Building fabric

Energy saving techniques to improve the efficiency of building structures
Preface

Reducing energy use makes perfect business sense; it saves money, enhances corporate reputation and helps everyone in the fight against climate change.

The Carbon Trust provides simple, effective advice to help businesses take action to reduce carbon emissions, and the simplest way to do this is to use energy more efficiently.

This technology overview introduces the main energy saving opportunities relating to building fabric and demonstrates how simple actions save energy, cut costs and increase comfort for building occupants.
Introduction

Improving a site’s building fabric is a good investment

The building fabric refers to the ceiling, walls, windows, floors and doors of a building. It plays the leading role in the energy efficiency of a structure and must be considered in the design and planning phase of a building. Optimum design of building fabric can minimise potential heating and cooling requirements, which may lead to the downsizing of heating and cooling systems or sometimes eliminate the need for them at all. It is also possible to significantly improve the energy related performance of the existing building fabric. The majority of energy savings available in existing buildings may only be cost effective as part of planned building refurbishment work, but there are a number of simple, low-cost measures that can be implemented as stand-alone projects. This technology overview focuses mainly on achievable energy saving measures for existing buildings.

Who is this publication for?

Building managers, energy managers and anyone involved in building management who wishes to improve internal comfort levels or reduce heating, cooling or ventilation costs, could benefit from the information provided in this guide. There are many techniques that can be implemented immediately, regardless of building type or fabric, and other actions which can best be undertaken during major refurbishment or new build. Examples of each can be found throughout this publication.
The best time to upgrade your building fabric is during major refurbishment. Incorporating energy efficient measures into the plans can be extremely cost effective.

**Why consider building fabric as part of an energy efficiency programme?**

Improving a site’s building fabric leads to:

- Reduced energy costs as a result of minimising the loss of treated (heated or cooled) air.
- Better temperature control – it can lower ventilation and air conditioning costs and prevent overheating.
- Improved productivity – the output and morale of the people in the building can be enhanced by providing a more comfortable working environment through reducing draughts, solar glare, overheating and noise.
- Lower capital expenditure – a more efficient, well-insulated building needs smaller heating and cooling systems.
- Good investment – better insulation can increase a building’s value and attractiveness.
- Compliance with regulation – businesses may need to consider building fabric under Government Building Regulations (see box, right).

**Building regulations**

Building regulations now stipulate that if you are refurbishing an element of the building fabric, you have to improve its energy efficiency if the work will, or may, affect the thermal performance. This includes considering the whole building even if only part of it is being refurbished.

Changes to the regulations require buildings to include 'reasonable provision' for improvements with a payback period of up to 15 years. Such reasonable provisions include:

- Increasing the insulation in roof spaces.
- Insulating all available empty external cavity walls.
Energy consumption

The design and specification of the building fabric is a major determining factor of energy use in any building. It has to strike a balance between ventilation and daylight requirements, and the need to provide comfortable temperatures for the people inside.

Although ventilation and air conditioning requirements are both affected by building fabric, it is heating which has the largest overall energy cost implication. Typically, two thirds of the heat generated in a building is lost through the building fabric itself. The remaining third is lost through gaps and vents in the fabric which allow warm air to leave and cold air to enter the space (either deliberately through ventilation or uncontrolled through gaps and cracks). This lost heat has to be made up again by the heating system and can be an expensive waste of energy.

The rate at which heat is lost depends on:

- The temperature difference between the inside and outside of the building.
- The insulation properties of the building fabric.
- The amount of fresh air entering the building either by controlled ventilation or through poorly fitting windows, doors or joins in walls.

Figure 1 below shows the proportion of heat which is typically lost through different elements of building fabric.

Figure 1 Breakdown of heat loss for a typical industrial building with a central valley gutter

Following building fabric upgrades and refurbishment, maximum energy savings will only be achieved if your heating system is well controlled locally, to take advantage of the lower rate of heat loss.

It is estimated that around 10-15% of total energy costs is wasted by heat losses through the building fabric, but significant savings are achievable through the implementation of some simple energy efficiency measures.

Fact:
An industrial building could be losing 75% of its heat through the building fabric.
A good starting point for improving building fabric is to look around a building and create a checklist of areas to inspect regularly and problems to look out for. Check roofs and lofts, walls, windows and doors which can offer low or no cost efficiency measures. All of these elements are discussed in subsequent sections of this overview, and some example actions can be seen in the diagram opposite.

Following building fabric upgrades and refurbishment, maximum energy savings will only be achieved if your heating system is well controlled locally, to take advantage of the lower rate of heat loss.

**Opportunities for improving building fabric**

As shown in Figure 2 right, there are many opportunities to reduce heat loss from a building. Taking action on these opportunities can provide more comfortable internal conditions as well as saving energy and money.

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**Top tip:**

Ensure building fabric is checked regularly for signs of damage from moisture or rodents, which could increase heating and cooling costs. Catching a problem early is almost always cheaper and easier to rectify.
Building fabric and the external environment

The energy consumption of a building is affected by a variety of interrelated external environmental factors, which govern how a building responds to the environment around it.

Climate and weather
The characteristics of the climate have a large part to play in the energy use of any building. Factors such as temperature, humidity, prevailing wind conditions and light levels interact with the building envelope to determine the energy use and energy efficiency of a building. For instance, buildings in more exposed locations will generally have higher heating costs, due to greater volumes of cooler air entering the space than those in more sheltered places.

There is currently some debate about how potential changes in climate can be accounted for in the design, construction and operation of new buildings. For existing buildings, there are several ways to reduce the impact of climatic conditions starting with low cost measures such as installing draught stripping, upgrading insulation levels or providing external shading.

Orientation and layout
The direction in which buildings face and the amount of shading from other buildings or plants has a direct effect on the amount of daylight and heat from the sun that enters the building. As heated air rises, this can also have an impact on the successful provision of effective natural ventilation, although it could be taken advantage of and used to encourage ventilation through the stack effect. Buildings with the major fenestration on the building facing south will directly face the daily path of the sun. This can help to maximise daylight, but may also provide problems in relation to the heat from the sun entering the space. External shading is often required for these windows to prevent overheating and to minimise problems associated with glare.

