Retrofitting your house

For a cosier, greener home

June 2024

HCCSP
Hertfordshire Climate Change and Sustainability Partnership

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The importance of home retrofit in Hertfordshire

Hertfordshire Climate Change and Sustainability Partnership (HCCSP) has created this guide to serve as a roadmap for homeowners seeking to embark on their retrofit journey. It's packed with invaluable information, practical tips and actionable advice tailored to the homes that you live in.

Our 2024 Homeowner Retrofit survey revealed a strong desire among Hertfordshire residents to **address rising energy costs** and the climate crisis through home retrofitting. However, many expressed uncertainties about where to begin and which measures are most effective.

Comprised of the ten district and borough councils and the county council, HCCSP is dedicated to **local climate action** and achieving Net Zero Greenhouse Gas Emissions targets. Through our collaborative efforts, we tackle climate change, environmental issues, and sustainability challenges.

This guide offers practical advice tailored to Hertfordshire residents, covering a range of retrofitting options from low-cost solutions to comprehensive "deep" retrofits. In light of the potential impact of each measure on your home, we advocate for a comprehensive "whole-house approach." Whether you opt for a complete retrofit in one go or prefer to tackle it step by step, this approach ensures a cohesive effort, minimising unintended consequences and **maximising efficiency** at each stage.

Hertfordshire has experienced house building in regular 'waves' at significant scale. This means that we can provide typically suitable retrofit work programmes for **different types of Hertfordshire homes**, using factors such as build date and construction type.

Beginning with an overview of retrofitting benefits and targets, the guide provides insights into **suitable retrofit works**, along with template "whole-house retrofit plans". Estimated costs, accurate as of autumn 2022, are provided to help prioritise initiatives based on budget considerations and assume the involvement of a professional building company. However, undertaking the works on a do-it-yourself basis may lead to reduced costs.

Links to additional resources and next steps are included, with interactive features for easy navigation. We hope this guide serves as a valuable resource as you embark on your retrofit journey. Your feedback is important to us as we work together towards a more sustainable future for Hertfordshire and beyond.

Councillor Adrian England
Chair of HCCSP, Spring 2024

What is retrofit?

Simply put, retrofit is undertaking works on your home after it was built – retrospectively. Typically, a retrofit project will involve works to a home that are designed to reduce its energy use, making it more environmentally friendly as well as warmer and more comfortable for the people who live there.

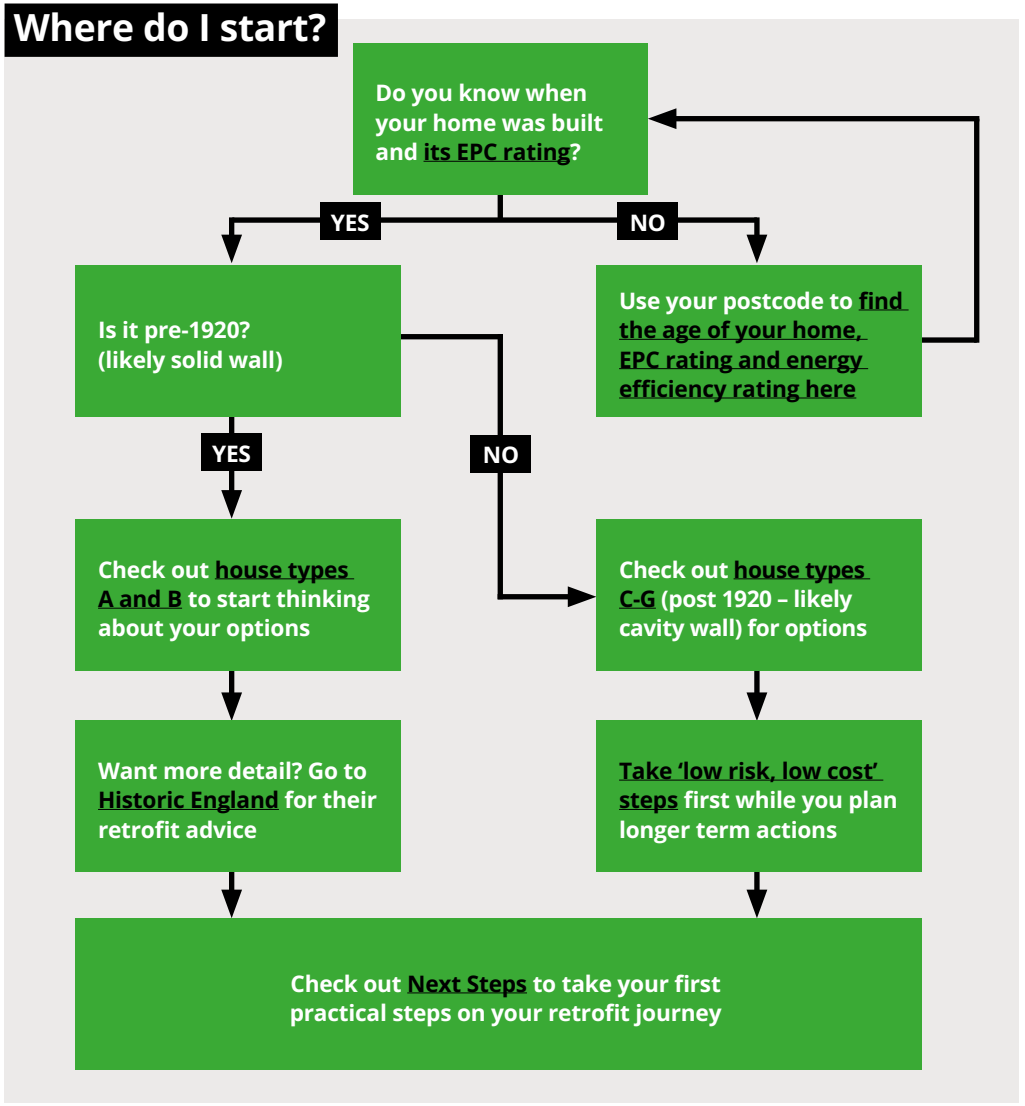
To achieve this, retrofit works will make homes more energy efficient, for example by making them better insulated, or will enable them to generate their own renewable energy, for example by installing solar panels.

When retrofitting your home, it is important to carry out any necessary property maintenance at the same time. For example, there is little point installing wall insulation if a leaking gutter above is causing issues with damp.

Similarly, it is important to take steps to retrofit your home in a sensible order: there is little point installing solar panels and an electric heating system if the building is not well insulated: the renewable generated energy will heat air that then simply leaks out of the building, keeping it just as uncomfortable as before the works.

Think about...

Work with your property rather than against it and make sure your interventions will stand the test of time.



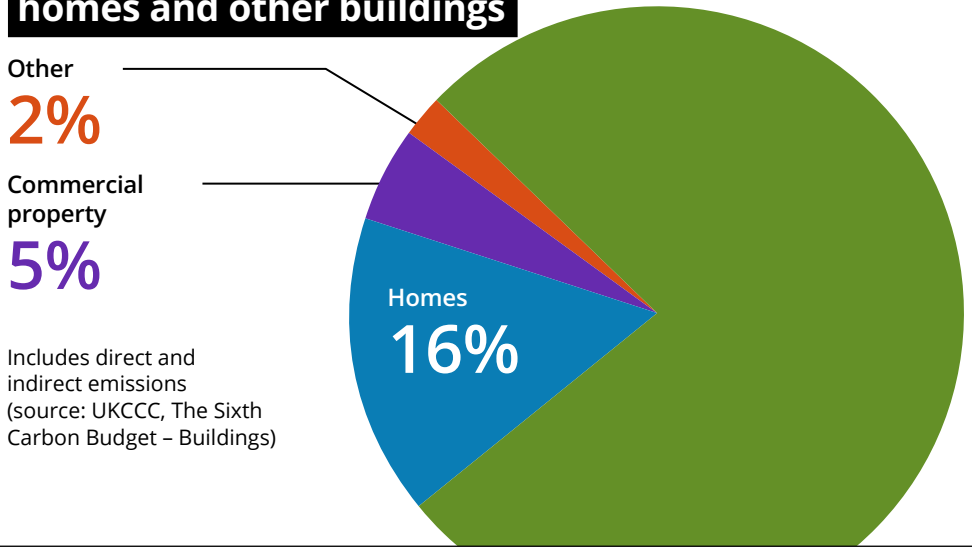
The benefits of retrofit

To prevent catastrophic climate breakdown, most homes and other buildings need to make significant carbon savings. Emissions from existing homes represent around 15-20% of UK carbon emissions, and 80% of these homes will still be in use by 2050.

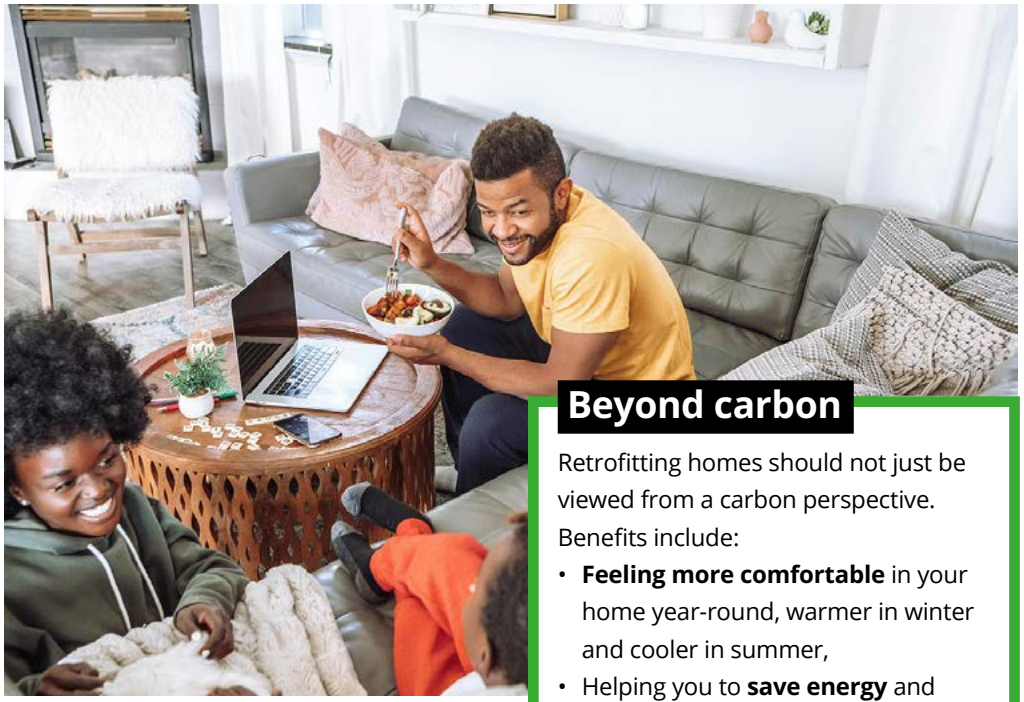
This means that it is not possible to achieve our climate change targets without retrofitting the homes that we live in now. Retrofitting homes should not just be viewed from a carbon perspective.

The International Energy Agency and Organisation for Economic Cooperation and Development state that 75% of the advantages of retrofit are seen in improved health outcomes. Residents have described the effects of retrofitting as 'life changing' from reduced asthma symptoms and other health benefits to lower fuel bills and a sense of warmth and comfort.

UK CO_2e emissions from homes and other buildings



Includes direct and indirect emissions (source: UKCCC, The Sixth Carbon Budget – Buildings)



Work to the outside of your home can improve its appearance, and retrofit may increase its value too.

Private Landlords will be aware of MEES (Minimum Energy Efficiency Standards), which set a legal minimum energy efficiency rating that a home must achieve before it can be let.

Beyond carbon

Retrofitting homes should not just be viewed from a carbon perspective. Benefits include:

- **Feeling more comfortable** in your home year-round, warmer in winter and cooler in summer,
- Helping you to **save energy** and therefore **save money** on your energy bills,
- Protecting you against energy price fluctuations,
- Homes that are **less noisy**, and **free of mould and draughts** that can cause allergies and respiratory illnesses,
- **Supporting jobs** and the local economy.

How far should I retrofit?

What measures do I need for my home, and how can I reduce its environmental impact?

Ideally, we would all aim for **net zero homes**, where a home produces onsite all the energy that it consumes across a year. However, we do not recommend trying to achieve this when retrofitting: the benefits are usually far outweighed by the expense of achieving the final 10-20% of energy savings.

Depending on the property, not all retrofit measures will be suitable, and some works will create more energy efficiency gains than others. We suggest prioritising the **health and comfort** of the occupants alongside a reduction in energy consumption, considering the whole house throughout the planning process. The cost and scale of retrofit works can be built into other renovation work which can help absorb some costs and disruption too.

Think about...

Let your mortgage and home insurance companies know about any changes you make which may impact your policies.

Rebuild or retrofit?

Wouldn't it be easier, or cheaper, to rebuild homes rather than to retrofit? We do not advocate this for several reasons. The widespread demolition of homes would be disruptive and would severely harm Hertfordshire's character. The UK is currently struggling to meet current demand for new housebuilding. And in environmental terms, the demolition and rebuilding of homes would emit much more carbon than would be saved. There are a few exceptions, which include poorly performing and badly-built extensions.

How long could retrofitting take?

The proposals in this guide range from low and no cost through to deep retrofit of a building. As a result, the time required can also vary greatly. In general, the low and no cost measures can be achieved rapidly within days or weeks. The shallow measures may take a few months to install whilst a deep retrofit can often take one or two years from planning through to installation. A **retrofit professional** will be able to advise on the specifics of your project.

How energy efficient are homes in Hertfordshire?

- The majority of homes in Hertfordshire are EPC band D or below, with over 50% of homes built before 1970, when energy efficiency standards were first included in building regulations.
- One in ten Hertfordshire homes were estimated to be in fuel poverty in 2020, that is needing more than 10% of their income to pay for sufficient energy for their home.
- Over 5,000 homes have no central heating.
- It is widely accepted that almost all existing homes would benefit from some form of refurbishment to improve their energy performance.

An Energy Performance Certificate (EPC) tells you how energy efficient a property is, on a scale of A (very efficient) to G (inefficient). Government Net Zero strategy is targeting that all homes reach EPC band C by 2035.

Jargon busting

Some key terms used in this guide

Fabric First

Fabric first is an approach that prioritises the envelope or fabric of the building, that is walls, cladding, windows, and air tightness before considering energy generation or building services like heating systems. Before retrofitting a property, it is important to ensure that the building envelope is in good condition and fully functional.

PAS 2035

PAS 2035 provides a specification for the energy efficiency of home retrofit projects and sets out best practice guidance. When looking for advice on retrofitting, always use a PAS2035 registered professional.

Passivhaus

Passivhaus is an energy performance and comfort standard and certification. The standard is defined by the International Passive House Institute. It is primarily defined by strict limits to reduce heat being lost through walls, roofs, floors, windows, and doors. Very high air quality is achieved by stopping draughts and recovering heat usually lost in ventilating a home. EnerPHit is the Passivhaus standard for retrofits. It is considered the exemplar level retrofit target.

Whole house plan

Piecemeal retrofits may have unintended consequences that could be detrimental to the performance of a home, and even to the health of its occupants. A 'whole house plan' ensures that retrofit measures are planned so that they can work together, even if you complete each measure in stages. A retrofit designer will be able to assist you in the creation of whole house plan specific for your home.

General retrofitting issues

Poorly designed and executed retrofits can be at best ineffective and at worst damaging to the health of a home and its occupants.

A retrofit designer will assess the risks associated with your home and put a plan in place to manage them. This will ensure:

- Pre-existing maintenance issues are not locked in (i.e. covered in new materials that make them inaccessible and impossible to resolve in the future),
- Condensation, damp, and mould issues are remedied,
- Retrofitting works will not cause your home to overheat,
- Good ventilation is maintained,
- Your home will keep the 'breathability' that it needs,
- Heritage constraints are considered and heritage features are maintained,
- All works are in line with Planning Regulations, Building Control or Listed Building Consent.

During the build

Retrofitting, like all building works, can be messy, so consider your needs during the build phase. For complex or major retrofits it is strongly advised to leave your home during the works. If this is undesirable or not possible, this needs to be considered in the whole house plan.

Statutory frameworks and permits

Your retrofit professional will help guide you through these requirements. The key statutory requirements are Planning Permission, Listed Building Consent (if your building is Nationally Listed) and Building Control. Planning permission may be required for Locally Listed buildings, particularly if they are subject to an Article 4 Direction. A party wall agreement may be required under the Party Wall Act. Skip and scaffolding permits may be required for work directly onto the street. You may need to consider environmental or watercourse permits if your home is next to a watercourse and you'll be obstructing the flow of the river during your works.

Asbestos risk

Before it was banned, asbestos was used in materials including wall cladding, gutters, cisterns and roofs. If any part of your home was built from 1920s through to the 1980s it is essential to consider an asbestos survey before disturbing the building materials: discuss this with an appropriately qualified building surveyor. Asbestos materials can be deadly as they can be breathed deep into the lungs and can lead to permanent damage.

Listed buildings, conservation and heritage

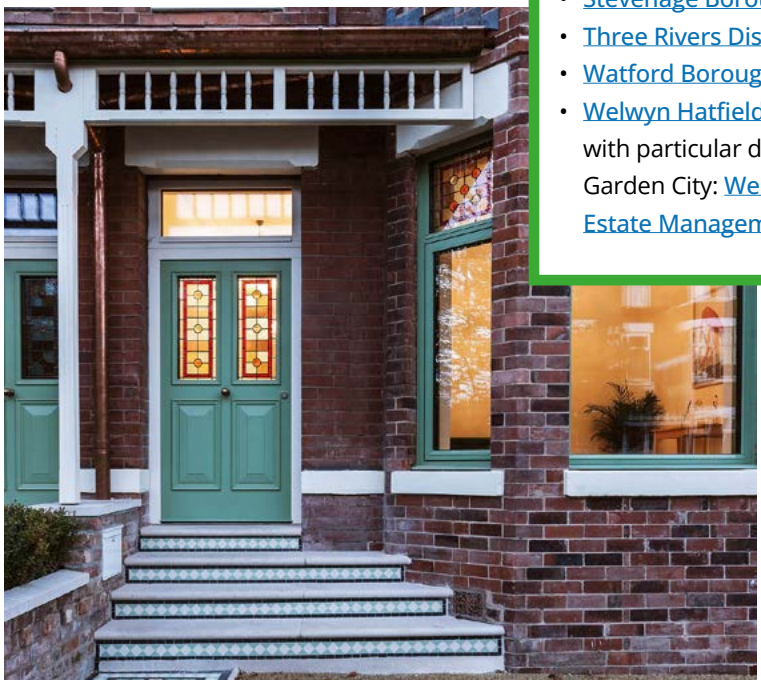
If you live in a listed building or in a conservation area (whether your home is rented or owned, freehold or leasehold), there are likely to be additional considerations and consents required from your particular planning authority, depending on the nature of the works you wish to carry out.

This guide covers some general considerations, particularly for homes built before 1919. In these homes, we recommend you use breathable materials (lime plaster, natural wood fibre insulation, hemp etc) to avoid potential damage to the building fabric.

If your home is in a conservation area or is heritage listed, this is a constraint. It's important to note that it is illegal to carry out any works to a listed building without consent. The Sustainable Traditional Buildings Alliance and Historic England provide specific advice for traditional buildings.

