property to the **EnerPHit standard**.* It involves installation of **high levels of external wall insulation** and **extra attention to airtightness** around leaky 'junctions'. This option also includes **triple glazed windows & doors** and **MVHR** ventilation.

Cavity wall insulation: as per Option A; Windows: Triple glazed (U value 0.75 W/m²K); External walls: insulation such as 250mm XPS polystyrene with rendered finish (or brick slips); Loft: Insulation topped up to 450mm; Solid ground floor: 30mm vacuum insulated panels topped with laminate flooring.

Detailing as for Option B but with higher attention to detail at all junctions eg careful taping around installation of windows; 'Parging' of all external walls before insulation applied; Re-roofing for airtightness measures.

Attention paid to ensuring continuous insulation at various junctions. Roof eaves extended to deal with thickness of external wall insulation and to ensure continuity with loft insulation.

Use MVHR (mechanical ventilation with heat recovery) system (see page 5).

* EnerPHit is the Passivhaus standard for refurbishments.

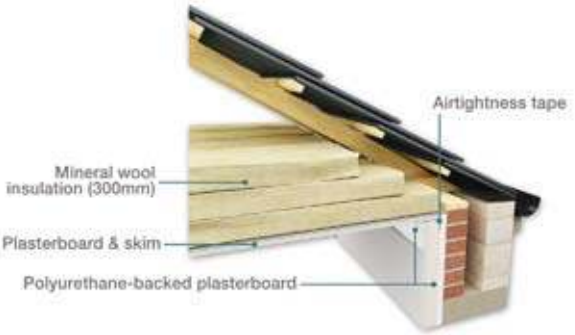
Attention to detail

The details below are our **best practice** (option C) suggestions for improving the **insulation, airtightness and continuity of insulation** at all the important junctions for the Victorian mid-terrace home.

Roof eaves detail (unheated loft)