Buildings facing east and west may suffer from variations in glare and heat from the sun over the course of a day, with one side of the building being overheated in the morning and the other in the afternoon. East and west facing windows are hardest to shade effectively as the morning and late afternoon sun is lower. Remember: north facing rooms are often the coolest areas in a building so are ideal for storing heat-emitting electrical equipment (such as photocopiers). This could help save on energy costs related to air conditioning and help improve internal comfort levels.

Form
A building’s shape and the proportion of the building which is exposed to the environment will also affect internal temperatures and heat loss. The smaller the external surface area of a building the less opportunity there is for heat to escape, but this can also reduce the scope for providing day-lighting and natural ventilation. Getting this balance right may only be an option at the design stage of a new building. This is illustrated in Figure 3 on page 9.
Building fabric

Figure 3 Variation in building forms showing different lengths of perimeter and wall area

Properties of the building fabric – U-values
Different fabric elements have different thermal (heat transfer) properties. Glazing, for instance, is usually the part of the fabric least able to retain heat. The ability of fabric to transfer heat is a measured factor expressed as its U-value. See the box right for more information.

The airtightness of the building
Air enters and leaves a building both by controlled ventilation, which is through windows and dedicated air vents, and through uncontrolled ventilation, such as poorly fitted windows or doors. Uncontrolled ventilation of a building is often called air infiltration, indicating that the air has worked its way into the building rather than being brought in to ventilate the building. Air infiltration is not controlled and rarely ventilates the building in the required manner. A ‘leaky’ building with poor airtightness will allow cold draughts to enter and heat to escape through cracks and gaps in the building fabric, reducing staff comfort in the process.

In recent years buildings have had to become more airtight, and revisions to the Building Regulations require new buildings to be tested for airtightness prior to building inspection approval. This increase in airtightness and increasing thermal improvements to fabric elements can sometimes result in newer buildings (especially offices) overheating, unless good controls are provided.

U-value – Explained

The ‘U-Value’ is a measure of the amount of energy (heat measured in Watts) that is transferred through an area of 1 square metre of material when there is a 1°C difference in temperature between inside and out.

The lower the U-value the better the material is at preventing heat loss. Although calculating U-values can be quite complicated due to the mixture of materials used for any one element of the building fabric, it is relatively easy to obtain U-value information for standard building elements either from the manufacturer or from independent bodies such as trade associations. Building regulations suggest minimum U-values for different building elements, but there is some flexibility to allow designs to integrate other options for reducing heat loss, for example minimum window U-values can be relaxed if the glazed area is reduced.
Condensation can occur on the surface of, or within, the materials that make up the building’s fabric. Surface condensation occurs when the relative humidity of the air in contact with the surface reaches 100% relative humidity, or dewpoint. Changes to heating, ventilation and occupancy patterns not foreseen at the design stage can often lead to condensation.

Condensation within the building materials is called interstitial condensation. Interstitial condensation is caused by water vapour generated within a building, creating a vapour pressure difference which drives the vapour through the wall and roof materials. This causes a gradient of vapour pressure, and therefore dewpoint temperature, through the structure. The dewpoint gradient will depend upon the permeability, or vapour resistance, of the materials. There is also a temperature gradient through the different materials within the structure, which depends upon the thermal resistance of the different materials.

If the temperature gradient across the fabric falls faster than the relative humidity gradient, there can become a point within the fabric where they meet, and condensation will occur at that point. As the condensation takes place, so the thermal resistance of the wall decreases and the rate of condensation can then increase.

**Figure 4 Interstitial condensation in a wall**

- Temperature
- Dew point
- Condensation plane

![Diagram showing interstitial condensation in a wall with temperature and dew point gradients through different materials.](image-url)
Thermal bridging explained

A thermal bridge is part of a building which has lower thermal resistance and bridges, or passes through, adjacent parts of the building fabric which have a higher thermal resistance. This path of lower thermal resistance allows heat to be lost from the building by bypassing installed thermal insulation. Thermal bridges are caused by full or partial penetration of the building fabric by materials which have a higher thermal conductivity, or by a change in the thickness of the building fabric.

Thermal bridges often occur at floor/wall, roof/wall, or ceiling/wall junctions. They can result in localised cold surfaces on which condensation, mould growth and/or pattern staining can occur. Prolonged exposure to condensation can lead to the deterioration of plaster and paintwork.

Figure 5 Heat loss from a commercial building
Opportunities for energy saving

Roofs and lofts
Over 20% of heat in a building is lost through the roof. Improving insulation levels in this area can often be cost effective, particularly with pitched roofs.

Maintenance opportunities
Insulate to accumulate
Installing loft insulation in an uninsulated pitched roof is likely to be the single most cost-effective way to improve the efficiency of building fabric and save money. In fact, insulating any loft spaces in a building could reduce heat loss by 25%, providing a quick payback in 1-4 years. It is also possible to upgrade existing insulation on the majority of roofs by adding to what is already there (providing it is in good condition and not damp). If there is less than 15cm (6 inches) of insulation, it is always worth adding more.

Mineral wool quilting is often the easiest option. Insulate any pipework or water storage tanks within the roof space to reduce the risk of freezing.

Inspect for signs of damage
It is always important to ensure your roof is in good condition; however, this is particularly pertinent for flat roofs. Keep an eye out for signs of damp, puddles of surface water and any indication that the roof is changing shape as any of these can let in water and cause significant – and expensive – damage to the property. For pitched roofs, check that insulation, including pipe insulation, remains dry and undamaged by rodents.

Take action to remedy any problems and replace any damaged insulation as soon as possible. Leaving it will only increase costs when the work is eventually carried out. If it is necessary to enter a loft space for any maintenance, it will be necessary to lay walking boards as it will no longer be obvious where joists lie beneath the increased insulation.
Re-circulate warmer air
Hot air rises and in high roofed buildings such as industrial sites, this can lead to layers of very warm air at high level – sometimes up to 10°C warmer than at working level. This leads to a higher rate of heat loss through the roof. Consider installing ceiling circulation fans (sometimes called de-stratification fans) so warm air can be redirected down to where it is needed. In most cases, the value of heat savings far exceeds the cost of the electricity required to operate the fans.

Types of insulation
There are several types of insulation available for use within construction, some of which are available in a range of forms. A brief description of general types of insulation is given below, together with more detail on their suitability for different methods of insulating pitched and flat roofs, see Table 1 on page 14.