The Garden City areas of Hertfordshire have particular schemes which have design guidance on the acceptability of particular retrofitting measures. Similarly, conservation areas may have restrictions in place also, through Article 4 Directions or otherwise, that remove permitted development rights. The measures suggested in this guide may not be considered acceptable in these areas, so you should consult local guidance.
It is likely that the planning authority and/or a local conservation scheme will review your plans before you will be permitted to start any work that will change the external appearance of the building.

Think about...
Repair and maintain is often better than 'replace'. Consider whether original features can be repaired rather than ripped out.



Local guidance

- Broxbourne Council
- Dacorum Borough Council
- East Herts District Council
- Hertsmere Borough Council
- North Herts District Council, with particular details for Letchworth Garden City: Letchworth Heritage Foundation
- St Albans City and District Council
- Stevenage Borough Council
- Three Rivers District Council
- Watford Borough Council
- Welwyn Hatfield Borough Council, with particular details for Welwyn Garden City: Welwyn Garden City Estate Management Scheme

How to retrofit

No cost and relatively low cost measures

The following measures in this section are either free or relatively low cost (from a few hundreds of pounds to a few thousand). Many are possible with an informed DIY approach and represent a great start while you consider more substantial steps. There are many instructional videos online to help you here.

Controls and use

- **Turn down your thermostats, but only if your health or wellbeing needs allow.** Generally, for a healthy person, temperatures should be kept at 18°C but may be lower at night. It is generally considered wise to stop the property falling below around 15°C to help minimise condensation. Those more vulnerable to the cold may find it beneficial to their health to heat to 21°C in the rooms in which they spend most of their day.
- **Heat higher temperatures only in the rooms you are using.** You may need to install thermostatic radiator valves (a simple device that controls the temperature of an individual radiator) to lower the heat in un-used spare rooms. You should still maintain some background heat and ventilation to rooms you use less often. However, some heating systems including heat pumps will work less efficiently when a building is 'zoned' so room controls should be carefully considered.
- **Use conservatories as the Victorians did: enjoy them when the sun shines, and don't heat them.** These spaces are often excluded from Building Regulation standards as they are considered outside of the 'heated' home. The high amount of glass and sometimes poor build quality means they often lose a lot of heat. Consider heavy curtains or installing doors if your conservatory makes the adjoining rooms too cold. An infrared heating panel could be used for occasional use because it responds very quickly when switched on.
- **Switch off appliances or chargers at the plug when not in use** to eliminate 'phantom loads': appliances, particularly old ones, use considerable energy when in 'stand-by' mode.
- **Smart products** (such as an app-controlled plug, light or thermostat) can save 10% or more from your energy bill.

Basic draught proofing

- **A draughty home will not only increase energy bills but can be a primary cause of thermal discomfort.** It is crucial to differentiate between unwanted draughts and necessary ventilation for indoor air quality, which is covered in more detail in the next section.
- **Ventilation is a necessary part of keeping a home 'healthy'.** Air bricks, window trickle vents and extractor fans all play their part. Making sure that ventilation is controlled, balanced and safe is very important to make sure you're not leaking energy, but that you still have access to fresh, cycled air in your home.

Open chimney

Open chimneys are a major source of draughts – not surprisingly, as the entire purpose of a chimney is to move air through a home! Several off-the-shelf products are available to reduce the flow of air through an unused chimney, sometimes called chimney balloons. We recommend a breathable and ideally natural material. An old pillow or ball of insulation in a paper sack is a cheap alternative, but remove it if you're going to light the fire!

Risk

Chimneys that are not suitably sealed at the top must be allowed to breathe to prevent moisture build up and potential damp issues. Use a breathable seal or, if using a chimney balloon, ensure it is fitted loosely to ensure some air flow. Only reduce the flow of air through your chimney if it is no longer in use. We recommend fitting a chimney cap if you have safe access to your roof.

Wood burners

If you have a wood burner, check the seals at the edges of the register plate. A register plate is used when a chimney has no stainless steel chimney liner. The register plate closes off the chimney at its base, just above a wood burning stove. The register plate acts as a barrier to prevent the smoke and fumes in the chimney from entering the room. Remember, wood burners should have adequate ventilation in the room to work safely. It's a good idea to fit a carbon monoxide detector as well as a smoke detector.

Holes in outside walls

Whenever a cable or pipe comes from the outside to the inside of your home a hole must be made. These holes are rarely sealed and so often leak air. These are relatively easy to seal using an appropriate sealant for small gaps. Air tightness tape or traditional lime based fillers are useful for larger gaps. Foam can also be used but is prone to shrinkage, so look for specific air tightness foam. Try to fill holes first from the outside then from the inside.

Holes in outside walls are typically due to soil stacks and waste pipes, electricity cables, gas pipes, telephone and internet cables, cable TV, etc.

Risk

This work is generally safe. However, if your home does not have an up-to-date gas safety or electrical certificate this should be sought first. Do not attempt to move any pipes or cables without appropriate advice. Be mindful of air bricks and ventilation necessary to maintain safe airflow.

Cracks and gaps

Cracks and gaps develop in buildings either because they were built poorly or, more likely, because they have simply moved over time. Fixing them is an easy and cheap DIY measure.

Internally, use filler where the hole doesn't move (such as a screw hole in plaster board) or decorators' caulk or mastic where the hole might move (such as the gap between skirting boards and walls). Brushes and seals may be needed for windows and doors, while traditional draught excluders are effective on poorly-fitting windows and doors.

Caulking or filling internal cracks

- Gaps in skirtings where they meet the floor around outside walls,
- Mouldings or covings,
- Cracks in plasterwork/ plaster board,
- Screw holes (particularly for dot and dab plaster work).

Weather brushes or seals

- Doors,
- Windows,
- Loft hatches,
- Storage doors/hatches.

Air tightness is often particularly poor behind bathroom and kitchen fittings. This can be because waste and soil vent pipes have been sealed poorly. Soil vent pipes are often built as a chimney from the ground, where the pipe enters, rising all the way to the roof. Sealing this can prevent significant heat loss, although professional help might be required.

Kitchens perform badly as often there is no plaster or plaster board behind the kitchen units. If you are having a kitchen fitted, ensure the air tightness works are done before the units are installed alongside extremely good ventilation planning to reduce issues with condensation and mould.

Sealing floorboards

Suspended timber floors are designed to be ventilated from below to protect the floor timbers from moisture, but these draughts can be unwelcome in the home.

- If you have exposed timber floors, consider caulking or sealing the gaps.
- A layer of new carpet or an airtight membrane can be laid over floorboards.
- The edges of a room where boards and skirting boards meet can be a source of draughts. This can be remedied with air tightness tape if removing skirtings. If skirtings are retained, then the gaps can be caulked or filled with sealant.

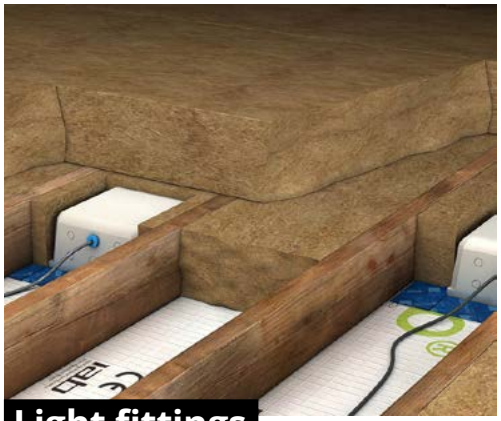


Image credit: Ecological Building Systems

Light fittings

Light fittings, particularly downlighters, in the ceilings of pitched roofs or in loft floors often leave holes in the insulation and cause significant draught in the gaps. When decorating, choose surface mounted lights. For lights that have already been installed, an off-the shelf fitting can create an air-tight seal over the light.

Risk

Old incandescent or halogen lights can become very hot and overheat if insulated or if airflow to them is blocked. Do not attempt to insulate or seal such fittings; ideally replace them with a low-energy model. Use an electrician if any cables or fittings require work.

Test your air tightness

Air tightness tests are relatively cheap (around £200) and will allow you to measure how airtight your home is and to find any leaks. Make sure to ask your air tester for a diagnostic visit to find air leakage pathways, not just for an air tightness rating. The professional body ATTMA (Air Tightness Testing & Measurement Association) is a good place to find accredited testers.

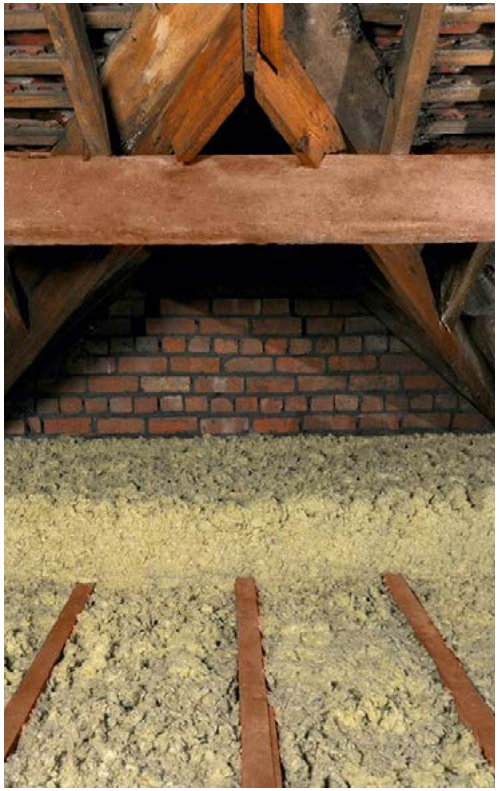
- Attach draught seals to windows and doors.
- Use airtight seals for down lighters (for example, Thermohood).
- Use low-energy light fittings throughout.
- Stick additional insulation to your loft hatch and draught proofing.
- Lag/insulate pipework.
- Fit thermostatic valves to radiators.

Low-cost ventilation

Simple extractor fans should be installed in bathrooms and kitchens (unless you are planning a more extensive retrofit, in which case refer to the section below on Air tightness and ventilation. Fans are available that recover the warmth from the extracted air. Bathroom and kitchen doors should have a gap big enough to fit your finger through at the bottom to allow air to enter the rooms while the fan extracts. If your windows have trickle vents, make sure they are open in rooms that are in use.

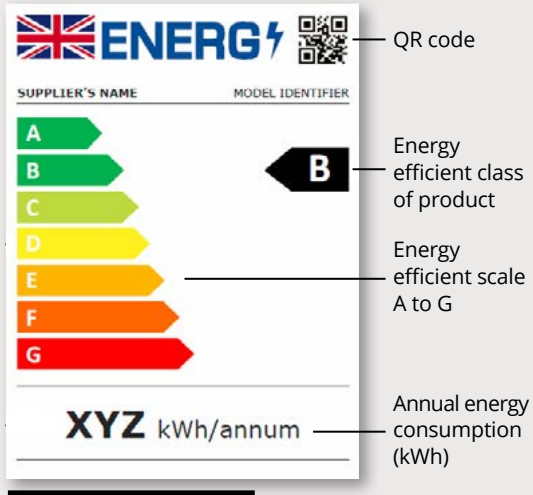
Loft insulation

Most homes have this low-cost measure already. However, it is often only 100mm (between the floor joists) and sometimes poorly laid or in poor condition. Top-up loft insulation is an easy DIY measure (depending on how much you have stored up there!).



We recommend an extra 200-300mm, which should be laid at a right angle to the layer of insulation below, to limit gaps forming. You may need a 'loft pack' – essentially chip board flooring on stilts – to create a storage area if required. You should leave a small (20mm) ventilation gap between the chip board and the top of the insulation, just in case any moisture forms. Be careful not to block any eaves ventilation with the new insulation. A slab of ridged insulation and air tightness seals to the loft hatch will complete this potential weak spot.

Loft insulation can often be cheaper and easier to have fitted by professionals and there are often grants and subsidies available too. Your installer can check if there is adequate ventilation above the insulation and fit additional vents if required. TrustMark registered installers often have access to funding and can ensure the job is completed properly. If you are unsure, check with a retrofit professional.



White goods

Choose white goods that have the highest energy standards that you can afford. Note that under new energy rating guidelines, energy labelling has been changed. Older products go up to A+++, while the maximum energy rating under the new guidelines is an A. Please also note that old A+++ rated-goods are rated much lower under guidelines re-scaled in 2021, sometimes as low as a D or E rating. When upgrading your kitchen, consider installing an induction hob, as their high efficiency means any additional upfront cost will be paid back quickly.

Water

Water takes a lot of energy to heat. To reduce the amount of water that you use, low-flow fittings can be fitted on taps, flushes, and shower heads when they need replacing, or when redecorating. The AECB Water Standard is a useful standard to aim for because it is easy to understand and relatively easy to achieve. You can find ideas for saving water in your bathroom, kitchen and garden in our sister publication 'Sustainable Actions that work for you, your money and our environment'.

Lighting

LED light fittings are now widespread, affordable, effective, and reliable. To achieve quick savings, upgrade your incandescent bulbs immediately and replace fluorescent bulbs as they expire.

Pipe lagging

It is essential to insulate all pipes that run outside of the insulation line of the building, for example through a cold loft space and sub-floor spaces. You should also insulate hot water pipes that run though spaces that don't need heating, such as though a utility cupboard or storage room.

Deeper retrofit measures

This section gives an overview of the main measures you can take to improve the fabric of your home. The following section will show you which of these will be most applicable for the type of property that you have.

Fabric improvement

Your home's 'fabric' is its walls, floors, roofs, windows, and doors. A better building fabric is more comfortable as it loses less heat through it, has fewer draughts, and is less likely to have issues with damp. Retrofitting is often described as a 'fabric first' approach. This means that first you improve the performance of the building's materials and construction before then installing low carbon or energy efficient technologies.

Wall insulation

Improving the insulation of the loft and any cavity walls of your home almost always offers the biggest improvement in energy efficiency performance and the greatest return of benefits for the money you invest. External or internal wall insulation also offers big improvements, but it can cost a lot more to install.

There are three methods of insulating walls:

1. **external wall insulation** on the outside of the house,
2. **internal wall insulation** on the inside external walls, or,
3. **cavity wall insulation**, which fills the cavity between the inner and outer leaves of the walls, if present.

Homes can have a mix of wall insultation, for example: External Wall Insultation at the rear and Internal Wall Insultation at the front.

Risk

No form of wall insulation is without some form of challenge — often centred around how your home deals with moisture. The installation can be costly and disruptive, but, done correctly, the payback in energy costs and comfort can be enormous.
The benefits, characteristics and costs of insulation materials vary enormously (e.g., single use polystyrene vs wool or hemp panels) so this is worth a conversation with your building professional before deciding what is right for your home.

Cavity wall insulation

The key advantage of cavity wall insulation is that it is hidden within your walls, meaning the inside and outside of your house will look the same, and most building services will not be affected. For newer homes with wide enough cavities this is a highly appropriate measure.
The work quality of cavity wall insulation can be hard to assess and only thermal imaging can show areas that have been missed or areas where the filling material has settled. For this reason, you should ensure an installer can provide a guarantee from CIGA (Cavity Insulation Guarantee Agency). If they are unable to do so, then they should be avoided.

Internal wall insulation

Internal wall insulation is a good choice for solid wall buildings where, for aesthetic or heritage reasons, it is not appropriate to insulate the outside walls. It is also very appropriate for incremental retrofits, doing one room at a time before redecorating.

Risk

Moisture may build up behind internal wall insulation. The use of breathable insulation is highly recommended (for example 60-100mm wood fibre board). Non-breathable insulation manufactures will recommend a ventilation gap behind the wall to mitigate this risk. However, this significantly reduces the effectiveness of the insulation as warm air is in circulation behind it. A qualified tradesperson should carry out a moisture calculation to assess this risk. Typically, the supplier of the insulation will be able to provide the calculation. You may create 'cold bridges' (or thermal bridges). Thermal bridges can occur at any junction between building elements or where the building structure changes (for example between floors). These are weak points (or areas) in the building envelope which allow heat to pass through more easily. Make sure that you decorate with permeable plaster and paint to make sure that all-important breathability is retained.

Associated work

Insulate between floor joists. There will be a gap between floors where your internal wall insulation starts and stops. To eliminate this, you should include insulation between the floors. This can be of the same material as your internal wall insulation, or a flexible insulation material pushed between the rafters. If possible, you should plaster the wall between your floorboards to improve air tightness. For solid wall construction this is very important and lime plaster should be used to protect and regulate moisture where the joists enter the external wall. Speak to a retrofit coordinator for advice.

External wall insulation

External wall insulation provides the biggest opportunity for improved performance. This is because it can be thicker than other kinds of wall insulation, and there is less risk from moisture. It also enables the masonry of the wall to act like a 'heat battery' in the same way that night storage heaters with concrete blocks in them work; they are heated up by the central heating and then release the heat when the interior is cooler, evening out temperature fluctuations.

The main issue to consider will be managing moisture permeability, the appearance of your house and a significant number of associated works.

Therefore, it is important to engage fully with the relevant building control, heritage and conservation teams within your council.

Please note that any works that alter the character of a listed building require Listed Building consent, a separate process to obtaining planning permission. This would include internal works; re-facing external walls; replacing windows and installing external boiler flues. Planning permission will also be required for any property where the external insulation would cause a material change to its external appearance.

Finishes

If replacing a rendered house, the change in appearance can be small. However, external wall insulation can significantly affect the appearance of a brick or stone house. Brick tiles (brick slips) or brick effect render are an option to recreate a brick appearance.

Associated work

- Your **roof may need extending**, or the top of the insulation capping, if the eaves are not large enough.
- The **gutters and downpipes will need refitting**, although may be reused if in good condition.
- External services such as **water or soil vent pipes will need extending** and adjusting.
- **Lintels should ideally be revealed and checked for integrity** before the insulation is installed.

Roofs and Ceilings

Flat roofs

Flat roofs are most easily insulated from above the structure (typically timber joists with a plywood deck), but this is only possible if the roof covering is removed. Therefore, a condition survey is a critical first step before deciding on an approach.

Insulating from below and between is possible and more possible as a DIY approach. However, there is a condensation risk and ventilation should be added above the insulation to avoid this. Any work should therefore be specified by a competent person, ideally with PAS 2035 accreditation.