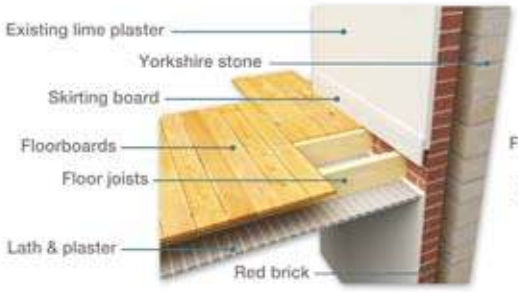
before

after

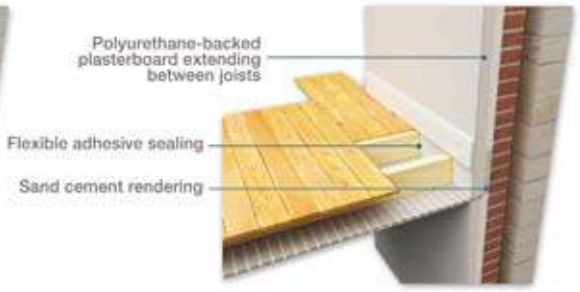


First floor junction with external wall

before

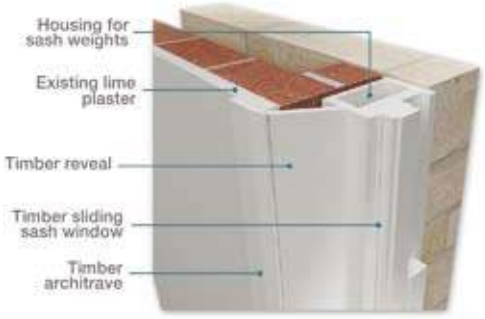


after



Window

before



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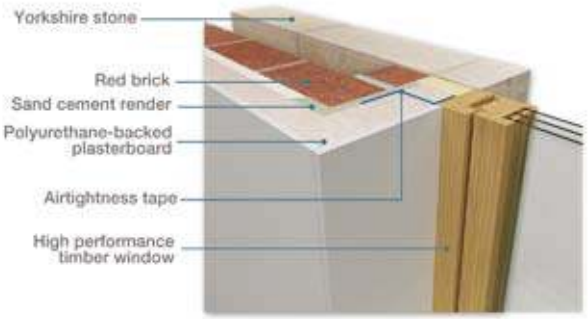
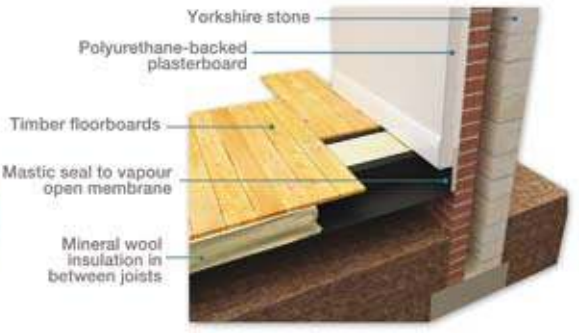


Suspended ground floor (no basement)

before

after



Animated versions of these details also appear in the Warmer Homes film which accompanies this booklet at www.warmerhomes.org.uk

What else can I do?

idealheating.com

As well as **addressing the efficiency** of the fabric of your home, another important way to reduce bills is to **improve the efficiency** of your **lighting and heating** systems.

Boilers & heating systems

Condensing boilers Replacing an old gas boiler with a high-efficiency condensing boiler, combined with improving your heating controls, could cut 30% off your bills.

Zoning It may be possible to set up separate heating circuits within your home which can be timed separately to avoid overheating areas that are unoccupied or need lower temperatures (eg bedrooms).

Heating controls The Energy Saving Trust recommends the use of boiler thermostat, timers & programmers, room thermostats and thermostatic radiator valves to help keeps homes at comfortable temperatures and to prevent overheating.

Weather compensators make the boiler work more efficiently by regulating the boiler flow temperature to take into account outside air temperature (for example, on a warmer day the flow temperature will be lower; on a cold day the flow temperature will be hotter).

Insulation of pipework and hot water tanks is one of the cheapest and easiest ways to save energy in the home.

Lighting

Installing low energy lightbulbs throughout would use 80% less electricity than ordinary ones.

mygreenlighting.co.uk

LED lights last up to 50,000 hours and use very little energy, particularly offering an alternative to the spotlights often used in bathrooms/kitchens.

datalexservices.co.uk

More information: www.energysavingtrust.org.uk or call 0800 512012

Funding the project

With the Government's **Green Deal** & **ECO programme** due to launch later in 2012 there are potentially a number of ways to access funding or loans with which to undertake low energy refurbishments. In addition, the Ecology Building Society offers its **C-Change** retrofit mortgage option, which would be suited to more radical projects. More information on the various funding options is available from our website at: www.greenbuildingstore.co.uk/greendealplus

Passfield Drive – towards Passivhaus retrofit (bere:architects)

useful resources

The Warmer Homes film to accompany this booklet is available to view at: www.warmerhomes.org.uk and on YouTube (type in Warmer Homes - Green Building Store)

Energy Saving Trust
www.energysavingtrust.org.uk
tel: 0800 512012

Green Building Store
Resources on Passivhaus and low energy retrofits and Green DIY question and answer section
www.greenbuildingstore.co.uk

How much heat is lost from your property?
Kirklees thermal imaging map undertaken in 2006
map.kirklees.gov.uk/heatloss

Institute for Sustainability
Good technical information and detailing on low carbon retrofits
instituteforsustainability.co.uk/retrofitguides

Passivhaus Trust
More information on the EnerPHit standard for refurbishments
www.passivhaustrust.org.uk

Retrofit for the future
Database of information on radical retrofit projects
retrofitforthefuture.org

SuperHomes Network
Network of 'Super Homes' throughout the UK – case studies and annual open days
www.superhomes.org.uk

Warmer Homes project – MASTT
(Marsden & Slaithwaite Transition Towns)
www.warmerhomes.org.uk

Research for the case studies in this booklet was undertaken by Green Building Store using Passivhaus Planning Package software (PHPP). Airtightness figures to help with the modelling were a mixture of actual figures from tested properties and estimates of likely improvements.

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www.greenbuildingstore.co.uk

Warmer Homes

MASTT Marsden & Slaithwaite transition towns

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Environment conscious and energy efficient construction

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