Mineral wool
Mineral or glass wool comes in blanket form or high density slabs. This form of insulation has been used widely throughout the British Isles since the 1960s and 1970s and has a proven track record of performance.

Sheep wool
Sheep wool insulation comes in a blanket form and is made from pure new wool fibres. Sheep wool has a similar performance to mineral wool, but is less hazardous to handle and install, requiring no special handling or protective equipment.

Rigid insulation boards
These insulation boards cover a wide range of different insulating materials including polyurethane, polystyrene foam, polyisocyanurate foam and phenolic foam amongst others. They all offer high levels of thermal performance because of their closed cell content. They are very effective at reducing the U-value of a roof, and only one layer of insulation board may be required.
### Table 1 Insulation properties and methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Material</th>
<th>Attributes</th>
<th>DIY?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between wooden frame members and laterally across the frame members</td>
<td>Glass wool and rock wool blanket</td>
<td>Average thermal insulation properties</td>
<td>Yes</td>
<td>Insulate to a thickness of 250mm to 300mm. Costs around £6/m² for 270mm depth</td>
</tr>
<tr>
<td>Sheep wool and cellulose fibre blanket</td>
<td>Sheep wool and cellulose fibre blanket</td>
<td>Average thermal insulation properties</td>
<td>Yes</td>
<td>Renewable/recyclable option as a direct replacement for glass or rock wool blanket. Insulate to a thickness of 250mm to 300mm. Costs around £20/m² for 270mm depth</td>
</tr>
<tr>
<td>High-density slabs</td>
<td>High-density slabs</td>
<td>Good thermal insulation properties</td>
<td>Yes – but requires measuring and cutting skills</td>
<td>Insulate to a thickness of 150mm. The amount of insulation needed depends on existing insulation. Costs around £14/m²</td>
</tr>
<tr>
<td>Blown into gaps and cavities and difficult to reach areas</td>
<td>Glass wool and rock wool loose fill Cellulose fibre</td>
<td>Average thermal insulation properties</td>
<td>No</td>
<td>Insulate to a thickness of 250mm to 300mm. The amount of insulation needed depends on existing insulation. Costs around £10/m² for 250mm depth</td>
</tr>
<tr>
<td>Sprayed in place</td>
<td>Foam-in-place, usually polyurethane</td>
<td>Good thermal insulation properties</td>
<td>Yes – but does take some skill</td>
<td>Mainly for difficult to insulate, smaller areas and to prevent thermal bridging. Can be combustible and emit toxic gases, although modern products usually have an added flame retardant. Fire rated expandable polyurethane foam can cost around £14 for a 750ml canister</td>
</tr>
<tr>
<td>Method</td>
<td>Material</td>
<td>Attributes</td>
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</tr>
<tr>
<td>Between wooden frame members and rafters</td>
<td>High-density slabs</td>
<td>Good thermal insulation properties</td>
<td>Yes – but requires measuring and cutting skills</td>
<td>Insulate to a thickness of 150mm. The amount of insulation needed depends on existing insulation. Costs around £14/m²</td>
</tr>
<tr>
<td></td>
<td>Mineral and rock wool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid urethane boards with silver foil backing</td>
<td>Good thermal insulation properties</td>
<td>No</td>
<td></td>
<td>Insulate to a thickness of 80mm to 100mm. May need to insulate to a thickness of 150mm depending on the product and existing insulation. 80mm board costs around £14/m²</td>
</tr>
<tr>
<td>Stapled or batten to the underside of rafters</td>
<td>Multilayer quilted foil system</td>
<td>Good thermal insulation properties</td>
<td>Yes – but does take some skill</td>
<td>Requires fixings and accurate cutting. Costs for a single layer are around £12/m²</td>
</tr>
<tr>
<td>Extra layer of insulation applied to the underside of flat roof using studs or other fixing method</td>
<td>50mm insulated plasterboard lining</td>
<td>Good thermal insulation properties</td>
<td>No</td>
<td>Very effective at reducing the U-value of a roof, but requires care to establish an effective vapour control layer, particularly around the edges. It will not – on its own – achieve a U-value of 0.3 W/m².K. This method will reduce the height of a room and involves extra costs for re-decorating and electrical work. Vents may also need to be relocated. Costs around £17/m²</td>
</tr>
<tr>
<td></td>
<td>Rigid insulating boards: polyurethane, polystyrene foam, polyisocyanurate foam, phenolic foam and so on</td>
<td>Very good thermal insulation properties</td>
<td>No</td>
<td>Very effective at reducing the U-value of a roof, but requires care to establish an effective vapour control layer, particularly around the edges. Some boards represent a high fire risk and could change the spread of fire rating of the ceiling. One layer may be enough to achieve a U-value of 0.3 W/m².K. This method will reduce the height of a room and involves extra costs for re-decorating and electrical work. Aesthetics could be an issue. Vents may also need to be relocated. Costs around £9/m² for 75mm board</td>
</tr>
<tr>
<td>Method</td>
<td>Material</td>
<td>Attributes</td>
<td>DIY?</td>
<td>Comments</td>
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<tr>
<td>Insulating layer fixed to the outer surface of the flat roof</td>
<td>Rigid insulating boards, probably load-bearing with weatherproof membrane cover</td>
<td>Good thermal insulation properties</td>
<td>No</td>
<td>Probably the most expensive type of roof insulation, both in materials and installation costs, but often the only solution for many flat roofs. Insulate to a thickness of 80mm to 100mm. May need to insulate to a thickness of 150mm, depending on product and existing insulation. Costs of installation could be from £70/m² to £140/m²</td>
</tr>
</tbody>
</table>
Refurbishment opportunities

**Insulating pitched roofs**

Insulating pitched roofs at ceiling level (‘cold roof’) offers relatively short paybacks and can be carried out at any time. Install insulation carefully to ensure there are no thermal bridging problems and it is imperative that the roof is ventilated to prevent condensation. Ensure water services and ducting are insulated to avoid condensation and freezing and have an effective vapour control layer as necessary.

Alternatively, following a condensation risk assessment, a pitched roof can be insulated at rafter level using rigid foam insulation boards with low vapour permeability or high density mineral wool slabs. This provides a ‘warm roof’ and allows the space under it to be converted for use. However, this method can be more expensive and is usually best carried out when re-roofing.