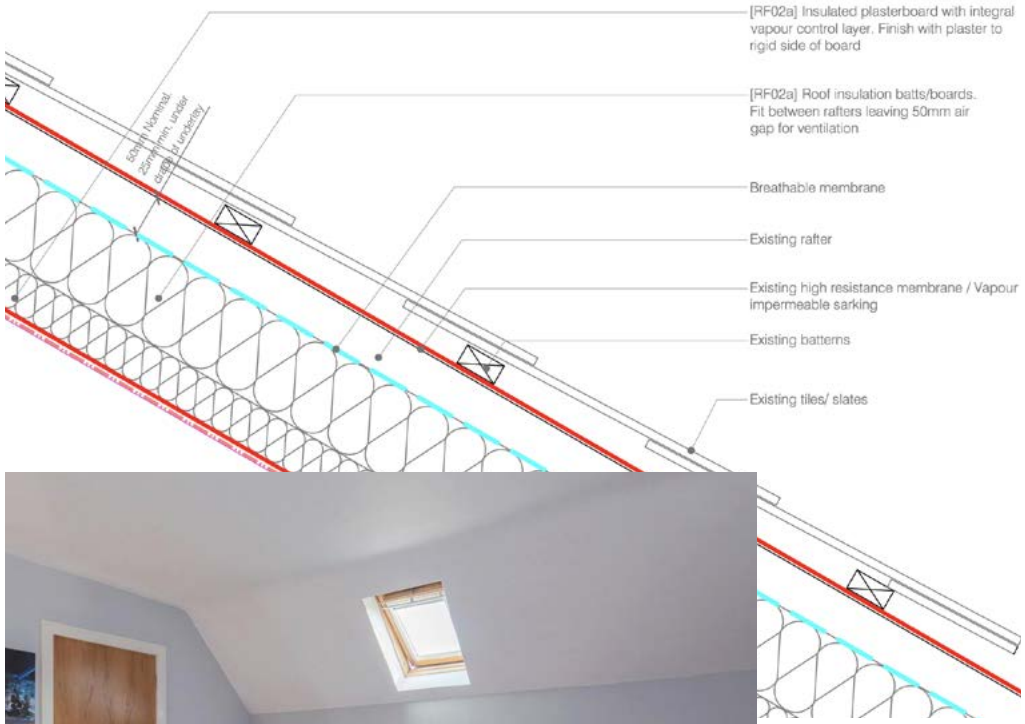
Pitched roofs

Many homes don't require insulation to pitched roofs. This is because the insulation layer is in the loft floor (between and over the joists). In construction this is referred to as a 'cold roof'. However, if the pitched roof is also the ceiling of a warm room below then this element needs insulation. Typical examples are room-in-the loft extensions or lean-to extensions.

As with a flat roof, a retrofit coordinator or similar person should assess the roof construction before deciding on an approach. Whether tile, slate, or metal, a ventilation space is required behind the covering. Check whether the roofing membrane is vapour permeable - pre2000 roofs tend to be non-permeable and have a bitumen-like finish. Modern roofs tend to be breathable and have a woven fabric like appearance.

❗ Maintaining ventilation

Maintaining ventilation and a path for moisture to escape is essential and needs specifying by a competent person. Care must be taken at the eaves to avoid weak spots in the insulation where heat can escape. At best it is inefficient, at worst these cold areas can result in damp and mould. The Retrofit Pattern Book provides free to download construction detail such as the examples to the right.



Skeiling

Skeiling is a construction term that relates to an angled roof, rather than a horizontal ceiling. This may be the whole area of the room or just a small section at the perimeter – this is typical of interwar and post-war construction (see house types C and D, below). They are very often uninsulated and may be an existing area of damp and condensation. This may become worse if the adjacent wall and ceiling are insulated and the skeiling is not. The same approach should be taken to the room in the roof section.

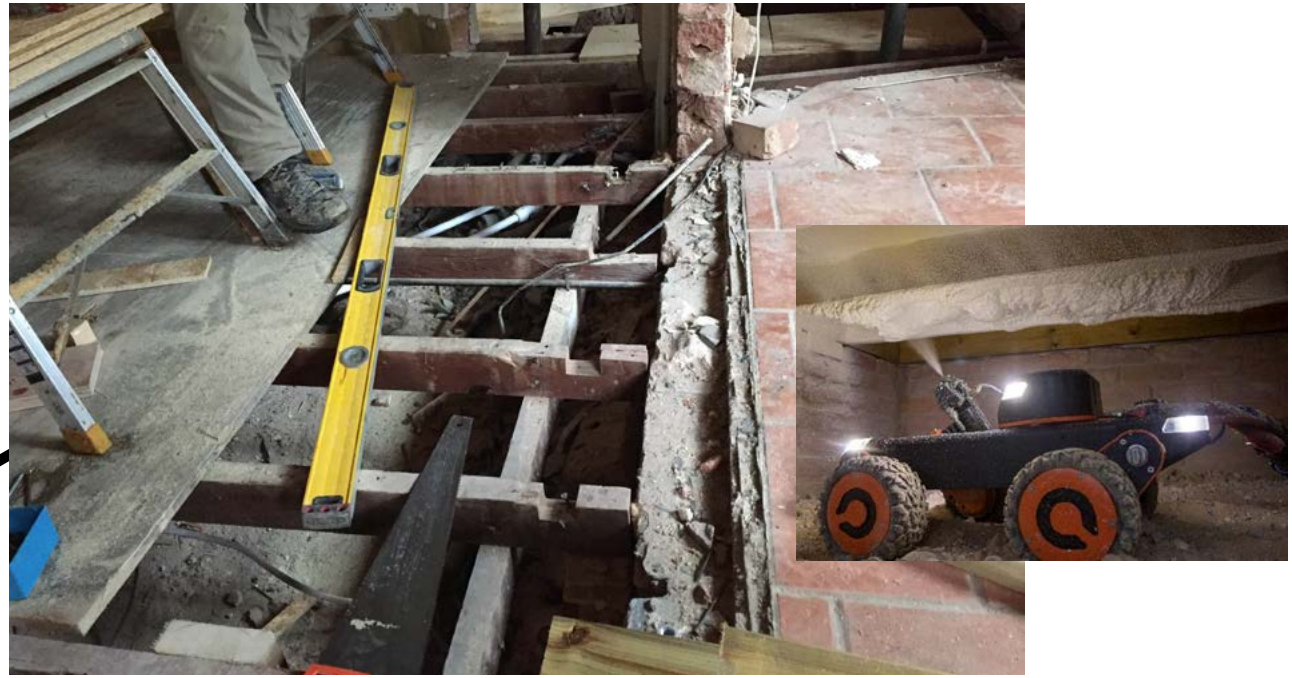
Biodiversity in roofs

With the increased priority on insulation, there has unfortunately been a decline in house dwelling species such as birds (swallows, swifts, house martins, house sparrows) and crevice and void dwelling bats.

Swift boxes and bricks can be incorporated into most retrofit work without loss of insulation benefit, including where external insulation is being put on buildings.

- ***If you'd like to give these red-listed species a helping hand, discuss with your contractor and ensure your swift brick or box conforms to building regulations.***

Floors



Suspended timber floor

Typically used until the 1950s, these are timber joists that are lifted above the floor and away from the moist ground. A ventilated space is left below the floor. Clues that you have a suspended floor are the presence of vent bricks and a slightly bouncy feel to the floor. There are broadly two ways to insulate this construction: placing an insulation material between; or spraying from below. If there is a large void below the floor or the floorboards are being lifted, then insulation can be placed between. Best practice involves draping a breather membrane over the joists; snuggly filling with flexible insulation between; adding an airtight membrane above; then adding a floor finish.

Solid concrete floor

Solid concrete floors became popular from the mid-20th century onward, but only towards the turn of the millennium were these insulated. These tend to be costly to retrofit. A high performing aerogel insulation can be installed as this can be as thin as 30mm. A lower performing phenolic could also be used, installed between timber battens or directly laid (floated) over the existing concrete. If cost is a barrier, a high-quality carpet with quality underlay will provide more thermal benefit than a hard surface.

Beam and block floor

From the 1980s onwards, concrete blocks laid between precast concrete beams became increasingly popular, particularly for mass house builders. If already insulated, then further work is only needed if you are aiming for the highest energy efficiency standards. If uninsulated, you can use any of the methods described above.

Air tightness and ventilation

A draughty home isn't just uncomfortable; it can waste a lot of energy. Up to a quarter of heat losses can be due to a leaky building.

Fixing this could save more energy than fitting new windows, and it's cheaper too. However, just because you've fixed the draughts doesn't mean you're stuck with poor air quality too. That's why having a ventilation plan and system is crucial. It helps maintain good air quality while still being energy-efficient.

There are a range of ventilation targets with their distinct pros and cons. The below list is not exhaustive but covers the key systems recommended in this guide.

❗ Insulate right and ventilate right

Poorly performing UK homes often have damp issues and knock-on poor health impacts on the humans and the building itself. Retrofitting deals with these issues alongside reducing energy consumption. Therefore, a key (and often overlooked) part of a successful retrofit is improving and upgrading ventilation systems to ensure that moisture and fresh air can circulate effectively. Good controllable ventilation can be important to avoid condensation risks and poor air quality. Examples of controllable ventilation include extractor fans and window trickle vents that can be opened or closed.

Single room ventilator with heat recovery (SRV)

This is the same as a typical extractor fan in a kitchen or bathroom, with the key difference that it contains a heat recovery unit. This can collect around 60-80% of the heat from the extracted air. This is an affordable consideration if no extractor fan is currently present. As above, this is not needed if any of the following systems are to be installed.

Building regulations minimum

This is a blend of extractor fans and background ventilation. Mechanical extractor fans are placed in bathrooms and kitchens. The background ventilation occurs through trickle vents (slots or grills) in the window frames which most modern windows will have. If you don't have trickle vents, make sure you open windows for 15 minutes a day (even in cold weather) to prevent moisture building up in the home.

It's worth making sure you have those trickle vents, but if you're planning to install further ventilation measures down the line, they will not be required.

Mechanical ventilation with heat recovery (MVHR)

Mechanical ventilation with heat recovery is a whole-house system that extracts stale air and supplies fresh air that has been prewarmed with heat recovered from the extracted air. Air is typically extracted from warm and wet rooms, i.e., kitchens and bathrooms, and supplied to bedrooms and living spaces. Because 80-90% of heat can be recovered through this system, significantly more fresh air can be delivered while ensuring occupants remain warm. The system requires air ducts to be carefully placed through the house. The unit is about the size of a large suitcase and space equivalent to a fridge freezer is required when the insulated exhaust and intake ducts are included.

Demand control ventilation (DCV)

An alternative whole-house system is demand control ventilation. One or two fan units extract air from kitchens and bathrooms. Air is admitted from the outside via smart grills that automatically open and close dependent on the moisture level in a room. Although it does not recover heat from warmer air, it efficiently only supplies ventilation when and where it is required.

Recirculating cooking hoods

Typical cooker hoods that are ducted to the outside are not compatible with DCV, MVHR and SRV systems. They should be replaced with a recirculating cooker hood. These include charcoal filters to remove moisture and cooking smells.

Windows and doors

Doors

Original doors can be thick, well made and an integral part of the character of a property. Your first step would be to improve draft seals and adding secondary glazing. However, if this has not proved effective, aim for triple glazing for transparent elements and two layers of draught and weather proofing. A Passivhaus-certified door will achieve the highest of standards. It is worth noting that many original doors would be replaced with uPVC or composite alternatives, which create challenges regarding whole-life carbon and end of life disposal, so attempt to retrofit before you replace.

Windows

Should your building have pre-1990 double-glazing, single glazing, or metal framed windows then this could be a good upgrade.

Use a thermal imaging camera to check for the quality of what's already in place and if appropriate, check on Historic England for guidance on restoring original fixtures. Don't underestimate the impact of thermal curtains and secondary glazing before replacing original wood with plastic frames.

Many Hertfordshire homes have reasonably well performing double glazing. If yours are in good condition, this guide only recommends an upgrade to triple glazing if you are aiming for a very high performing retrofit. This is because the cost is high for the money invested – it will save around half the energy per pound compared to wall insulation, air tightness measures, or ventilation systems.

Nevertheless, high performance windows can increase the value of a home, and significantly increase your comfort, especially in bathrooms.

Secondary glazing

Secondary glazing, as the name suggests, is a second layer, usually made of glass, that is fixed to the inside of the existing windows. This can be highly appropriate for traditional buildings when there is heritage value in retaining the existing glazing and is very suitable for integration with internal wall insulation. Improved acoustic performance is a further benefit of single glazing.

As an alternative to UPVC, there are several specialist suppliers on the market. Metal frames are slimmer and have less visual impact, but timber frames lose less heat. They can be both single or double glazed, with the latter offering better performance but requiring a larger frame.

Loft and storage hatches

An affordable DIY option is shown in the low-cost measures (below). For increased air tightness, a purpose made hatch is a robust option.

Heating upgrades

Heat pumps

A heat pump is essentially a fridge in reverse; instead of cooling it is used for heating. It works by taking heat energy from the air or ground and circulating it into your home using refrigerants and a compressor. Heat pump refrigerants have very low boiling points, typically below -25°C, so they are still able to extract useful heat, even in the harshest UK winter. For each unit of electricity used, it is possible to produce two-to-five units of useful heat.

- **Ground source heat pumps (GSHP)** are more efficient but require greater up-front costs; either horizontal pipes in a large garden or boreholes if land is not available.
- **Air source heat pumps (ASHP)** are less efficient but cheaper to install.
- **Water source heat pumps** are also available but can only be used next to a river, lake, or other major body of water and more permissions may be required.

You may need to increase the size of your existing radiators because heat pumps are far more efficient when run at lower temperatures. An easy way to test if you need upgraded radiators is to reduce your radiators to their lowest settings and leave on for a long time. If you still feel warm on a cold day, then your radiators are the correct size.

Split Heat pumps have the refrigerant unit situated inside the property along with a hot water cylinder and are typically the size of a tall fridge freezer. Externally, an ASHP is the size of a large suitcase. A monobloc heat pump is bigger where the pump and refrigerant are incorporated into one unit outside.

Poorly designed ASHPs can make some noise and ideally should not be installed under bedroom windows. There are requirements on where you can fit them. These include a requirement that all parts of the air source heat pump must be at least one metre from the property boundary and (if installed on a flat roof) be at least one metre away from the roof's edge.

A typical ASHP produces 2.5 units of heat for every unit of electricity. In comparison, a gas boiler needs one unit of gas to produce 0.9 of useful heat. Despite this, an ASHP will not necessarily reduce your heating bills (because electricity is currently around four times the price of gas) unless in conjunction with improvements to insulation and air tightness. The UK government's boiler upgrade scheme currently provides grants to install heat pumps.

Given the high upfront costs of GSHPs they are not included in the budgets that follow. They are more efficient than ASHPs, though, and are worth considering for longer-term benefit if space and budgets allow.

Gas boiler

Due to their high carbon emissions, you should not install new fossil fuel heating systems. If you have an existing gas boiler, regular servicing can ensure they run as efficiently as possible. Old boilers can be replaced to improve efficiency.

Electric boilers

New electric boilers can be installed as a like-for-like replacement for a gas boiler. Solar panels can help to provide zero carbon electricity to run the boiler. The carbon content of electricity from the national grid is falling rapidly as more renewables provide electricity to the grid. Your bills may increase because electricity is currently more expensive than gas. An electric storage boiler which runs during off peak prices can be cheaper to run.

Infrared heating panels

The principal of 'heat the person not the building' lies behind infrared panels. This technology can be very suitable to heat a localised area in an otherwise low-performing room or building. For example, a home office in a poorly insulated loft conversion.

On-site generation

For most homes, it is only feasible to install photovoltaic/solar panels if enough suitable roof space is available (orientation, angle and structural considerations need to be considered).

Generating power from wind is rarely viable in urban areas and generating hydroelectricity is reliant on access to a water source. Unlike other retrofit measures, photovoltaics can be installed at any point in the whole house phasing plan (although it is best to look at low-cost and no-cost measures first).

Installing photovoltaics provides a source of renewable electricity that can be used in homes and battery storage allows you to make use of any unused energy once the sun has gone down!

You can also consider solar thermal panels which are mounted on your roof. Rather than converting the sun's heat into electricity, solar thermal panels absorb the sun's heat and use it to heat up water, stored in a cylinder, to use in your home.

Solar PV installations can be considered 'permitted development' and will generally not need planning permission. However, in some cases, such as in Conservation Areas and on Listed Buildings, planning permission may be required.

● *For planning advice please contact your planning department*

House types

House type finder

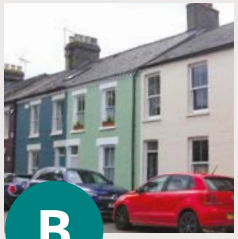
These photos show some of the most common types of houses in Hertfordshire. To discover the most appropriate retrofit opportunities for your home, find the house type most similar to yours, and click on the appropriate letter in the navigation bar below.

This should outline the most suitable measures for your home, although you may also need to look at measures from earlier or later eras if the fit is not exact. For example, you might have a 1960s home with a suspended timber floor. Equally your Victorian terrace may have had a solid concrete floor installed as a later addition.

Please note that not all houses will fit neatly into one of these categories and there are likely to be exceptions to the information provided here, when considering heritage buildings, conservation areas, flats and multiple-ownership homes. Check out Next steps advice before making any financial commitments.

A

Large historical house
Age: pre-1919



B

Victorian terrace/ workers' cottage
Age: pre-1919

C

Small semi-detached
Age: 1920-1950

D

Large semi-detached
Age: 1945-1959

E

Mid-century 'modern' and new town housing
Age: 1960-1979

F

End of century mass house builder
Age: 1980-1999

G

Modern mass house builder
Age: 2000-onwards

Large historical house

Age: **pre-1919**
Typical Size: **from 72m² (when converted into apartments) up to 200m²+ (whole house)**

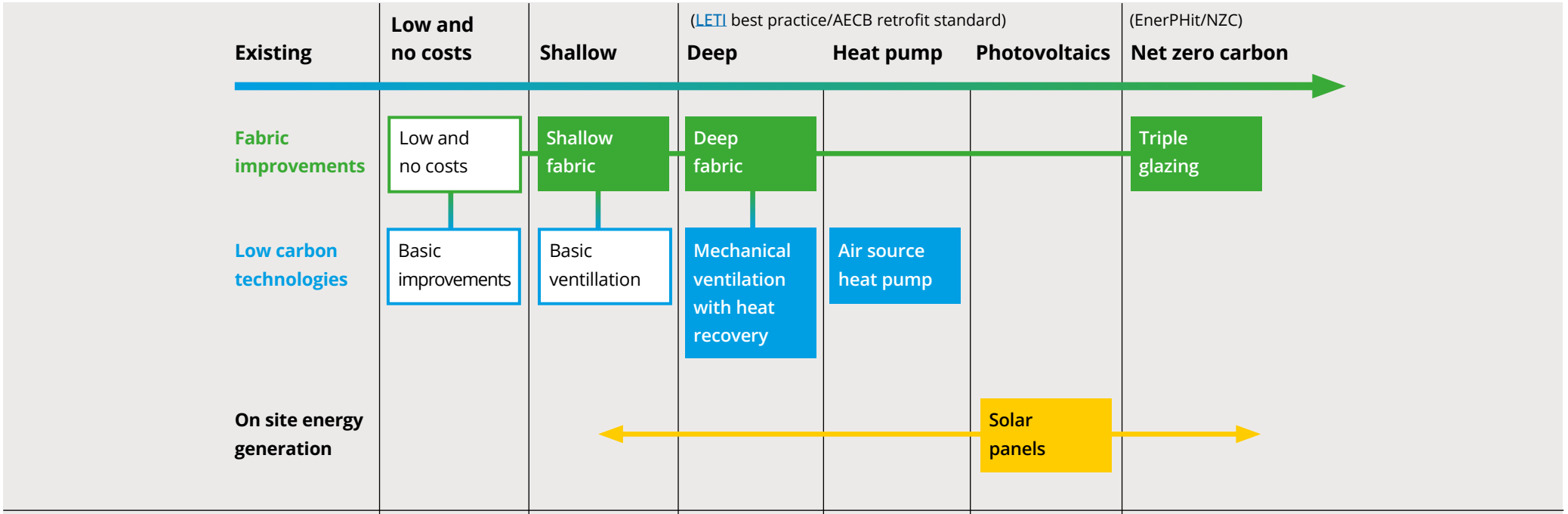
Description

This archetype covers pre-1919 (including those subsequently subdivided into flats). The properties covered in this type are largely constrained due to their historic value.