*Figure 6a An illustration of cold pitched roof, with insulation at ceiling levels*

*Figure 6b An illustration of a warm pitched roof, with insulation at rafter level*
**Insulating flat roofs**

Flat roofs can be more difficult and expensive to insulate than pitched roofs, and it is not usually economical to add insulation unless carrying out repair or refurbishment work at the same time.

Locating the insulation above or below the roof deck will depend upon the roof construction and which part of the roof requires maintenance; the roofing membrane or the insulation.

Insulating a flat roof with a warm deck is appropriate when the weatherproof membrane of a concrete steel or timber warm deck flat roof has failed and needs to be renewed or where the membrane is in good condition, but the insulation needs to be upgraded. For timber flat roofs, the method may also be used to replace a cold deck construction where only the structural joists are in a satisfactory condition.

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**Figure 6c An illustration of a cold flat roof, with insulation at ceiling level**

- 50mm gravel or paving slabs to hold down insulation
- 100mm extruded polystyrene (closed cell) insulation placed above waterproof roofing
- Waterproof layer
- Roof deck
Insulating a flat roof with an inverted warm deck may be used when the existing construction is to be renewed or when it is necessary to upgrade an existing poorly insulated construction. When upgrading an existing roof, it will be necessary to check:

- the condition of the existing weatherproofing membrane.
- the thermal resistance of any insulation previously installed below the weatherproof membrane.
- the ability of the roof to support the proposed increased load.

**Remember**

Energy saving options may depend on the type of roof your building has and the associated space available. For example, flat roofs can be difficult and more costly to insulate than pitched roofs. Always seek professional advice before carrying out any major work.

*Figure 6d* An illustration of a warm flat roof, with insulation above the deck but below the weatherproof membrane and insulation above the deck, but above the weatherproof membrane (upside down or inverted roof)
In order to insulate a flat roof with a cold deck, the insulation is placed at ceiling level with a void ventilated to the outside between the insulation and the deck. It should be considered only for timber construction where there is adequate ventilation across the whole roof. With increased levels of insulation it may prove impractical to achieve the desired thermal performance and maintain the required ventilation without increasing the depth of the joists by additional battening. The preferred option is always to provide a warm deck flat roof.

The cold deck roof is considered a poor option in the temperate, humid climate of the UK, where sufficient ventilation may not be achieved in sheltered locations or in windless conditions, even when the roof is correctly designed.

**Figure 7a – Detail of a flat roof with a warm deck**  
**Figure 7b – Detail of a flat roof with an inverted warm deck**
**Insulating between ceiling spaces**
In multi-storey buildings, dependent upon the building function, it may be beneficial to insulate between ceiling and floor spaces. This approach can assist in reducing the problem of underheating on lower floors and overheating on the higher floors of a building. If electrical services are supplied through these ceiling voids, special care is needed to ensure the cabling does not overheat.

However, in order to reduce summer overheating in offices, a more appropriate strategy may be to utilise the thermal mass of the building by exposing the concrete slabs and structure, provided this can be cooled overnight. In addition, the extra volume achieved by having high ceilings above occupied areas allows heat stratification, which combined with thermal mass can reduce costs through a reduction in the building’s cooling load.

Figures 8a and 8b show the improved heat retention of buildings with insulated stories.

*Figure 8a* Heat loss through uninsulated stories

*Figure 8b* Improved insulation between the stories leads to improved heat retention
Walls
Around 9% of heat lost in a building is through the fabric of the walls. Improving insulation here is particularly cost-effective in cavity walls.

Maintenance opportunities
Regularly check buildings for damp
Damp can cause significant damage to the building structure and reduces its insulating properties. Repair split downpipes, faulty gutters and leaky roofs immediately to prevent further damage. Check for signs of damp and condensation at least once a year, preferably in winter months when condensation risk is at its highest.

Seal gaps in walls
Check walls for draughts, especially around skirting and roof joins as well as around window and door frames. Seal any gaps where draughts can be felt to reduce heating costs and improve comfort.

Refurbishment opportunities
Heat reflective foil
Fit heat reflective foil behind radiators to reduce the amount of heat escaping. This is particularly recommended for radiators located on walls with an external aspect. Fit the foil so that the shiny side faces into the room.

Cavity wall insulation
Installing cavity wall insulation is simple. The procedure causes minimal disruption to staff and business operations during installation, making it suitable to carry out at any time. Installers will generally give free advice on the viability of this approach and the likely costs involved. Do not fill the cavities of buildings regularly exposed to driving rain, particularly in the south west.

Expanded polystyrene beads or mineral wool are the most commonly used materials for existing buildings and most cavity fill materials can plug gaps up to 12m high. It is usually possible to install specialist insulation in buildings up to 25m high.

Filling cavities provides a more comfortable environment for occupants, reduces draughts as well as the risk of condensation. In buildings where rain penetration is already a problem, cavity insulation should be avoided.

Installation must be carried out in accordance with manufacturer’s instructions to prevent any bridging caused by mortar droppings or other debris leading to damp penetration.

External insulated rendered systems
One of the most common ways to insulate a solid external wall is by applying insulation board to the external fabric of the building and protecting it with a specialist render. This method can be employed in new build construction and also during refurbishment of existing buildings. The risk of condensation within the wall construction (known as ‘interstitial’ condensation) is reduced as the structure is protected from extreme temperature fluctuations. Ensure that the proposed new surface finish or render complies with relevant local planning regulations and that it is applied in accordance with manufacturer’s recommendations.
Internal wall insulation

The addition of insulation to the internal face of solid external walls is a less expensive option, but disruption to building occupants can restrict this to times of major internal refurbishment. Insulation can be fixed to battens and covered with plasterboard, or incorporated in a single 'composite' board (consisting of insulation and plasterboard together). It is important to incorporate a vapour control layer on the warm side of the insulation to avoid condensation risk. When applying internal insulation, consideration should be given to heavy items such as radiators which may require additional support. When putting in services such as electric sockets and pipework, penetration of the insulating layer should be minimised in order to maintain the insulating properties of the material. Penetrations through the vapour control layer must also be sealed to avoid the risk of condensation within the wall.

Figure 9 Insulating different wall types

Cavity wall construction

60mm cavity filled with insulation

U-value = 1.5

U-value = 0.46

Solid brick wall (335mm thick)*

50mm thick insulated plasterboard lining

U-value = 1.7

U-value = 0.45

Timber-framed wall

50mm mineral wool between studs

U-value = 1.7

U-value = 0.38

*Not cost-effective on energy efficiency grounds alone
Effect of insulation on different wall types
The figure on page 23 shows the U-values of different types of wall construction. Note the effects of insulation on different types of wall construction, improving the U-value dramatically.

Exposing the fabric
Consider whether building fabric can be exposed to provide slower heating responses. Heavyweight building fabric like concrete can act like a sponge for heat if exposed to the internal air temperature. Allowing heat to be absorbed by the building fabric in this way allows the building to heat up more slowly and to hold its temperature for longer, figures 9a and 9b. The use of the building fabric in this manner can be advantageous when the space is occupied for long periods, but where spaces are used infrequently, a fast heating response time is more suitable.

Exposing the fabric can have significant benefits in reducing peaks and troughs in internal temperatures and can prevent the building overheating during occupied periods. A building made of steel and glass is more likely to heat up and cool down quickly. This means the building will be more prone to overheating during occupied periods as it responds rapidly to gains from outside and internal gains from equipment and people. Exposing the walls and ceilings in such buildings will not provide significant thermal ‘buffering’ benefits. Comprehensive insulation measures with long payback times may have long-term benefits such as:

- An increase in value of the property
- Improvements in working conditions.
- Increased staff morale and productivity.
- Reduced capital expenditure on building services (for example, solar shading may remove the need for air conditioning).

Remember
If a building is listed, such as a heritage site, that listing protects all services including boilers and pipework. It is therefore a criminal act to change anything without permission. If in doubt, seek professional advice.

Fact:
**Blocking up chimneys**
Old, unused, open chimneys can be blocked up when redecorating. This reduces uncontrolled ventilation losses and draughts. Ensure that sufficient controllable ventilation will be provided before blocking the chimney and that some residual ventilation is provided through the chimney to keep it dry. There is a risk otherwise of dampness mobilising old combustion products, which then leach through the construction and cause staining of internal finishes.
During the following day the pre-cooled structural mass can absorb the internal heat gains and thereby maintain relatively stable and cool internal surface temperatures. The diurnal changes in surface temperature are limited due to the total mass and conductivity of the structure. During a sustained period of hot weather, if the daily gain in the temperature of the structural mass has not been offset by the night cooling regime, the slab temperature will rise and so will the internal temperature. The temperature in a lightweight building, though, at the beginning of the hot spell, would have risen even more quickly.

During summer nights, when outdoor air temperatures are lower than internal temperatures, it is possible to ventilate the building to cool the exposed internal surfaces. This ventilation may be achieved naturally through openable windows or mechanically using energy efficient fans to blow the ambient air either over or through the structural mass. The ventilation must be achieved without comprising the security of the building.
Windows

Used effectively, windows can reduce requirements for lighting and mechanical cooling. However, they can account for over a quarter of a building’s heat loss. Glazing lets in solar heat, and whilst this can be beneficial in reducing heating requirements in colder weather, it can make buildings uncomfortably warm in summertime, particularly for occupants placed next to windows.

Figure 11a Solar gain and the role of glazing in heat retention

Windows are made up of two components, the frame and the glazing (or glass) that sits inside it. The main attributes that affect a window’s performance are:

- Number of panes of glass (single, double or triple).
- Specification of the glass used. Some types have special coatings to keep heat in and reduce solar gain.
- Type of gas used to fill the vapour space within double and triple glazing.
- Frame design: The width of the thermal break and the design of the frame section affects its thermal performance.
- Glazed unit design: Investigate units with insulating spacers as metal spacers can conduct heat through the window.

Maintenance opportunities

Keep windows closed
Quite simply, to reduce the loss of treated air, keep windows closed when heating or air-conditioning systems are in operation. Use the system controls to achieve the right temperature.

Make good use of natural daylight
Most people prefer to work in natural light so occupants should be encouraged to keep lights switched off where there is sufficient daylight. Ensure windows and skylights are not obstructed and that they are regularly cleaned to maximise light levels.

Redirect the sun
Direct sunlight coming into buildings through glazing can create glare problems. Often building occupants react to this by lowering blinds and switching on lights. Instead, encourage users to angle blinds to reflect more light onto the ceiling or into the workspace rather than blocking the light completely. Once the sun moves away, open blinds fully again. If possible, decorating walls and ceilings in light colours will also help to reflect light more deeply into the building.

Draw curtains/blinds to improve comfort
Draw curtains and lower blinds at the end of each day to help keep warmth in during winter months. Using curtains and blinds in rooms exposed to afternoon and evening sun during summer can help lower room temperatures and improve comfort for the following morning.
Undertake regular maintenance
Regularly check windows, replace broken or cracked panes and frames. Fit draught stripping where appropriate and replace any sections showing wear or damage. There are a variety of draught-proofing systems to fit most window designs, many of which can be easily installed as a ‘DIY’ measure by in-house maintenance staff.

Reduce draughts
Openable windows in generally good condition can be draught-stripped to reduce heat loss. In naturally ventilated areas, controllable trickle ventilators can be fitted to ensure that minimum quantities of fresh air can be provided after draught-stripping. Ensure good quality materials are specified and correctly fitted. Consider sealing unused opening windows to further reduce draughts.

Refurbishment opportunities
Improving glazing can be expensive and may only be cost effective in energy saving terms as part of a refurbishment project. When refurbishment is being planned, consider the following:

Double/triple glazing
Double glazing is now a minimum requirement when replacing windows, but specifying triple glazing on north facing or exposed sides of a building can offer further comfort and energy savings. Some window units even allow for secure night opening which can provide additional ventilation and cooling benefits.

High performance and low emissivity glass
High performance glass has a coating or a film applied to it to improve insulation properties. This redirects heat either back into the room or prevents it from entering the space from outside and can improve occupant comfort.

Coatings that allow daylight through but block or reduce heat (infrared) can be particularly effective at reducing overheating from direct sunlight which can lower mechanical cooling requirements. However the coating absorbs heat which can cause glass failures so should only be installed where this risk has been considered and checked.

Top tip:
Do the 1 pence test
If a 1 pence coin can slide between a window and its frame, draught-proofing will be cost effective and improve comfort.
Building fabric

Analternative short-term measure is to apply a solar-control film to existing glazing. Note that this can also reduce daylight levels and affect the colour rendering of the remaining daylight. Solar control film can also absorb heat, which can increase stress on the glass and should only be installed where this risk has been addressed.