Typical features

- Solid masonry walls (generally brick)
- Suspended timber floor (uninsulated)
- Masonry load-bearing partition walls
- Lath and plaster or single brick partition walls
- Timber roof with slate or tiles
- Loft floor typically insulated between joists
- Single glazed windows
- Gas boiler and radiators
- Open chimneys with generally unused fireplaces

Phasing of retrofit work – Type A



Retrofit cost	£0	£3,000	£48,900	£87,600	£103,600	£107,000	£119,600	£ invested
Energy saving	0%	0-10%	17%	73%	85%	89%	93%	Percentage saved
Heating demand	**300**	**280**	**250**	**65**	**65***	**65***	**40**	**kWhr/m²/yr (heating)**
Carbon emissions	10	9	8	2	1	0.7	0.4	Tonnes CO_2/year
Annual bills	£2,000+	£2,000	£1,700	£1,000	£1,200**	£900	£600	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

* the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology

**bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Dormer window roof repair and insulation

Chimney cap

Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

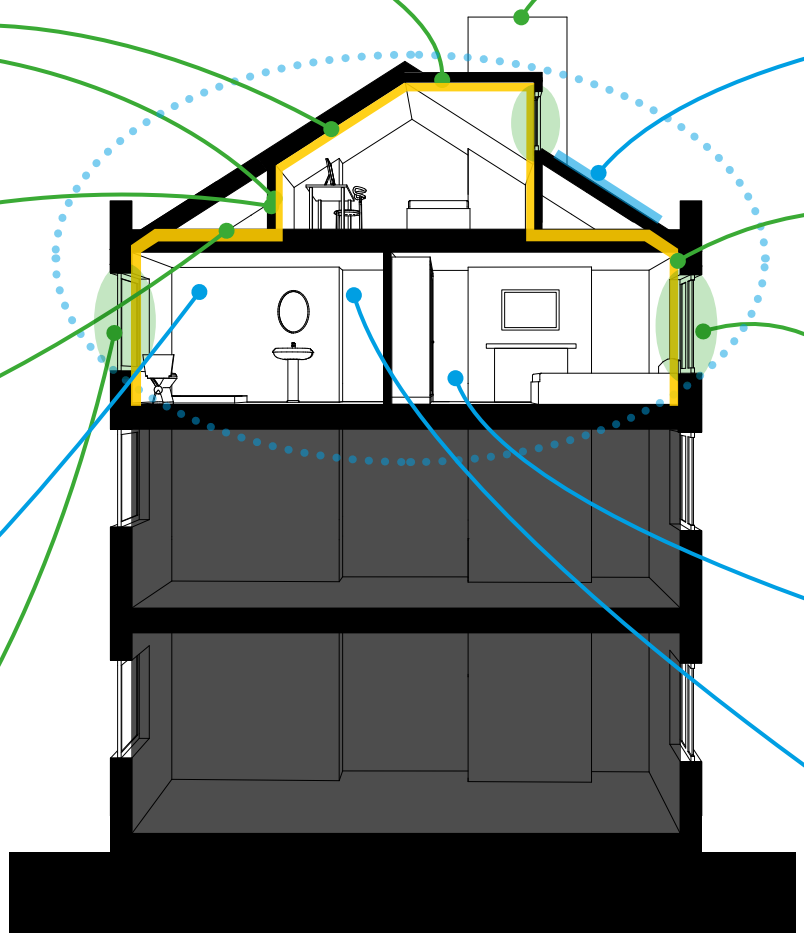
Insulation to pitched roof and knee wall
£7,300

Breathable materials

Topped up loft insulation at eaves
£5,100

Mechanical ventilation
£4,200

Draught free
£8,900

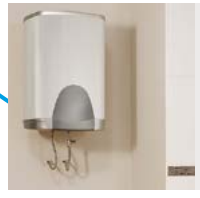


Solar panels
£3,700

Internal wall insulation
£70,300 (whole house)
£11,600 (per room)

Secondary glazing
£10,000 (all windows)
£1,600 (per room)

Low carbon heating:
Air Source Heat Pump
£21,300



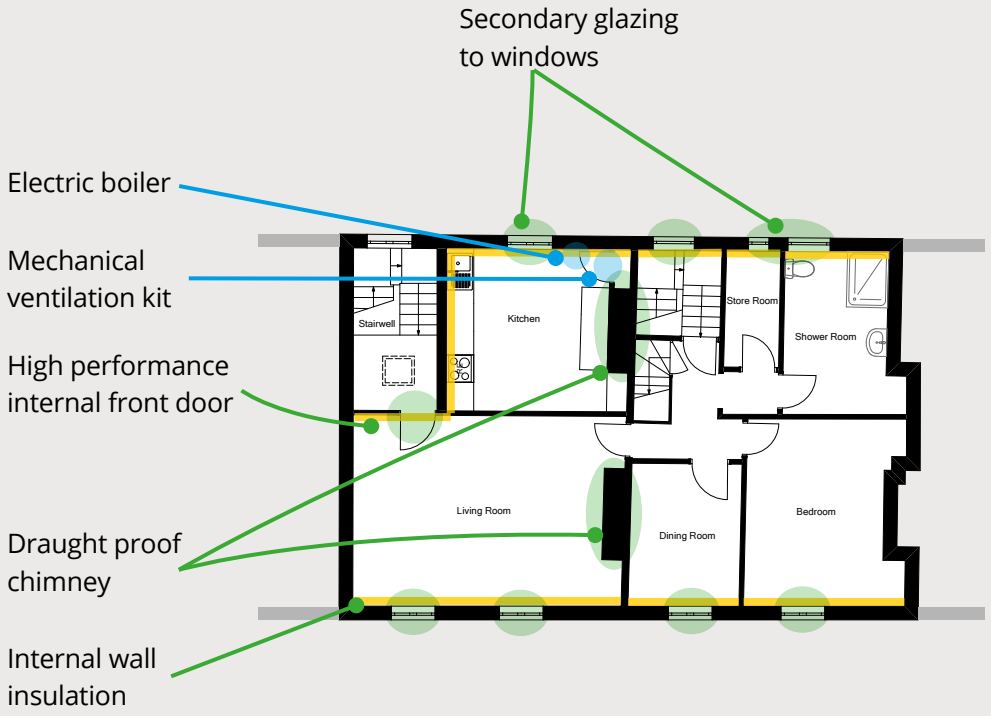
Electric boiler

Typical measures

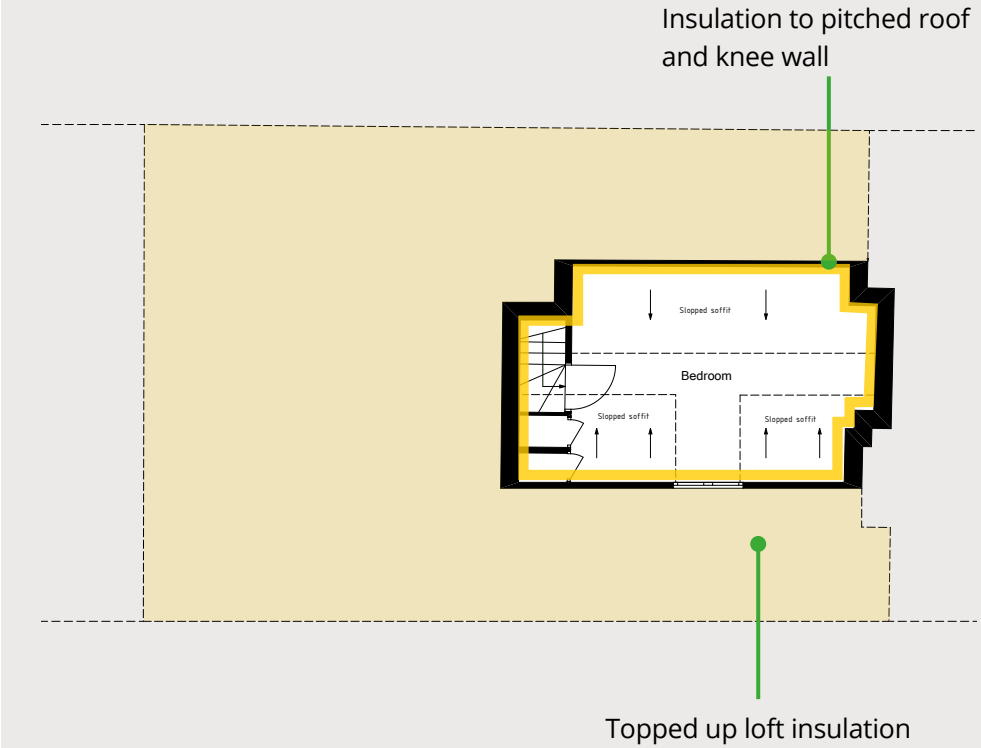
Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

Second floor



Third floor



Retrofit measures

Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips**, and/or **thermal curtains**, on windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- **Seal gaps** around old fireplaces.
- **Draught-seal** chimney fireplaces.
- Install **improved heating controls.**
- Make DIY improvements to **loft and storage hatches**.
- Lag pipes.
- Conduct **air tightness tests** to find leakage pathways.
- Use **thermal imaging** to find weak spots.

Shallow

- **Top-up loft insulation** with an additional 200mm over the existing 100mm to make 300mm in total.
- **Install mechanical extraction** from kitchens and bathrooms (unless whole house ventilation is planned for later phases).
- **Demand control ventilation (DCV)** can be a viable system as existing air bricks in rooms can be re-purposed, although MVHR (mechanical ventilation with heat recovery) offers higher performance and air quality. You will need Listed Building Consent if you live in a listed building, as the external appearance of inlet and extract vents is often protected.
- Fit **internal wall insulation**. This should be 100mm insulation that in most cases should be breathable. As a shallow measure this can be installed as a room-by-room basis. Care should be taken with any heritage features present (covings, picture rails, skirtings etc). A breathable lime-based insulation can be spray-applied if the walls are particularly uneven.
- If a knee wall (typically 1m high around the edge of a room in the roof) is present these are often uninsulated. These can be **insulated between and behind or in front of the existing timber studs.**
- **Eaves storage.** Often located behind the knee walls, access to these areas is often uninsulated and draughty. A DIY approach can be taken with draught strips and sticking ridged insulation board to the back of the door. Alternative off-the-shelf products are available.
- **Fit secondary glazing** (a secondary window, typically behind existing windows). This can significantly improve the thermal and acoustic performance of old single glazed windows. It can be installed on a room by room basis. It should be coordinated with the internal wall insulation.

Deep

- **Whole house insulation and secondary glazing.** Although a significant measure it will provide the greatest savings and increase in comfort. Installed as the shallow measures, but for the whole building.
- **External wall insulation** could be considered if interiors are particularly sensitive and/or there is low aesthetic or heritage impact. Subject to planning permission the front elevation can sometimes be insulated externally with consideration to the heritage and aesthetics by replicating the existing finishes. You may be asked to replicate the appearance of features such as stone window heads or brickwork. It may be easier to internally insulate the front wall to preserve the look of the street scene.
- **High performance front door.** Shared stairwells are often unheated or have poor thermal performance. In this case the internal front door should be treated as external and therefore upgraded or replaced with a higher performing model.
- **Mechanical ventilation with heat recovery.** In homes where duct runs are difficult, demand control ventilation is an alternative option. In conjunction, old passive ventilation measures should be sealed (trickle vents, kitchen, and bathroom extracts, etc). A recirculating extractor over the hob will be necessary to replace any existing direct extract.

Upgraded heating

- **Air source heat pump (ASHP).** You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) or by using a monobloc ASHP, the larger unit is outside. Both options require a hot water cylinder; therefore, a suitable location is needed.
- **Electric Boiler.** Electric boilers are designed to directly replace gas boilers. Upgrades to radiators and pipework are not typically needed. This may be practical where space is at a premium or heritage requirements mean the external unit of the ASHP is not permitted. As discussed elsewhere, an increase in fuel bills is likely.

Onsite renewables

- **Photovoltaic panels.** A 2-3kWp array can be installed at any time, but you should try and do this alongside other work that requires scaffolding. You will need access and permission to use shared roof or attic spaces, as well as planning permission, and lawful development certificates.

EnerPHit and Net Zero Carbon

- For buildings built before 1920, a comprehensive set of guides and information is available at the Historic England website
- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer. This may be hard to achieve due to the heritage constraints of the building.
- **Triple glazed windows and doors.** Triple glazing may be hard to install due to the heritage aspects of the building. However, there may be areas where this is possible and therefore recommended for the best performance and comfort.
- **Removal of chimney thermal bridge.** Chimneys will require extra attention to remove the thermal bridge and make fully airtight.
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of lime plaster) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Air changes per hour less than 1 at a pressure of 50 pascals.

Victorian terrace/workers' cottage

Age: **pre-1919**
Typical Size: **85m²**

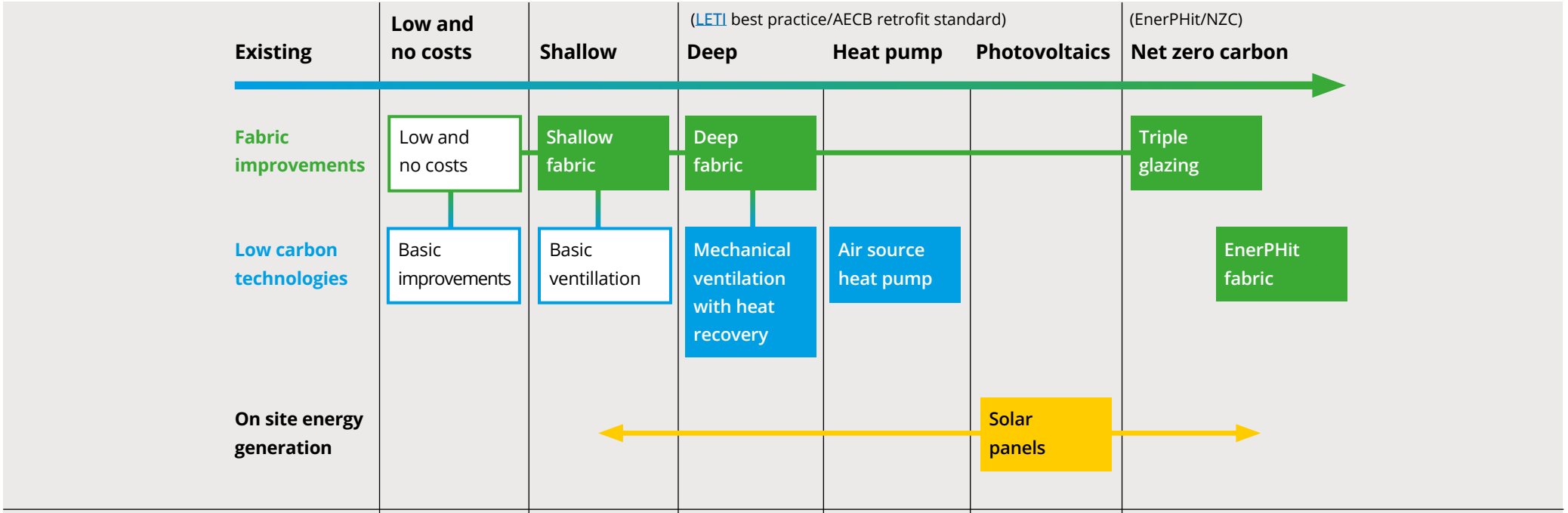
Description

This archetype covers pre-1919 Victorian workers' terraces and cottages. The properties covered in this type are largely constrained due to their historic value.

Typical features

- Solid masonry walls (generally brick)
- Suspended timber floor (uninsulated)
- Masonry load-bearing partition walls
- Lath and plaster or single brick partition walls
- Timber roof with slate or tiles
- Loft floor typically insulated between joists
- Double glazed windows
- Gas boiler and radiators
- Open chimneys with generally unused fireplaces

Phasing of retrofit work – Type B



Retrofit cost	£0	£2,500	£42,500	£62,500	£80,000	£91,000	£111,000	£ invested
Energy saving	0%	0-10%	36%	67%	80%	90%	100%	Percentage saved
Heating demand	**300**	**250**	**190**	**88**	**88***	**88***	**22.2**	**kWhr/m²/yr (heating)**
Carbon emissions	11	10	7	2.5	1.4	0.7	0	Tonnes CO_2/year
Annual bills	£2,000+	£2,000	£1,300	£950	£1,200**	£900	£170	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

* the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology

**bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

Topped up loft insulation
£5,400

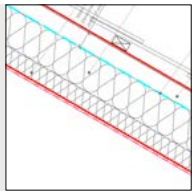
High performance loft hatch
£1,000

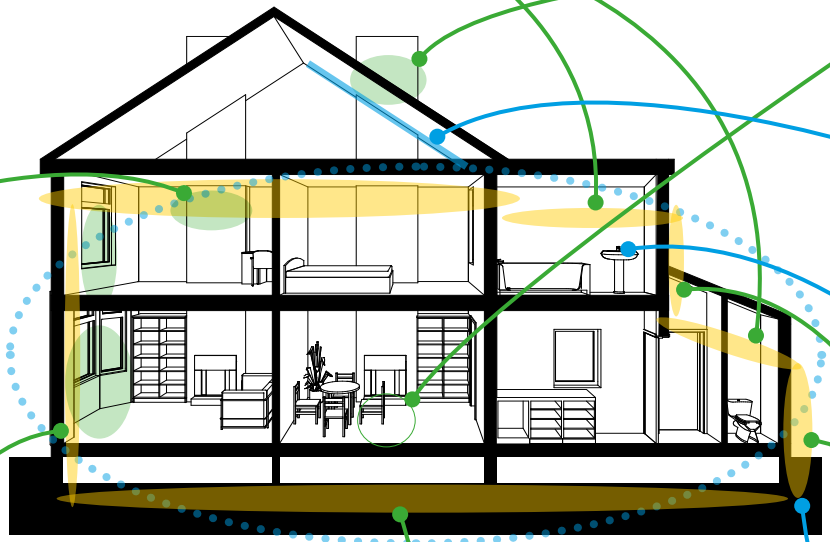
Triple glazed windows and external doors
£23,100