It is important to ensure this does not lead to an excessive increase in artificial light requirements and that any resulting colour changes are acceptable, before adopting this measure.

**Fact:**

**Low emissivity glass**

Commonly known as ‘low-E’ glass, this is often used in double and triple glazing units. It has a special thin-film metallic or oxide coating which allows the passage of short-wave solar energy into a building but prevents long-wave energy produced by heating systems and lighting from escaping outside. Low-E glass allows light to enter while also providing thermal insulation and is a good option to improve internal comfort conditions. There is potential for low-E glass to increase the risk of overheating in summer, so the benefits and risks need to be carefully considered.

**Thermal performance**

Thermal performance of glass can now be specified using the British Fenestration Rating Council Scheme which classifies windows using an A to G rating; ‘A’ rating being the best. The rating takes new technologies, coatings, triple glazing and evacuated cavities into account. As the higher performing glasses are more expensive, check the energy savings against the installation cost to get the best value.

**Replace glazing with insulation**

In highly glazed spaces, it may be more effective to replace some of the glazing with insulated blank panels. This will reduce the amount of light entering the space but provide better insulation. It will also reduce heat and glare problems associated with a large area of windows. These can be made to measure and are a simple retrofit option in areas where reducing daylight will not cause the area to become dark or oppressive, and where the location of panels will not look unattractive or detract from the business.

**Provide external shading**

Solar shading reduces unwanted heat and light from the sun during the summer, and can allow low-angled winter sun to provide some passive heating. It is most effective if combined with other measures to address overheating, including energy efficient lighting and appliances.

Although the heat sun from the sun is most intense on south facing facades, solar gain can be more problematic on east or west facing facades which are susceptible to overheating when the sun is at a low angle. For buildings with east-facing glazing this can cause overheating early in the day, and for west-facing glazing this causes overheating late in the day when the building is already warm.

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**Figure 13a An illustration of the sun’s path**

[Diagram of sun's path showing summer and winter angles]
Types of solar shading

There are several options for fitting solar shading to an existing building, using overhangs and awnings, external blinds or internal blinds. Shading on new-builds could also include coated glazing and mid-pane blinds.

Overhangs, awnings and light shelves

Overhangs are a simple, yet effective way of blocking out the high summer sun and are usually installed on south-facing facades.

Also known as ‘brise soleil’, this type of shading can be integrated with new-builds or fitted to an existing building. They don’t stop windows from opening and no visibility is lost. Awnings are a more simple form of overhang that are cheap to install and can be retracted if required.

Light shelves are similar to overhangs and awnings, but are installed part-way up a window, typically just above head height. The top of the shelf reflects extra daylight into the building without glare and without compromising shading.

The amount of shading depends on the degree of overhang compared to the window height. A ratio of 1:1 is usually ideal for south-facing facades.

Internal blinds

Internal blinds tend to be less effective than external shading at controlling heat gain as the blind becomes hot within the room— but can reduce glare. In some circumstances, the operation of internal blinds can impact on natural ventilation and vice versa.

- Reflective roller blinds look like reflective window film when closed and stop solar gain very effectively. They can also be opened when solar radiation and daylight are required.
- Opaque blinds reduce solar glare, but daylight levels will be poor and artificial lighting will usually be needed.
- Light-coloured blinds allow some natural light in and absorb less heat than opaque blinds. They do cut solar glare, but don’t give much privacy at night.
- Transparent blinds maximise daylight, but don’t completely stop solar glare.

Solar control film

Various types of solar film can be applied to glazing to reduce the transfer of heat and light to different extents, allowing heat gains and glare to be reduced.

External blinds

Various types of external blinds are available and can be used over a fixed overhang or awning (or between panes) for more control of shading. Blinds tend to be better on existing buildings because they have lightweight frames, whereas overhangs or awnings are often heavy and need chemical fixing. You can opt for manual control of the blinds from inside the building.

Trees and vegetation

Planting such as trees and climbing vegetation can be used to provide shade and control of solar gain where space permits. Tall deciduous trees give the best control, as they can provide shading in the summer whilst they are in leaf, but allow sunlight to penetrate the building to provide light and solar gain in the winter. However they should not be planted too close to the building otherwise the roots can cause damage.
Figure 14a A typical ‘brise soleil’ installation

Figure 14b A typical installation of a permanent overhang

Figure 14c A typical retractable external blind installation

Image from Solar shading of buildings, P. Littlefair, BRE, 1999
Doors

Maintenance opportunities

Easy access to almost any building is essential, but open doors can allow uncontrolled quantities of air into a building, reducing comfort conditions and wasting energy.

There are a number of opportunities to reduce heat losses through doors. Many of these solutions are applicable when designing or refurbishing a building but there are also some low-cost opportunities that can be implemented immediately.

Keep doors closed

All external doors should be kept closed when heating or cooling systems are in operation. Consider fitting automatic closers to external doors and to internal doors that separate areas with different heating or cooling requirements. This is a relatively inexpensive measure which can often be carried out by on-site maintenance staff.

Fit brush strips

Fit the strips to the internal side of doors and windows. For gaps between double doors, select one door and add the brush strips.

Replace seals and door closers

Regular maintenance and inspection of draught proofing and door closers will ensure that they continue to work properly and provide savings. Check all seals, draught stripping and door closers for signs of damage and replace them if required. Draught stripping comes in a variety of sizes to seal any gap and is easy to install.

Seal unused doors

Doors that are no longer used should be sealed around their perimeter to avoid heat escaping and cold draughts entering a space. This is a cheap and easy way of improving comfort conditions.

MYTH – Small gaps around doors do not let in much cold air.

REALITY – A door with a 3mm gap will let in as much cold air as a hole in the wall the size of a brick.

Fact:

Draught stripping is easy, inexpensive and improves occupant comfort. It also reduces heating costs by up to 10% and pays back any investment within a year or two.

Figure 15 Brush strips
Refurbishment opportunities

Fit draught lobbies to main entrances
Installing a draught lobby at frequently used entrances can reduce heating costs and draughts. Lobbies should be large enough to provide unrestricted access and enable one set of doors to be closed before the other is opened. Where possible, the two sets of doors should have automatic control.

Install a revolving door
An alternative to a lobby is a revolving door. These reduce heat loss when people are entering or leaving the building. Doors should be draught-stripped as shown in the illustration in Figure 16, right. An ordinary door nearby is often essential for emergency and disabled access. However, this should be kept closed when not being used in order to minimise energy consumption and wastage.

Figure 16 The benefits of adding a draught lobby

11a: Corridors link directly with entrance doors. Result – high air change rates deep into the building.

11b: Addition of entrance lobby and inner doors. Result – restriction of high air changes to a smaller volume of the building.
Interlocked control for heating systems
Open doors can result in substantial heat losses. If heating turns off when doors are opened, there is an incentive for people to keep them closed. Simple ‘interlock’ controls are relatively cheap to install and they will link the operation of heaters so that they switch off automatically when doors are opened. These can be particularly effective for doors in loading bays, garages and workshops.

Upgrade doors during refurbishment
Modern, well-insulated doors help to improve comfort levels through preventing draughts and retaining heat. When specifying new doors, consider their thermal, fire and security performance together with their access characteristics.

Vehicular access doors
Doors that provide access for vehicles are usually little more than large openings in the walls of a building. This can result in large volumes of moving air within the building, leading to very high heat losses and uncomfortable working conditions. Heat losses can be reduced through use of a vehicle entrance lobby (Figure 18a), PVC/plastic strip curtains (Figure 18b) or high speed motorised doors with automatic opening and shutting controls (Figure 18c).

To improve energy use as well as health and safety, motorised doors should have:
• An interlock to turn off heating when doors are open.
• An audible alarm that triggers after the door has been open for a set time.
• Separate personnel access alongside goods stores.
**Airtight door seals**
Insulating door seals are also available which allow the back of goods trucks to reverse into an airtight seal, preventing the inside heated or cooled air from escaping during vehicle loading/unloading.

Some small or medium-sized companies may be eligible for a loan to help cover the costs of installing these measures. See the box (below) for more details.

*Figure 19 Example of airtight door seals*
Floors

Floors are often overlooked as an area for energy saving, but nearly 10% of heat lost from a building will occur via the ground floor. In addition, uninsulated floors in multi-storey buildings can allow transfer of heat upwards causing higher floors to overheat whilst the lower ones struggle to reach a comfortable temperature.

Maintenance opportunities

Seal gaps and cracks
Sealing any cracks in flooring can improve comfort and reduce costs. This is especially applicable to cracks higher up in the building which can reduce any overheating problems that the space may be experiencing.

The use of carpet and underlay, or well fitted carpet tiles, will also assist in sealing the floor against unwanted cold draughts or heat rising from the lower floors.

Refurbishment opportunities

Suspended timber floors
Adding insulation between joists, where there is access to the underside of suspended timber floors, is a cost-effective measure at any time. In areas where there is no access, insulating between the joists can only be carried out from above. To do this, the flooring must be lifted so it is only worthwhile if floor renovation is part of a planned refurbishment. Either mineral wool or rigid foam insulation can be used.

To ensure optimal insulation, the following should be noted:

- Seal gaps at the skirting to avoid air infiltration.
- Maintain ventilation below the subfloor.
- Place electrical cables sheathed in PVC in conduit, or protect from direct contact with expanded polystyrene insulation.
- Avoid placing heating pipes below insulation. If this cannot be avoided, ensure pipes are insulated.
- Install a vapour control layer to avoid condensation within the insulation if using mineral fibre.

Concrete ground floors
Opportunities for insulating existing solid ground floors are limited; the possibility of adding insulation only occurs where an existing floor finish (such as old, wood block flooring or a cracking screed) needs replacing. Solid concrete ground floors can be insulated to reduce heat loss by:

- adding insulation prior to laying the final concrete surface.
- installing insulation above the concrete and installing a final 'screed' above the insulation.
- adding a floor finish on battens with insulation between the battens.

All options are likely to be disruptive and expensive and may only be cost effective during extensive refurbishment as the surface level of the floor will be changed.

Summary of opportunities

The diagram below illustrates an example of the scope for reducing building fabric heat loss following action on the major opportunities which could be available. The amount of heat lost through the building fabric can be reduced by more than half through a combination of draught proofing, double glazing and insulation. However, it is important to note that the level of savings shown will only be possible if the heating system is well controlled locally, to take advantage of the lower rate of heat loss.
Figure 20 Potential savings through improving building fabric

Amend heat loss through floor figure to 8%.

As existing

- Heat loss: 158kW
- Fabric: 58%
- Ventilation and infiltration: 42%
- Roof: 15%
- Wall: 21%
- Floor: 4%
- Glazing: 18%

Following roof and cavity wall insulation

- Heat loss: 119kW
- Fabric: 33%
- Ventilation and infiltration: 42%
- Roof: 3%
- Wall: 25%
- Floor: 4%
- Glazing: 25%

Following draught proofing and double glazing

- Heat loss: 67kW
- Fabric: 58%
- Ventilation and infiltration: 22%
- Roof: 3%
- Wall: 22%
- Floor: 4%
- Glazing: 58%

Improvements in performance

<table>
<thead>
<tr>
<th></th>
<th>U-value before</th>
<th>U-value after</th>
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<tbody>
<tr>
<td>Walls</td>
<td>1.94</td>
<td>0.54</td>
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<tr>
<td>Roof</td>
<td>1.99</td>
<td>0.41</td>
</tr>
<tr>
<td>Glazing</td>
<td>5.60</td>
<td>3.20</td>
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## Action checklist