Internal wall insulation
£12,200

Draught free
£5,700

Pitched roof insulation
£4,000





Floor insulation
£6,500

Chimney draught proofing
£800

Solar panels
£12,900

Mechanical ventilation
£10,200

External wall insulation
£23,500

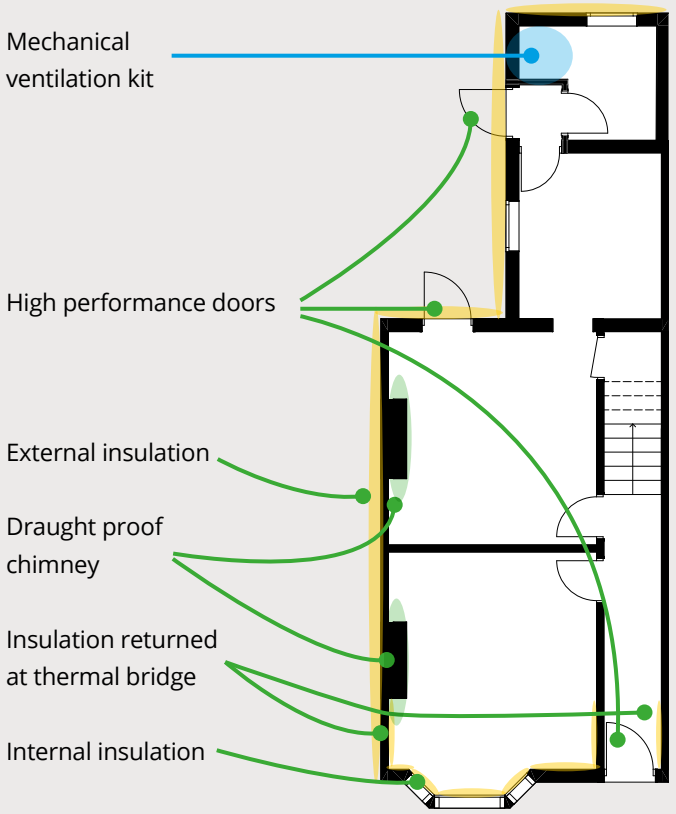
Low carbon heating
£23,900

Typical measures

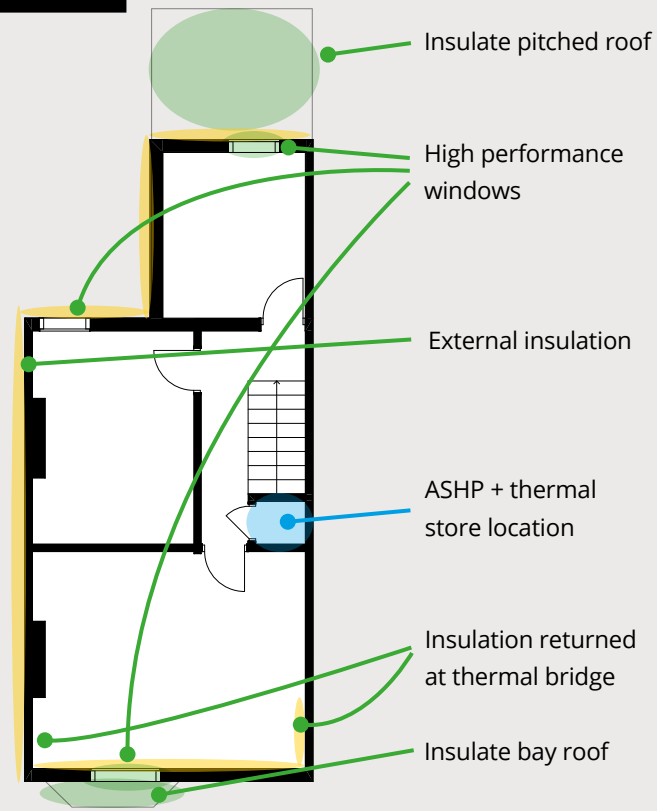
Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

Ground floor



First floor



Retrofit measures

Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips**, and/or **thermal curtains**, on windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- **Seal gaps** around old fireplaces.
- **Draught-seal** chimney fireplaces.
- Make DIY improvements to **loft and storage hatches**.
- Lag pipes.
- Test **air tightness** to find leakage pathways.
- Use **thermal imaging** to find weak spots.
- Fit improved **heating controls**.

Shallow

- **Insulate and re-roof your bay window roof** (if present and in poor repair).
- **Top-up loft insulation** with an additional 200mm over the existing 100mm to make 300mm in total.
- **Install mechanical extraction** from kitchens and bathrooms (unless whole house ventilation is planned for later phases).
- **Demand control ventilation (DCV)** can be an affordable option, although MVHR (mechanical ventilation with heat recovery) offers higher performance and air quality. You will need Listed Building Consent if you live in a listed building, as the external appearance of inlet and extract vents is often protected.
- **Fit internal wall insulation.** This should be 100mm insulation that in most cases should be breathable. Care should be taken with any heritage features present (covings, picture rails, skirtings etc).

Deep

- **External insulation and render to rear/side façade.** Subject to planning permission the front elevation can sometimes be insulated externally with consideration to the heritage and aesthetics by replicating the existing finishes. You may be asked to replicate the appearance of features such as stone window heads or brickwork. It may be easier to internally insulate the front wall to preserve the look of the street scene.
- Provision of whole house **mechanical ventilation** (mechanical ventilation with heat recovery or demand control ventilation).
- **Passivhaus standard loft hatch** to roof space.
- **Thermal bridge reduction** measures.
- **Air tightness measures** to achieve less than 3 air changes per hour at a pressure of 50 pascals.

Upgraded heating

- **Air source heat pump.** You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) plus an outdoor unit, and will require a hot water cylinder; therefore, suitable locations are needed. As discussed elsewhere, an increase in fuel bills is possible.

Onsite renewables

- **Photovoltaic panels.** A 2.5–5kWp array can be installed at any time, but you should try and do this alongside other work that requires scaffolding. You will need access and permission to use shared roof or attic spaces, as well as planning permission, and lawful development certificates.

EnerPHit and Net Zero Carbon

- **For buildings built before 1920**, a comprehensive set of guides and information is available at the Historic England website.
- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer. This may be hard to achieve due to the heritage constraints of the building.
- **Removal of chimney thermal bridge.** Chimneys will require extra attention to remove the thermal bridge and make fully airtight. This is typically done by removing the chimney at the loft insulation line. This would likely require permission for properties within conservation areas, along with locally and nationally listed buildings (and is unlikely to be granted due to the negative impact on the appearance).
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of lime plaster) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Air changes per hour less than 1 at a pressure of 50 pascals.

Small semi-detached

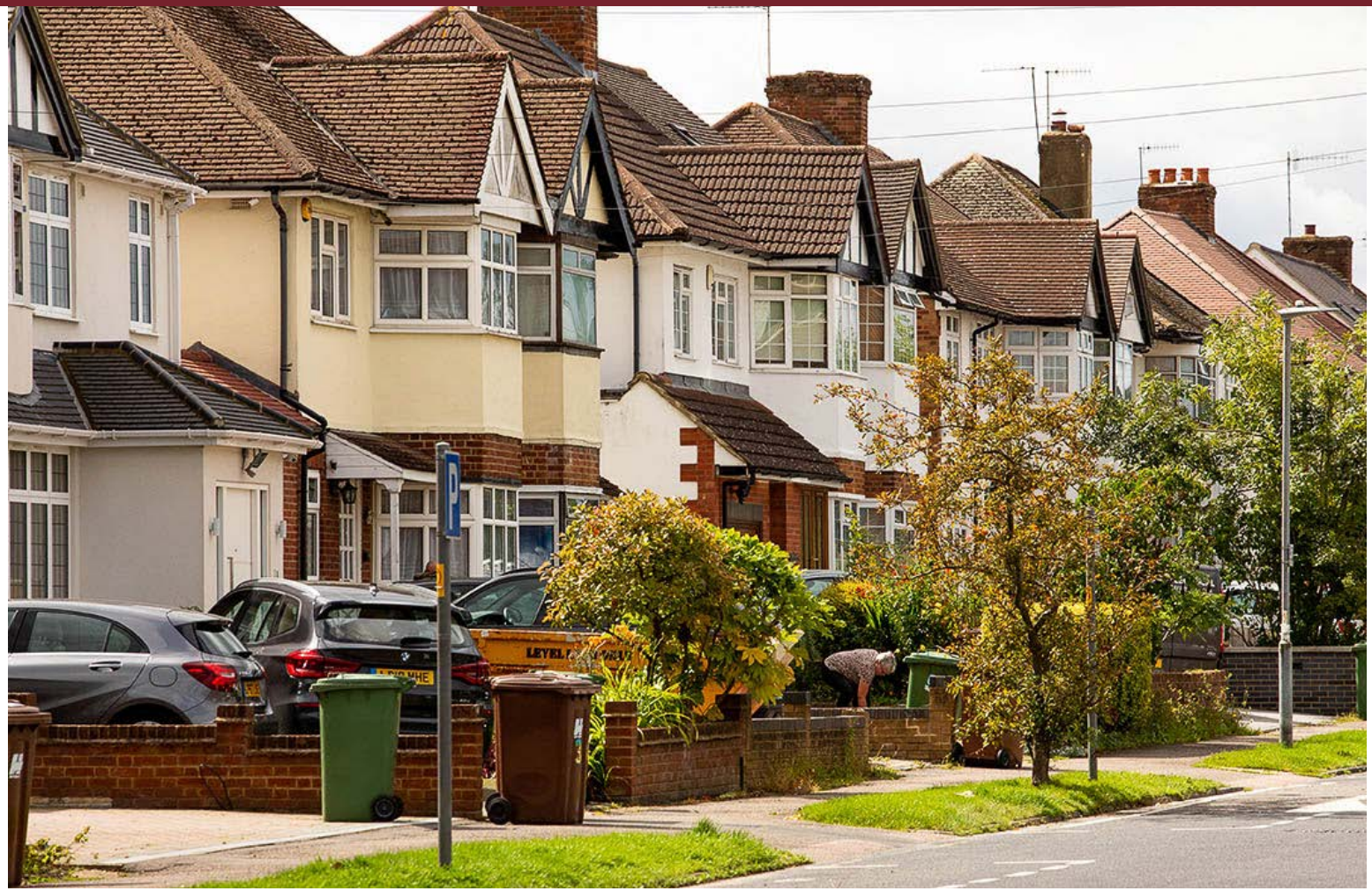
Age: **1920-1950**
Typical Size: **85m²**

Description

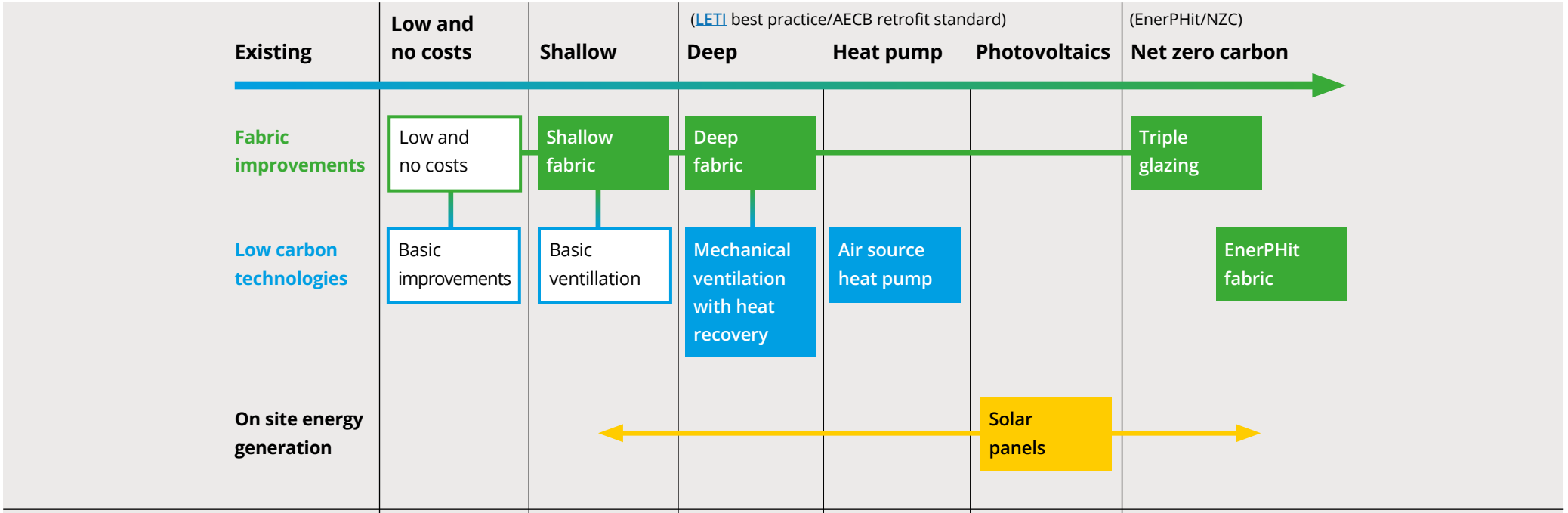
This archetype covers 1930s semi-detached homes

Typical features

- Solid masonry walls (generally brick)
- Suspended timber floor (uninsulated)
- Masonry load-bearing partition walls
- Timber stud and plasterboard partition walls
- Hipped timber roof
- Loft floor typically insulated between joists
- Air brick ventilation
- Gas boiler and central heating
- Double glazed windows
- Open chimneys with generally unused fireplaces



Phasing of retrofit work – Type C



Retrofit cost	£0	£3,800	£25,500	£60,500	£78,000	£86,000	£103,000	£ invested
Energy saving	0%	0-4%	10%	74%	85%	90%	95%	Percentage saved
Heating demand	**268**	**259**	**244**	**44**	**44***	**44***	**17**	**kWhr/m²/yr (heating)**
Carbon emissions	9	8.5	8	1.5	0.9	0.6	0.3	Tonnes CO_2/year
Annual bills	£2,400+	£2,300	£2,200	£1,200	£1,150**	£830	£490	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

* the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology

**bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

Topped up loft insulation
£4,000

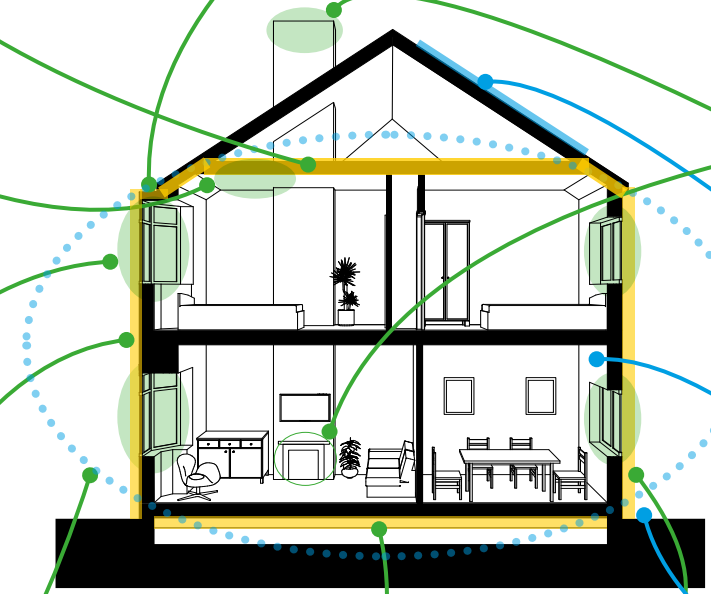
High performance loft hatch
£1,000

Triple glazed windows and external doors
£19,800

External wall insulation
£40,400

Draughty
£3,200

Bay window roof repair and insulation
£1,900



Chimney cap and draught proofing
£800

Solar panels
£9,200

Mechanical ventilation
£10,200

Floor insulation
£5,800

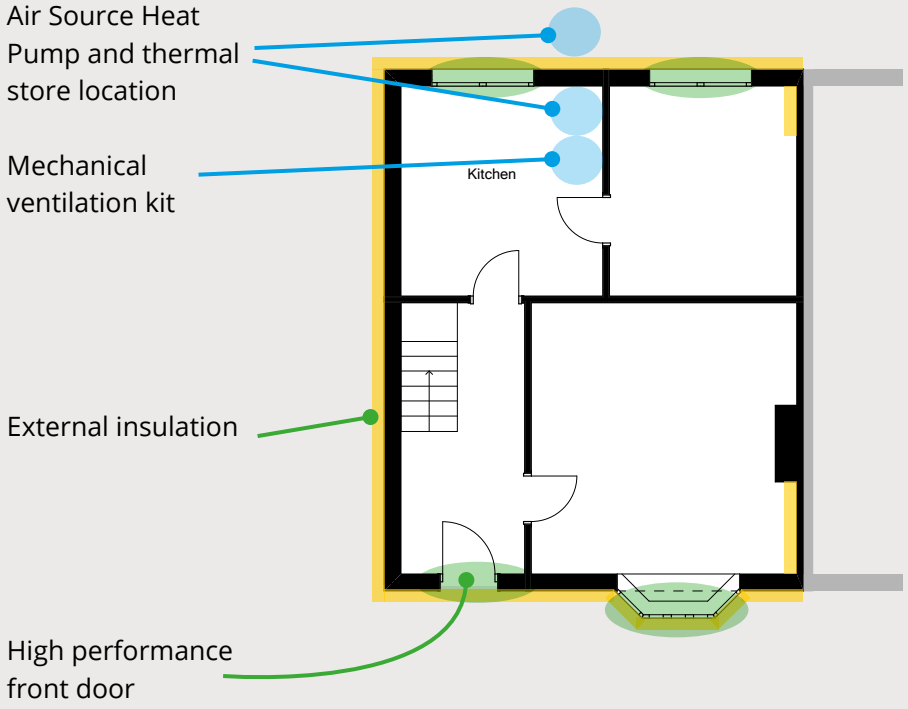
Low carbon heating
£23,400

Typical measures

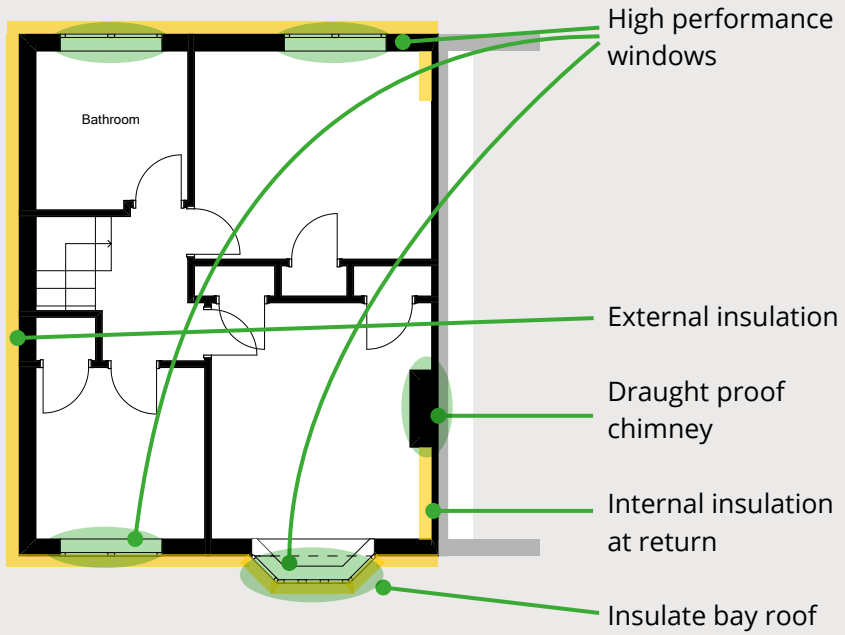
Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

Ground floor



First floor



Retrofit measures

Low-cost measures

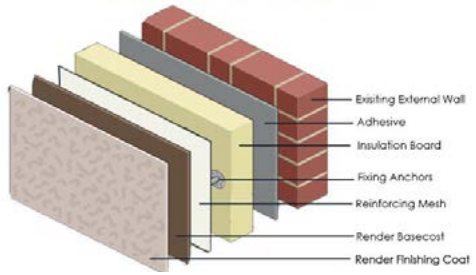
- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips and/or thermal curtains** to windows and doors.
- **Seal cracks**, holes and service penetrations.
- **Extractor fans** to bathrooms and kitchens.
- **Seal gaps** around old fireplaces.
- **Draught-seal** chimney fireplaces.
- Fit **improved heating controls.**
- Make **DIY improvements** to loft and storage hatches.
- Lag pipes.
- **Test air tightness** to find leakage pathways.
- **Use thermal** imaging to find weak spots

Shallow

- Install or improve suspended **timber floor insulation.**
- **Insulate and re-roof** your bay window roof (if present and in poor repair).
- **Top-up loft insulation.** An additional 200mm over the existing 100mm to make 300mm in total.
- **High performance loft hatch.** This is often a weak spot in a well insulated loft room. Fit a proprietary high-performance hatch if aiming for a deep retrofit.
- **Mechanical extraction** from kitchens and bathrooms (unless whole house ventilation is planned).
- **Demand control ventilation (DCV)** can be a very viable system as existing air bricks in rooms can be re-purposed. This should not be installed and mechanical ventilation with heat recovery installed instead if highest performance and air quality is desired.

Deep

- **From 90mm up to 200mm external wall insulation.** Although a significant measure, this provides the greatest carbon savings. You may need planning permission and should consider the heritage and aesthetics by replicating the existing finishes. You may be asked to replicate the appearance of features such as stone window heads or brickwork. It may be easier to internally insulate the front wall to preserve the look of the street scene.
- **High performance front door.** Even if double glazing is installed, front doors are often original and can be very poorly performing.
- Installation of **mechanical ventilation** with heat recovery.

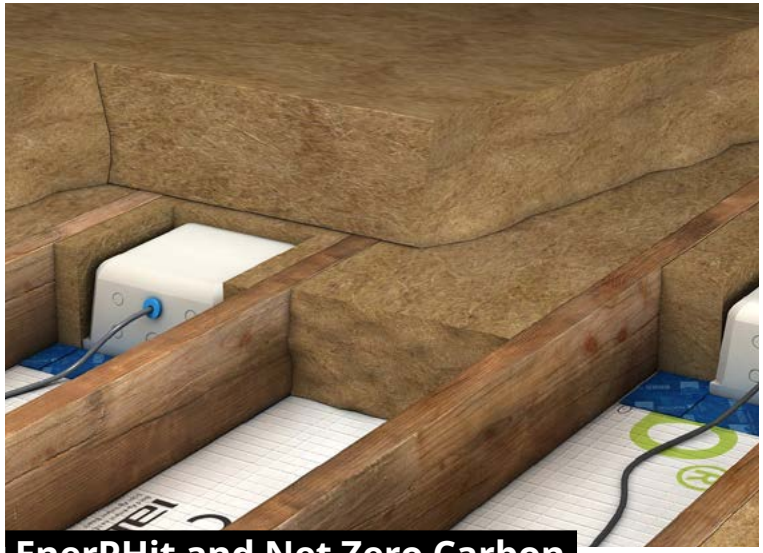


Upgraded heating

- **Air source heat pump (ASHP).** You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) plus an outdoor unit and will require a hot water cylinder; therefore, suitable locations are needed. As discussed elsewhere, an increase in fuel bills is likely.

Onsite renewables

- **Photovoltaic panels.** A 2-3kWp solar array can be installed at any time but is most convenient to install alongside other work that involves scaffolding. Up to 5kWp may be possible, if carefully designed and conditions allow.



EnerPHit and Net Zero Carbon

- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer.
- **Triple glazed windows and doors.** Recommended for the best performance and comfort.
- **Removal of chimney thermal bridge.** Chimneys will require extra attention to remove the thermal bridge and make fully airtight. This is typically done by removing the chimney at the loft insulation line.
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of lime plaster) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Air changes per hour less than 1 at a pressure of 50 pascals.

Large semi-detached

Age: **1945-1959**
Typical Size: **150m²**

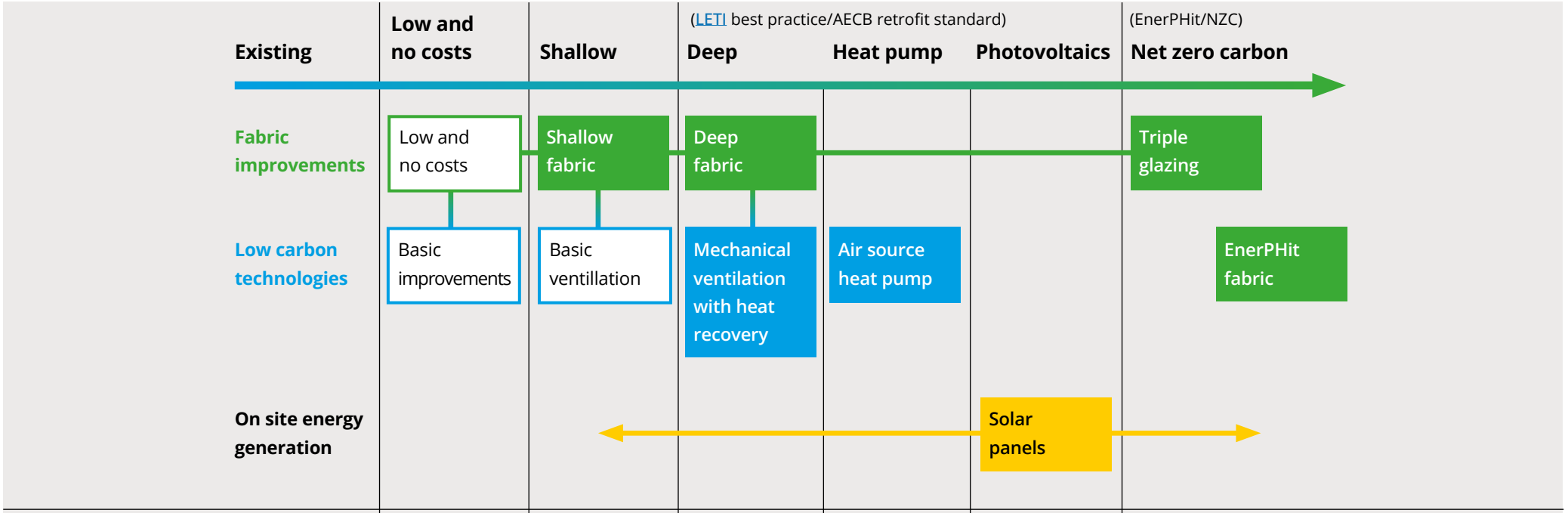
Description

This archetype covers post-WWII low-rise housing. Type C and D differ in size and style. These homes occasionally have arts and craft stylings.

Typical features

- Solid masonry walls or narrow uninsulated cavity (generally brick)
- Suspended timber floor (uninsulated)
- Masonry load-bearing partition walls
- Timber stud and plasterboard partition walls
- Hipped timber roof
- Loft floor typically insulated between joists
- Air brick ventilation
- Gas boiler and central heating
- Double glazed windows
- Open chimneys with generally unused fireplaces

Phasing of retrofit work – Type D



Retrofit cost***	£0	£5,000	£31,500	£106,000	£124,000	£137,000	£171,000	£ invested
Energy saving	0%	0-8%	50%	77%	86%	92%	99%	Percentage saved
Heating demand	**272**	**260**	**244**	**47**	**47***	**47***	**15**	**kWhr/m²/yr (heating)**
Carbon emissions	15	14	7.7	2.5	1.4	0.7	0	Tonnes CO_2/year
Annual bills	£3,200+	£2,300	£2,200	£1,300	£1,800**	£950	£250	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CBSI recommendations rather than national averages.

*the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology

** bills rise with the switch from gas to more expensive electricity.

*** the high cost is due to the large size of this archetype. See discussion below for clarification.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

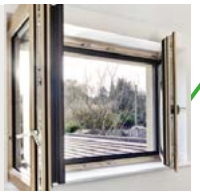
Bay window roof repair and insulation
£2,600

Chimney cap and draught proofing
£800

Topped up loft insulation
£5,600

High performance loft hatch
£1,000

Triple glazed windows and external doors
£39,400



Draught free
£5,000

Floor insulation
£8,100

Solar panels
£14,400

External wall insulation
£86,200

Mechanical ventilation
£10,200

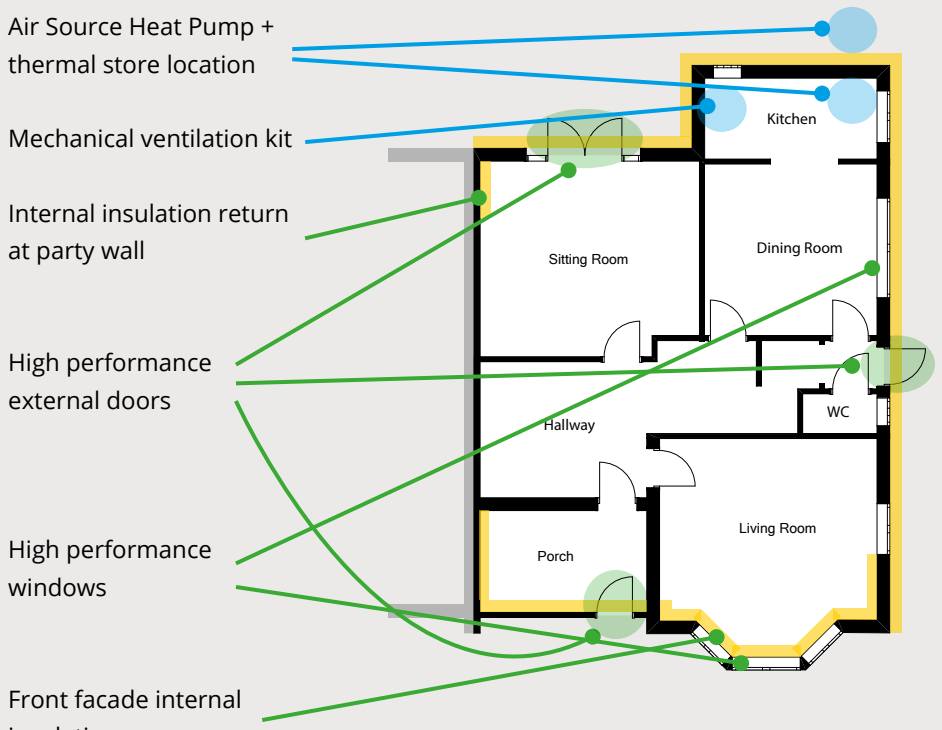
Low carbon heating
£25,000

Typical measures

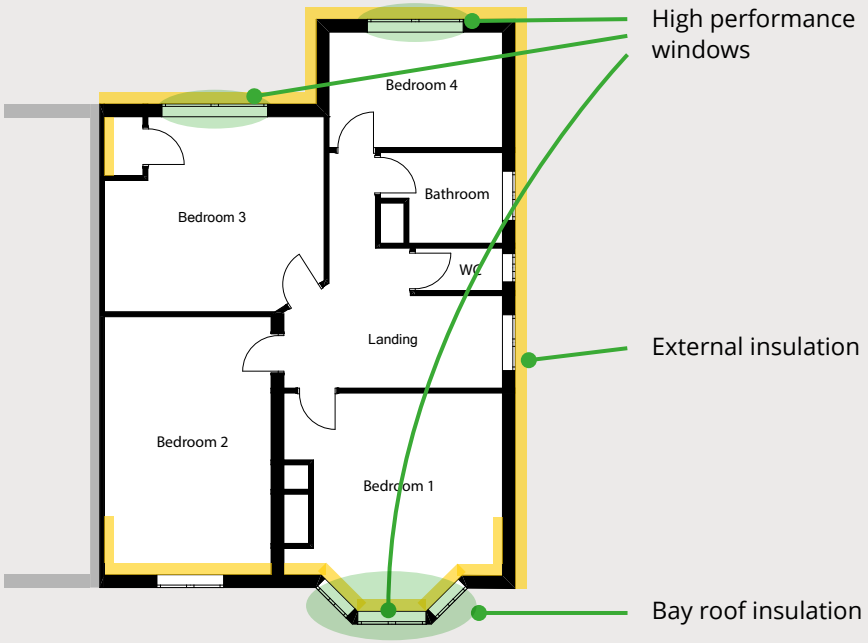
Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

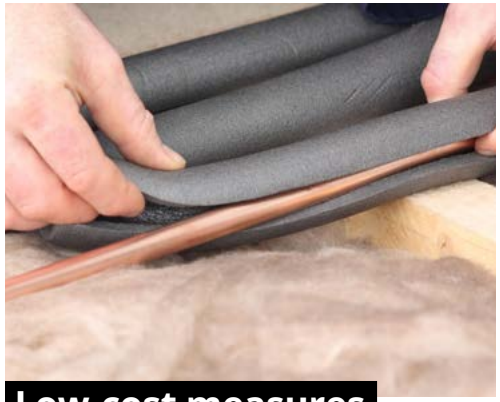
Ground floor



First floor



Retrofit measures



Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips**, and/or **thermal curtains**, on windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- **Seal gaps** around old fireplaces.
- **Draught-seal** chimney fireplaces.
- Fit **improved heating controls.**
- Make DIY improvements to **loft and storage hatches**.
- Lag pipes
- **Test air tightness** to find leakage pathways.
- Use **thermal imaging** to find weak spots.

Shallow

- Install or **improve suspended timber floor insulation.**
- **Cavity wall insulation.** Where possible this should be installed as it represents a high value saving.
- **Insulate and re-roof your bay window roof.** (If present and in poor repair).
- **Top-up loft insulation.** An additional 200mm over the existing 100mm to make 300mm in total.
- **DIY loft hatch.** Often a weak spot in a well-insulated loft room.
- **Mechanical extraction** from kitchens and bathrooms (unless whole house mechanical ventilation is planned).
- **Demand control ventilation (DCV)** can be a very viable system as existing air bricks in rooms can be re-purposed. This should not be installed and mechanical ventilation with heat recovery installed instead if highest performance and air quality is desired.

Deep

- **From 90mm up to 200mm external wall insulation.** Although a significant measure this provides the greatest carbon savings and the greatest value for money. A range of finishes can match the existing tiles, brick slips, render, and half-timber, etc. Subject to planning permission the front elevation can be insulated externally with consideration to the heritage and aesthetics by replicating the existing finishes. You may be asked to replicate the appearance of features such as stone window heads or brickwork. It may be easier to internally insulate the front wall to preserve the look of the street scene.
- **High performance front door.** Even if double glazing is installed, front doors are often original and can be very poorly performing.

- **High performance loft hatch.** A proprietary high-performance hatch is recommended if aiming for a deep retrofit.
- **Air tightness.** All services sealed, windows and cracks sealed and taped.
- Installation of **mechanical ventilation** with heat recovery.

Upgraded heating

- Air source heat pump (ASHP). You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) plus an outdoor unit and will require a hot water cylinder; therefore, suitable locations are needed. As discussed elsewhere, an increase in fuel bills is likely. On large homes like this, three-phase power may be required for a large heat pump.

Onsite renewables

- **Photovoltaic panels.** A 2-4kWp solar array can be installed at any time but you should aim to do this alongside other work that involves scaffolding if possible.
- The relatively large roof size means that up to 8kWp may be possible, if carefully designed and conditions allow.

EnerPHit and Net Zero Carbon

- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer.
- **Triple glazed windows and doors.** Recommended for the best performance and comfort.
- **Removal of chimney thermal bridge.** Chimneys will require extra attention to remove the thermal bridge and make fully airtight.
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of cement mortar) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Air changes per hour less than 1 at a pressure of 50 pascals.

Mid-century ‘modern’ and new town housing

Age: **1960-1979**
Typical Size: **95m²**

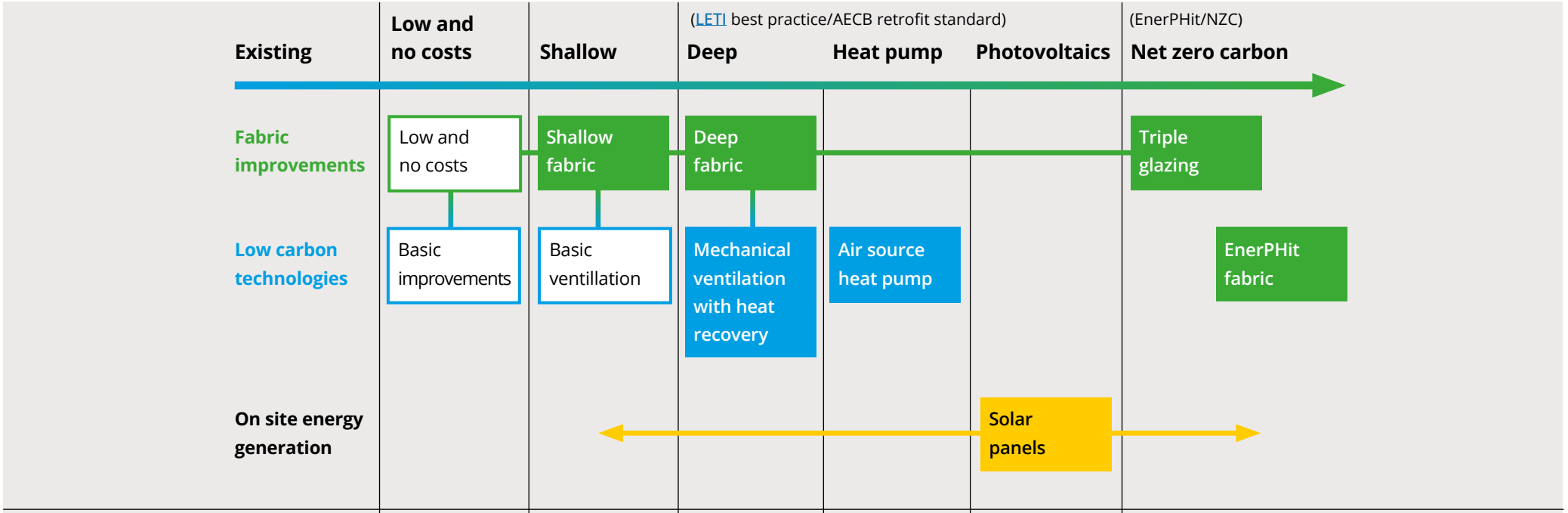
Description

Horizontal windows and banding. Often with timber clad elements. Flat roof elements. Garages often linked to the house. Lower pitched roofs apart from the chalet bungalow. Note that heritage constraints may limit possibilities in garden cities.

Typical features

- Cavity masonry walls with narrow cavity (rendered, fair faced brick or timber panelled) internal leaf typically aerated blockwork
- Solid concrete floor (uninsulated)
- Masonry load-bearing partition walls
- Stud work partitions with plasterboard
- Timber truss roof
- Loft floor with limited insulation
- Open fires largely phased out but some gas fires
- Metal, timber, or plastic windows either single or double glazed

Phasing of retrofit work – Type E



Retrofit cost***	£0	£4,750	£42,500	£79,000	£97,500	£105,500	£128,500	£ invested
Energy saving	0%	0-8%	43%	64%	79%	89%	99%	Percentage saved
Heating demand	**230**	**200**	**110**	**59**	**59***	**59***	**18**	**kWhr/m²/yr (heating)**
Carbon emissions	8.5	7.5	4.8	2.0	1.2	0.6	0.01	Tonnes CO_2/year
Annual bills	£2,000+	£1,800	£1,500	£1,200	£1,500**	£890	£250	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

* the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology.

** bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Key

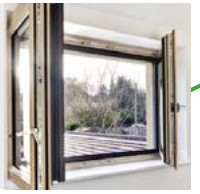
- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

Topped up loft insulation
£4,200

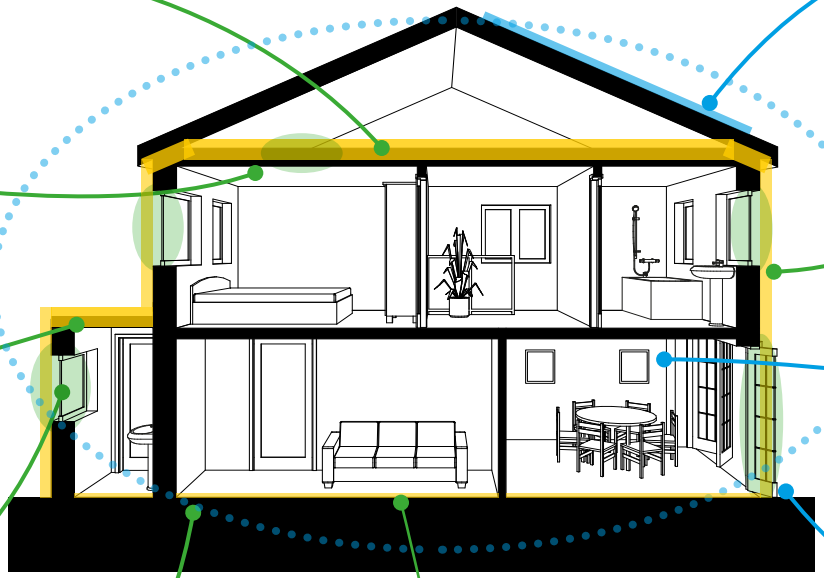
High performance loft hatch
£1,000

Repair and insulate porch roof
£2,000

Triple glazed windows and external doors
£26,500



Draught free
£4,300



Solar panels
£9,500

External wall insulation
45,900

Mechanical ventilation
£10,500

Ultra-thin insulation over existing floor
£20,000

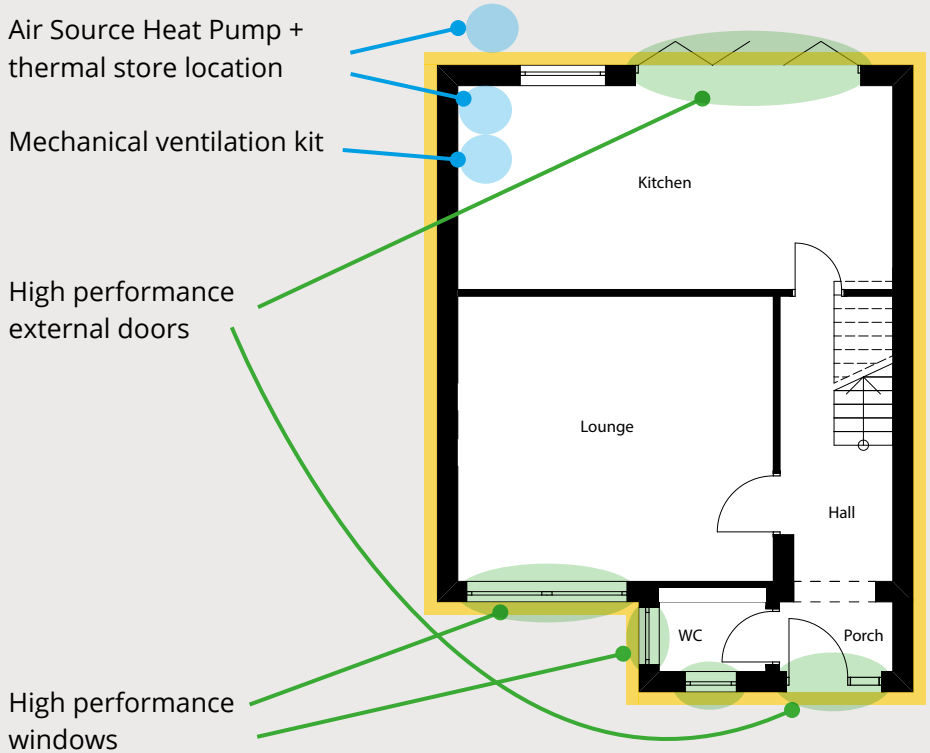
Low carbon heating - Air Source Heat Pump
£24,600

Typical measures

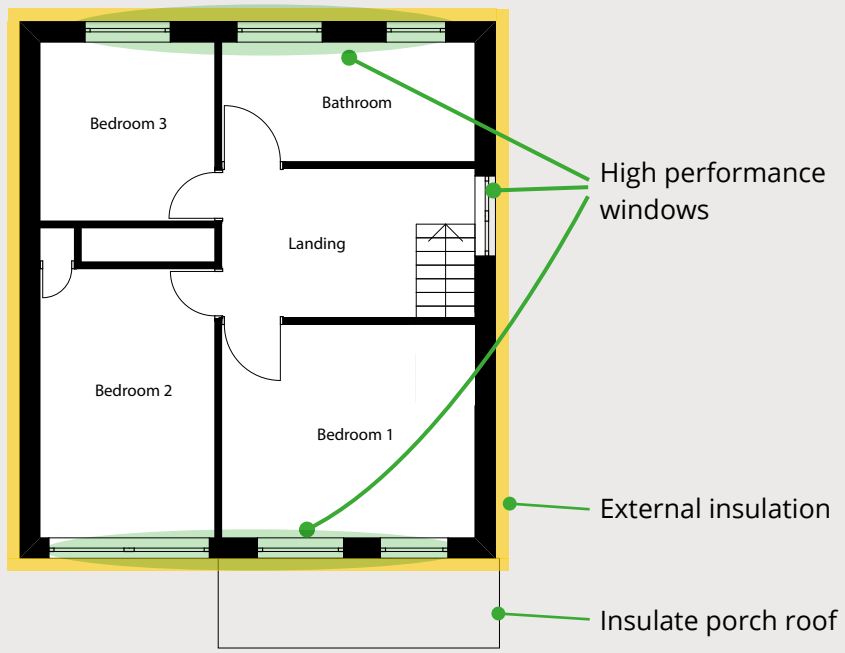
Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

Ground floor



First floor



Retrofit measures

Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips**, and/or **thermal curtains**, on windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- **Seal gaps** around old fireplaces if present.
- **Draught-seal** chimney fireplaces – if present.
- Make DIY improvements to **loft and storage hatches**.
- Lag pipes.
- Test **air tightness** to find leakage pathways.
- Use **thermal imaging** to find weak spots.

Shallow

- **Insulated and re-roofed porch roof.** These roofs are often in poor repair so should be reroofed and insulated (100mm). In the event the roof is in sound condition the roof may be insulated from below. Please note, if the porch is not heated and separated by a good quality external door this measure may not be required.
- **Top-up loft insulation.** An additional 200mm over the existing insulation.
- **High performance loft hatch.** Often a weak spot in a well insulated loft room.
- Mechanical extraction from kitchens and bathrooms (unless whole house mechanical ventilation is planned).
- **Demand control ventilation (DCV)** can be a very viable system as existing air bricks in rooms can be re-purposed. This should not be installed and mechanical ventilation with heat recovery installed instead if highest performance and air quality is desired.

- If the floor is concrete beam and block, then robotically **sprayed insulation** is a low disturbance method providing good insulation and air tightness although the environmental credentials are not ideal. The size of the floor void is critical for the viability and a hole(s) will be required for the robot to gain access. A thick carpet with good underlay is an alternative option.
- **Air tightness.** Easy to treat leakage pathways sealed.

Deep

- **From 90mm to 200mm external wall insulation.** Although a significant measure this provides the greatest carbon saving. This is typically rendered as a finish but can also be clad in timber, brick slips and other options.
- **High performance front door.** Even if double glazed windows are installed, front doors are often original and can be very poorly performing.
- **Air tightness measures.** All services sealed, windows and cracks sealed and taped.
- Installation of **mechanical ventilation** with heat recovery.

Upgraded heating

- **Air source heat pump** (ASHP). You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) plus an outdoor unit and will require a hot water cylinder; therefore, suitable locations are needed. As discussed elsewhere, an increase in fuel bills is likely.

Onsite renewables

- **A 2kWp solar array** can be installed at any time but, if possible, should be installed alongside other work that involves scaffolding.
- The relatively large roof size means that up to 5kWp may be possible, if carefully designed and conditions allow. Such a large system may be needed to meet or approach zero carbon.

EnerPHit and Net Zero Carbon

- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer.
- **Triple glazed windows and doors** are recommended for the best performance and comfort.
- **Removal of chimney thermal bridge.** Chimneys will require extra attention to remove the thermal bridge and make fully airtight. This is typically done by removing the chimney at the loft insulation line.
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of lime plaster) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Air changes per hour less than 1 at a pressure of 50 pascals.

End of century mass house builder

Age: **1980–1999**
Typical Size: **65m²**

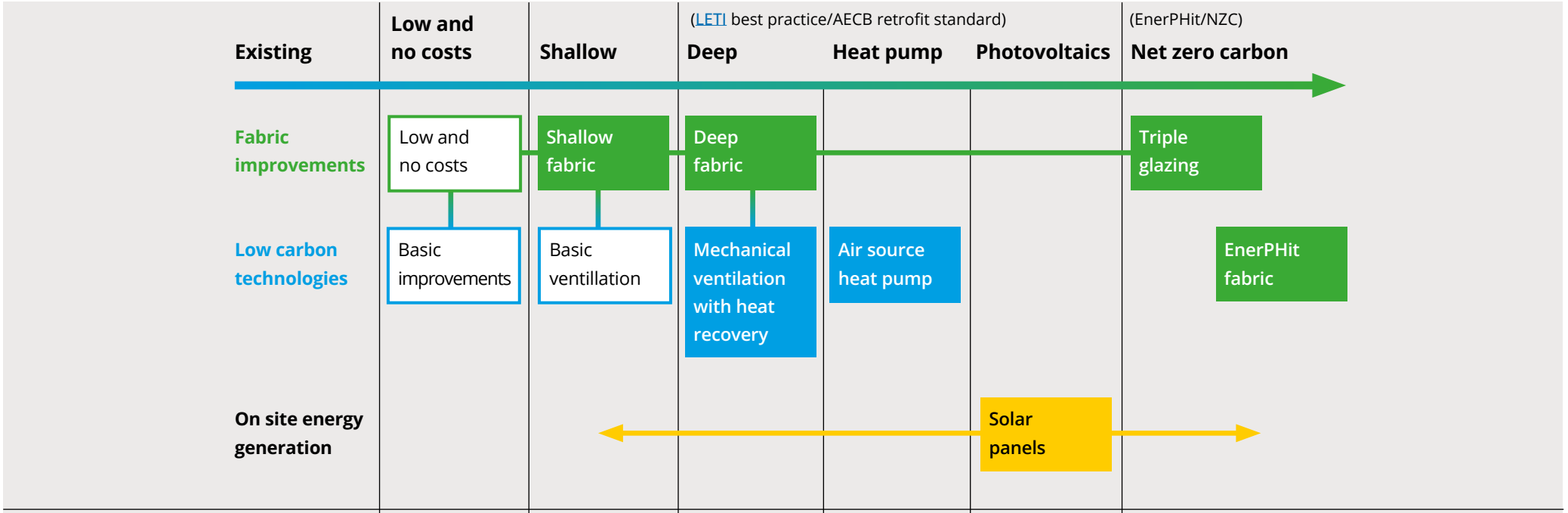
Description

This archetype covers early mass house-builder properties from 1980-2000. Often with dropped eaves. Generally, brick with some rendered elements. Some pastiche elements influenced by Poundbury trends.

Typical features

- Cavity masonry walls cavity either partially filled or unfilled with an inner leaf of aerated concrete block
- Dot and dab plaster board
- Solid concrete floor or beam and block
- Masonry load-bearing partition walls
- Studwork partition with plasterboard
- Timber truss roof
- Loft floor typically insulated
- Gas boiler with water tank
- Trickle-vents in all windows
- Extractor fan in bathrooms and windows
- uPVC but also some timber and metal double glazed windows

Phasing of retrofit work – Type F



Retrofit cost***	£0	£3,700	£23,500	£58,500	£77,500	£85,000	£98,500	£ invested
Energy saving	0%	0-10%	21%	55%	75%	96%	105%	Percentage saved
Heating demand	**210**	**200**	**154**	**57**	**57***	**57***	**27**	**kWhr/m²/yr (heating)**
Carbon emissions	5.6	5.1	4.4	1.7	0.9	0.15	-0.2	Tonnes CO_2/year
Annual bills	£1,700+	£1,600	£1,400	£1,000	£1,200**	£350	-£30	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

*the heating demand is efficiency of the buildings walls, floors, roofs and windows, therefore unaffected by low carbon technology.

** bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

Topped up loft insulation
£2,900

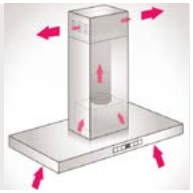
High performance loft hatch
£1,000

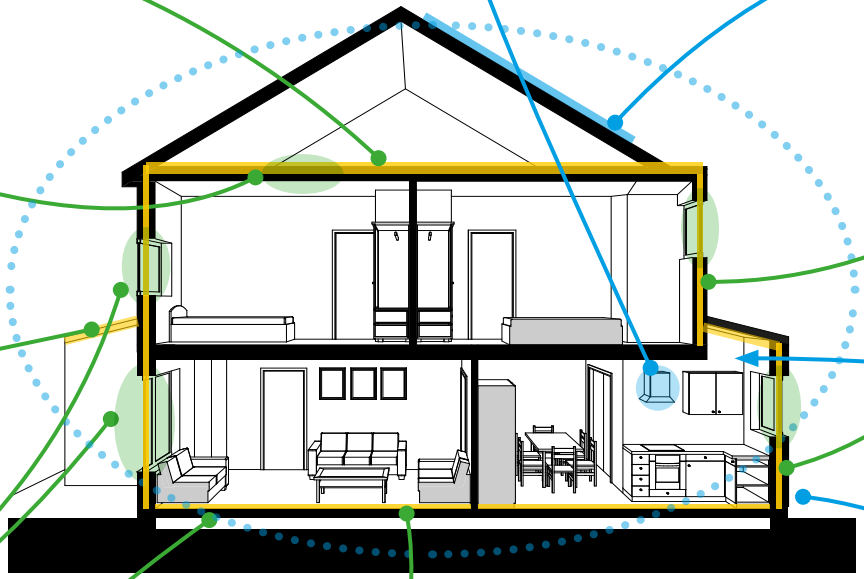
Porch roof repair and / or insulation
£2,000

Triple glazed windows and external doors
16,100

Draught free
£3,800

Recirculating cooker hood
£100





Ultra-thin insulation over existing floor OR sprayed insulation to beam and block
£5,400

Solar panels
£9,300

External wall insulation
40,800

Mechanical ventilation
£10,200

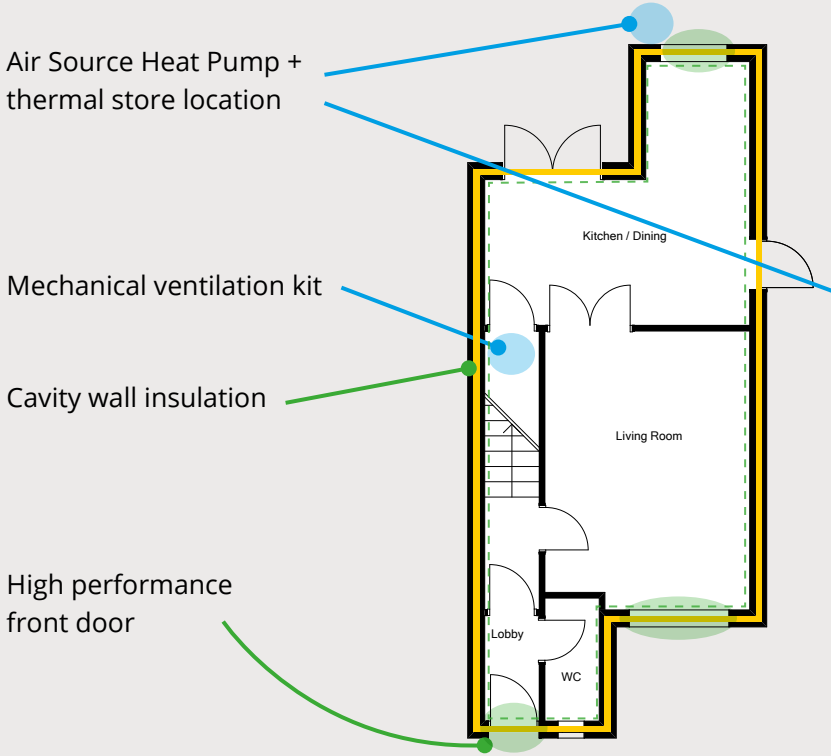
Low carbon heating - Air Source Heat Pump
£24,000

Typical measures

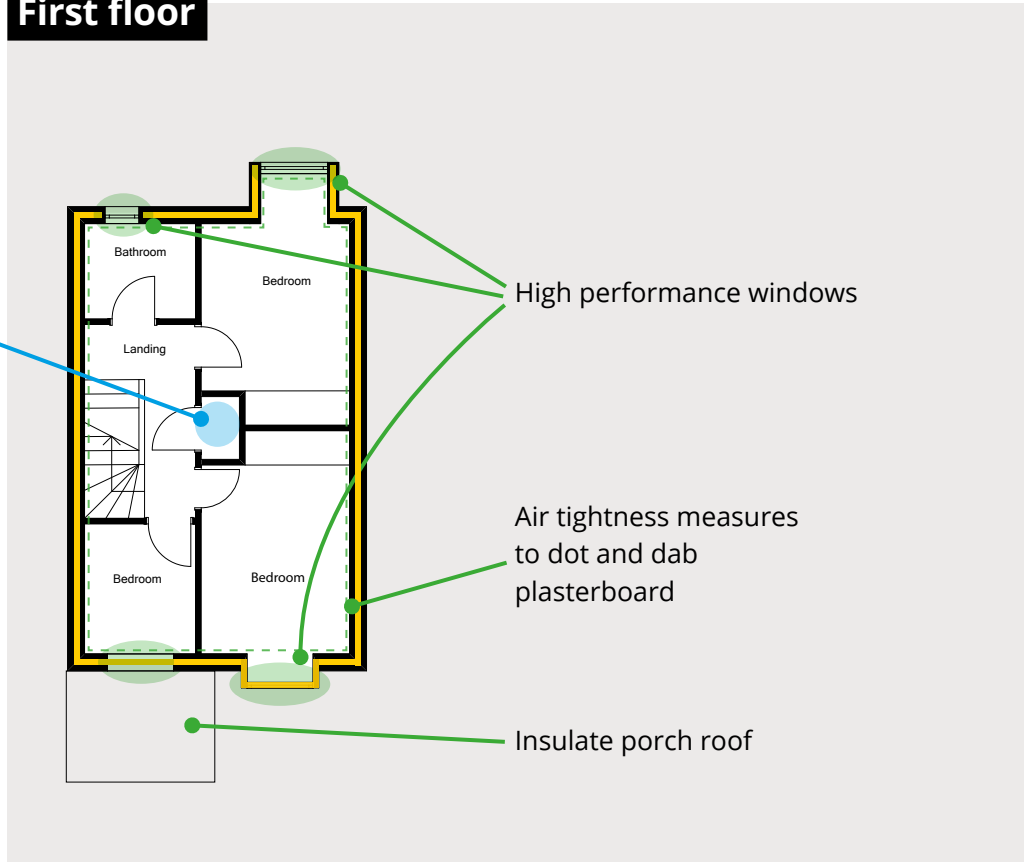
Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

Ground floor



First floor



Retrofit measures

Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips**, and/or **thermal curtains**, to windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- Fit **improved heating controls**.
- Make DIY improvements to **loft and storage hatches**.
- Lag pipes.
- Test **air tightness** to find leakage pathways.
- Use **thermal imaging** to find weak spots.

Shallow

- **Insulated and re-roofed porch roof.** These roofs are often in poor repair so recommended for reroofing and insulating (100mm). In the event the roof is in sound condition, the roof may be insulated from below. Please note if the porch is not heated and separated by a good quality external door this measure may not be required.
- **Top-up loft insulation.** An additional 200mm over the existing.
- **High performance loft hatch.** Often a weak spot in a well-insulated loft room. A proprietary high performance hatch is recommended if aiming for a deep retrofit.
- **Mechanical extraction** from kitchens and bathrooms (unless whole house mechanical ventilation is planned).
- **Demand control ventilation (DCV)** can be a very viable system as existing air bricks in rooms can be re-purposed. This should not be installed and mechanical ventilation with heat recovery installed instead if highest performance and air quality is desired.
- **75mm cavity wall insulation.** In the event the cavity is not filled this is a simple measure.
- If the floor is concrete beam and block, then **robotically sprayed insulation** is a low disturbance method providing good insulation and air tightness although the environmental credentials are not ideal. The size of the floor void is critical for the viability and a hole(s) will be required for the robot to gain access. A thick carpet with good underlay is an alternative option.
- **Air tightness measures.** Seal easy to treat leakage pathways.

Deep

- **100mm internal or external wall insulation.** Where the cavity is untreatable or greater performance is required internal or external wall insulation can be considered.
- **High performance front door.** Even if double glazing is installed front doors are often original and can be very poorly performing.
- **Air tightness measures.** All services sealed, windows and cracks sealed and taped. Dot and dab plaster board sealed or removed and replaced with wet plaster.
- Installation of **mechanical ventilation** with heat recovery.

Upgraded heating

- **Air source heat pump (ASHP).** You should install this after you have completed improvements to the fabric of the building (insulation and draught proofing). As described above, the radiators or similar may need upgrading. This can be about double the size of a gas boiler (around the size of a fridge freezer) plus an outdoor unit and will require a hot water cylinder; therefore, suitable locations are needed. As discussed elsewhere, an increase in fuel bills is likely.

Onsite renewables

- **A 2kWp solar array** can be installed at any time but recommended alongside other work that can involve scaffolding.
- The relatively large roof size means that up to 5kWp may be possible, if carefully designed and conditions allow. Such a large system may be needed to meet or approach zero carbon.

EnerPHit and Net Zero Carbon

- To achieve the Passivhaus retrofit standard EnerPHit you will need the support of a Passivhaus certified designer.
- **Triple glazed windows and doors** are recommended for the best performance and comfort.
- **Fastidious air tightness measures.** A number of extra measures with high quality control is required, e.g.: air tightness membrane in ceilings and floors; air tightness testing; parge coats (a thin coat of lime plaster) in hidden areas (between floor, behind stairs etc) and repairs to plasterwork; taping at junctions, windows and doors etc. Dot and dab plaster board sealed or removed and replaced with wet plaster. Air changes per hour less than 1 at a pressure of 50 pascals.

Modern mass house builder

Age: **2000-onwards**
Typical Size: **85m2**

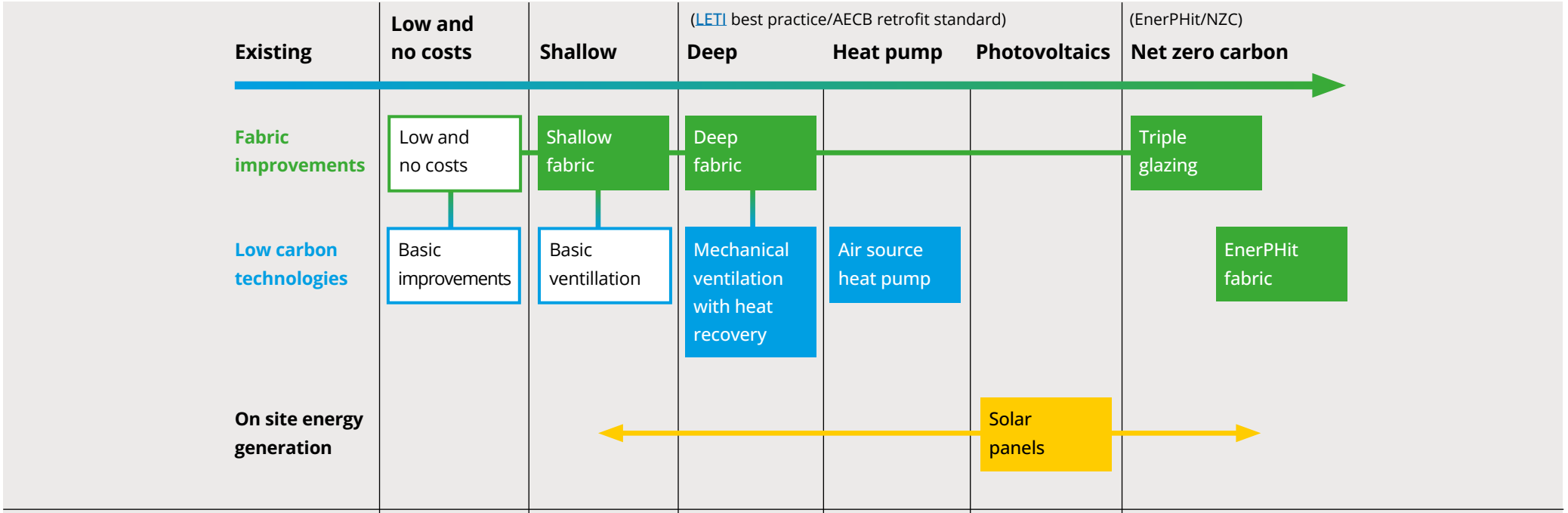
Description

This archetype covers mass house-builder properties from 2000 onwards. Typical brick with some render. Pitched interlocking tile roofs. Pastiche embellishments. Occasionally with fake chimneys.

Typical features

- Walls – filled cavity walls
- Dot and dab plasterboard as internal finish
- Floors – Insulated concrete beam, or, insulated solid concrete
- Masonry load-bearing partition walls
- Studwork partition with plasterboard
- Timber roof with insulated Skeiling
- Loft floor typically insulated
- Combi boiler with microbore pipes
- Trickle-vents in all windows
- Extractor fan in bathrooms and windows.
- uPVC windows and doors
- Gas boiler and radiators
- Open chimneys with generally unused fireplaces

Phasing of retrofit work – Type G



Retrofit cost	£0	£2,300	£19,000	£56,500	£78,000	£87,500	£118,000	£ invested
Energy saving	0%	0-10%	29%	59%	81%	110%	120%	Percentage saved
Heating demand	**143**	**130**	**100**	**51**	**51***	**51***	**20**	**kWhr/m²/yr (heating)**
Carbon emissions	5.5	5	4.1	1.5	0.7	-0.3	-0.7	Tonnes CO_2/year
Annual bills	£1700	£1600	£1350	£1000	£1300**	-£250	-£600	£ per year

Please note: Bill estimates are based on early 2022 prices, so a rise is expected. It assumes homes heated to CIBSE recommendations rather than national averages.

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**bills rise with the switch from gas to more expensive electricity.

Typical measures and approximate costs

Please note: Costs within this section are given as a guide, correct for autumn 2022, for a typical house and assume that the retrofit works will be undertaken by a building company.

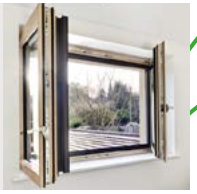
Key

- **Thermal envelope**
- **Active measure**
- **Passive measure (fabric)**

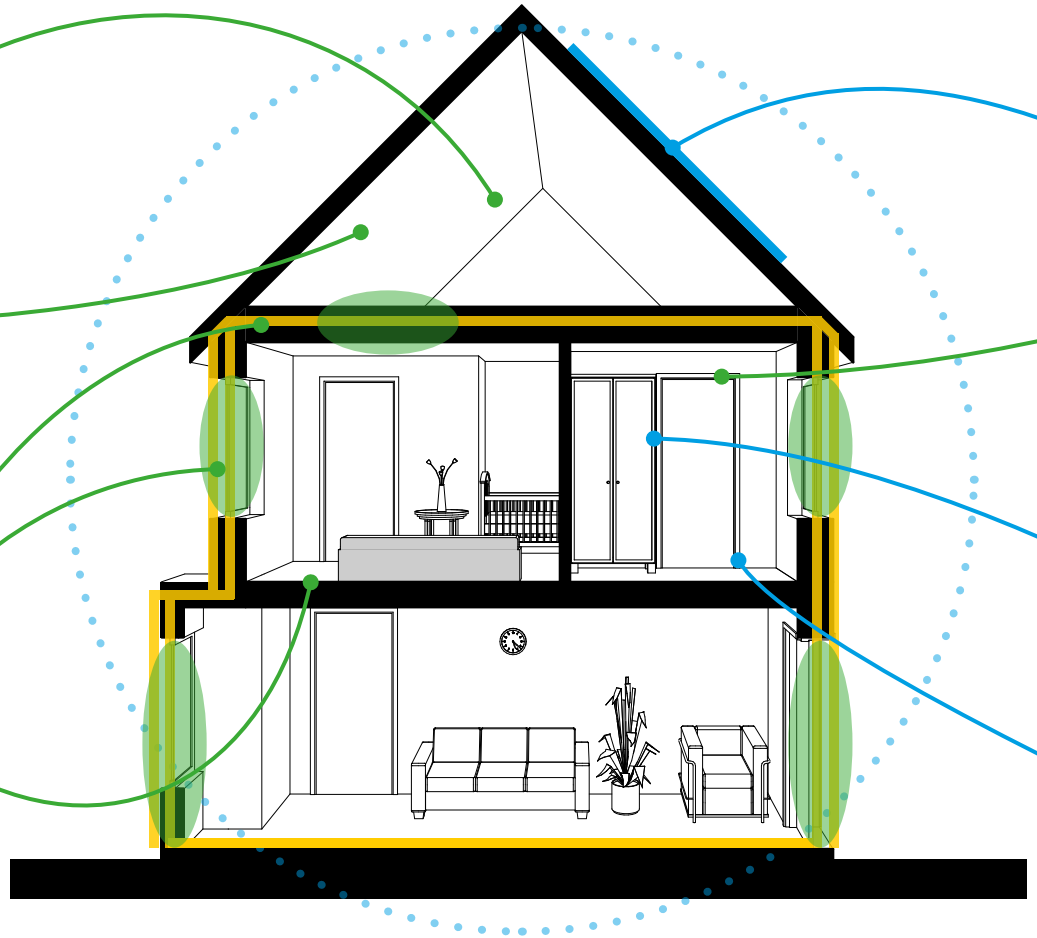
Topped up loft insulation
£3,500

High performance loft hatch
£1,000

Triple glazed windows and external doors
£19,300



Draught free
£17,900



Solar panels
£11,000

Extra external wall insulation
£46,400

Mechanical ventilation
£10,200

Low carbon heating –air source heat pump
£27,500

Typical measures

Key

- Thermal envelope
- Active measure
- Passive measure (fabric)

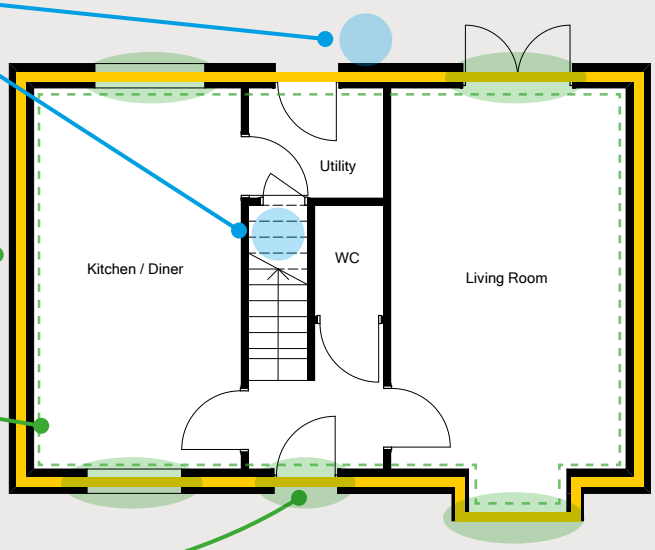
Ground floor

Air source heat pump and thermal store location

Existing cavity wall insulation

Air tightness measures to dot and dab plasterboard

High performance front door

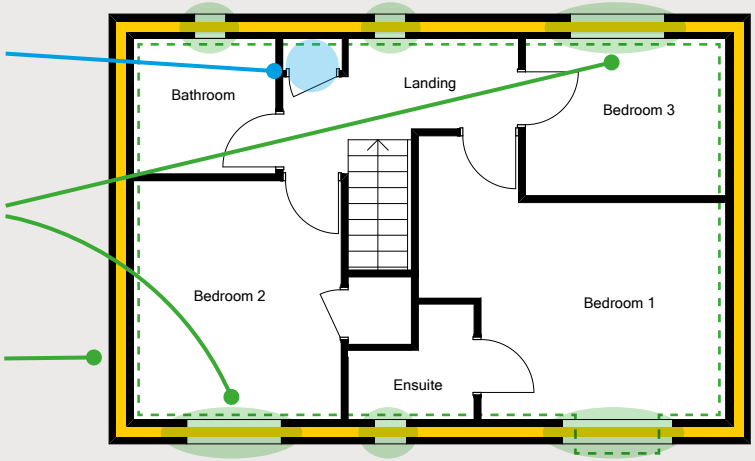


First floor

Mechanical ventilation kit

High performance windows

Cavity wall insulation



Retrofit measures

Low-cost measures

- Ensure **thermostat is at recommended levels** or according to your health needs.
- Fit **low energy lighting** and appliances.
- Fit **draught strips** to windows and doors.
- **Seal cracks**, holes, service penetrations and skirting boards.
- **Extractor fans** to bathrooms and kitchens.
- Fit improved **heating controls**.
- Make **DIY improvements to loft** and storage hatches.
- **Lag pipes**.
- **Test air tightness** to find leakage pathways.
- Use **thermal imaging** to find weak spots.

Shallow

- **Insulated and re-roofed porch roof.**
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- **Air tightness measures.** Seal easy-to-treat leakage pathways.

Deep

- **High performance front door.** Even if double glazing is installed front doors are often original and can be very poorly performing.
- **Air tightness measures.** All services sealed, windows and cracks sealed and taped.
- **Installation of mechanical ventilation** with heat recovery.

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Next steps

Your retrofit journey

The low and no cost measures represent the **first practical steps** of your retrofit journey. To plan which are the best measures for your home, and in what order, you can commission a **retrofit assessment** or retrofit feasibility study. This can cost a few hundred pounds for a basic assessment to low thousands for a detailed study and energy modelling.

You should approach a competent retrofit coordinator, architect, or built environment professional to commission a whole-house retrofit plan. You should use professionals with PAS 2035 accreditation/ certification, Passivhaus certification, or equivalent professional accreditation.

If you are more action-oriented, you could begin with the DIY, low and no-cost measures given above; however, do still seek advice to prevent unintentional consequences or incompatible measures. Please note that we cannot recommend any individuals or businesses. This page links to registers of individuals and companies accredited by trade and professional associations.

Finding a Retrofit Assessor

- TrustMark is a government endorsed quality scheme with over 20 retrofit assessors in Hertfordshire listed at time of publication.

Finding a Contractor

- If you would like to find **contractors to carry out retrofit works** on your property and you are able to pay for it, you can also use the TrustMark site.
- **For renewables (ASHP or solar)** you can find installers through the Microgeneration Certification Scheme (MCS Certified).
- **For listed buildings or those in conservation areas**, you can find appropriately skilled retrofit professionals with help from Historic England.
- **For easier DIY measures** you can use organisations such as Which? Trusted Trader. Hertfordshire County Council works jointly with Which? Trusted Traders to help you find trustworthy, reputable traders who offer good customer service. Every endorsed trader has met HCC agreed high standards. Traders with a "Hertfordshire Trading Standards approved" logo have been assessed by trading standards professionals and DBS checked. Which? Trusted Traders also offer advice on working with traders.

Renters

If you rent your home, then it is your landlord who would ultimately decide on whether to go ahead with any substantial energy efficiency work. Many of the low-cost interventions to reduce energy use such as thermostat management, lagging pipes, low energy lighting and basic draught proofing may not make a material change to the building's fabric and could be within a tenant's control. However, do not make changes to a property without your landlord's permission. Your landlord has a legal duty to ensure your home is in good condition and it is worth being aware of the MEES (Minimum Energy Efficiency Scheme), which sets a legal minimum energy efficiency standard for rented homes. At present, all rented homes should have an EPC level of E or above. Landlords also have to meet certain housing standards. Your rights as a tenant can be found here, and your landlord must keep the property to a minimum standard in terms of being free from excess cold. You can approach your local council for more information.

Financial Support

You may find that there is limited financial support available to help people retrofit their homes. Green mortgages and home improvement loans are becoming more common and may be worth a discussion with your bank. Funding detailed below may change over time. Check for up-to-date schemes prior to undertaking works. Information can be found here.

- Many government schemes detailed here support free or subsidised energy-saving measures. These aim to help vulnerable people and encourage energy efficiency in our homes.
- SMG Smart Export Guarantee – is a scheme for those with small scale low-carbon generators (renewable energy technologies) to get paid for the electricity they produce and export back to the grid.
- Boiler Upgrade Scheme (BUS) provides financial support for a heat pump or biomass boiler.
- VAT: It is worth noting that energy saving measures (including heat pumps and energy storage) in residential accommodation and community buildings are VAT exempt until April 2027 when they will revert to a reduced rate of 5%.

About this guide

This resource has been produced by Hertfordshire Climate Change & Sustainability Partnership.
The Partnership would like to thank Cambridge City Council for generously sharing their resource and allowing us to adapt **their original content** for use in this publication.

For ideas and information to take action in your home and local community to help us all thrive alongside nature in Hertfordshire, check out our sister publication **Sustainable Actions that work for you, your money and our environment**.

To find out more, please visit the **HCCSP website**.

HCCSP
Hertfordshire Climate Change and Sustainability Partnership

Design by Beehive Green