**Date of inspection:**

<table>
<thead>
<tr>
<th>Action</th>
<th>Checked</th>
<th>Further action required?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimal or no-cost good housekeeping measures</strong></td>
<td></td>
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<tr>
<td>Provide instructions for door operation and signage to remind occupants to keep doors closed</td>
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<tr>
<td>Keep windows and skylights clean to maximise daylight in the space</td>
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<tr>
<td>Use blinds and curtains to control light and heat penetration in the space</td>
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<tr>
<td><strong>Priority low-cost measures – excellent short-term payback</strong></td>
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<tr>
<td>Check levels of loft insulation. Add loft insulation to uninsulated roof space or top up to 200mm</td>
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<tr>
<td>Check uninsulated wall cavities and insulate cavity walls with blown-in insulant where suitable</td>
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<tr>
<td>Check draught proofing and add draught strips and seals to leaky windows and doors</td>
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<tr>
<td>Check insulation of suspended timber ground floors from below and add insulation where access is easy</td>
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<td></td>
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<tr>
<td>Install door closers to external doors and to internal spaces with differing temperature requirements</td>
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</tr>
<tr>
<td>Action</td>
<td>Checked</td>
<td>Further action required?</td>
<td>Comments</td>
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<tr>
<td>Priority investment measures – worthwhile savings in the medium term when carried out as part of refurbishment</td>
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<tr>
<td>Check internal wall insulation and consider upgrading</td>
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<tr>
<td>Check flat roof insulation and incorporate new insulation as part of any re-roofing work</td>
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<tr>
<td>Fix solar shading devices to air-conditioned areas or consider planting deciduous trees</td>
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<tr>
<td>Long-term investment measures – worth considering when major work is planned</td>
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<tr>
<td>Insulate suspended timber ground floors from above where access is not possible from below</td>
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<tr>
<td>Check quality of windows and replace with draught-proofed double glazing</td>
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<tr>
<td>Check internal wall insulation and apply to existing walls in good condition, where relevant</td>
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<tr>
<td>Add a draught lobby where draughts cause discomfort</td>
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<tr>
<td>Install automatic opening doors to improve comfort and convenience</td>
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<tr>
<td>Take advantage of any refurbishment work by ensuring fabric is improved at the same time</td>
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## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Building envelope</td>
<td>The exterior walls and roof of the building exposed to the weather.</td>
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<tr>
<td>Cold roof or cold deck roof</td>
<td>A type of flat roof where insulation is placed at ceiling level or the insulation is placed at ceiling level with a void ventilated to the outside between the insulation and the deck.</td>
</tr>
<tr>
<td>Energy Performance of Buildings Directive (EPBD)</td>
<td>A legal requirement for all EU countries to ensure, amongst other things, minimum energy standards for buildings and that, when any building is constructed, sold or rented out, a valid energy performance certificate, prepared by a suitably qualified and/or accredited independent expert, is made available to the prospective buyer or tenant.</td>
</tr>
<tr>
<td>Roof deck</td>
<td>The horizontal material (timber, ply, steel or concrete) of a flat roof below the waterproof and insulating layers.</td>
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<tr>
<td>Screed</td>
<td>A levelling finish applied to a floor or stair. This is usually cementitious or gypsum based and may form the base for a better finish.</td>
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<tr>
<td>Thermal bridge</td>
<td>An area of the building fabric where heat is transferred at a much higher rate than the surrounding area, resulting in a cooler area within the building that may cause condensation to form.</td>
</tr>
<tr>
<td>Thermal Mass</td>
<td>The ability of a material to absorb and retain heat. Materials with a high thermal mass operate much like sponge, soaking up heat and releasing it slowly over time.</td>
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</tbody>
</table>
Trickle ventilators. Trickle ventilators are a means of providing natural background ventilation in buildings. Purpose-designed trickle ventilators, sized according to these criteria and incorporated in the overall ventilation strategy of a building, can provide the required background ventilation during the heating season without compromising thermal comfort.

| Vapour control layer or vapour barrier | A material designed to reduce the rate of passage of moisture through a structure thereby reducing the risk of condensation on or within cooler materials behind. |
| Warm roof or warm deck roof | A type of flat roof where insulation is placed between the roof deck and the waterproof covering of a flat roof so that the deck is on the ‘warm’ side of the insulation. |
| Upside down roof | A type of flat roof where the insulation is placed on top of the waterproof covering, so protecting that covering from thermal shock and impact damage. It also means that the waterproof layer can act as a vapour control layer (see above). |
| U-value | The U-value of a building element (wall, window, roof, etc) is an expression of the rate of energy flow (in Watts) for a given surface area (in m²) for a one degree temperature difference between one side of the element and the other (usually inside and outside). U-values are expressed on the Kelvin scale (K), but practically measured in degrees Celsius. The measurement for U-values is expressed as W/m²K. A lower U-value indicates better thermal insulating properties. |
Next steps

There are many easy low and no-cost options to help save money and improve the energy performance of your building through upgrading your building fabric.

Step 1. Understand your energy use
Look at your building and identify the major areas of energy consumption. Check the condition and operation of equipment and monitor the power consumption over, say, one week to obtain a base figure against which energy efficiency improvements can be measured.

Step 2. Identify your opportunities
Walk round and complete an action checklist to identify where building fabric savings can be made. Examine windows, doors, roof spaces, skirting and eaves to see whether they are draughty or damp. This will help you assess the overall condition of your building and identify areas for improvement. A walk round checklist can be based on the example on page 20. Further tips on walk rounds and a generic checklist is available in *Assessing the energy use in your building (CTL172)* – free from the Carbon Trust.

Step 3. Prioritise your actions
Draw up an action plan detailing a schedule of improvements that need to be made and when, along with who will be responsible for them. When planning to update your heating or cooling systems, improve your building fabric first as you may then need less heating or cooling plant. Fit draught stripping to windows and doors where a draught can be felt and install or top up loft insulation in accessible areas.

Step 4. Seek specialist help
It may be possible to implement some building fabric energy saving measures in-house but others may require specialist help. Some building fabric upgrades have long payback periods, but should be considered during a planned building refurbishment. Discuss the more complex or expensive options with a qualified technician.

Step 5. Make the changes and measure the savings
Implement your energy saving actions and measure against original consumption figures. This will assist future management decisions regarding your energy priorities.

Step 6. Continue managing your business for energy efficiency
Enforce policies, systems and procedures to ensure that your organisation operates efficiently and that savings are maintained in the future.
Related publications

The following publications are available from the Carbon Trust:

**Management guides**
- Introduction to energy management (CTV045)
- Energy management (CTG054)
- Energy surveys (CTG055)

**Fact sheets**
- Assessing the energy in your building (CTL172)

**Technology overviews**
- Heating, ventilation and air conditioning (CTV046)
- Lighting (CTV049)
- Motors and drives (CTV048)
- Low temperature hot water boilers (CTV051)
- Steam and high temperature hot water boilers (CTV052)

**Technology guides**
- Heating control (CTG065)
- Air conditioning (CTG005)
- Refrigeration (CTG021)
- Variable speed drives (CTG070)
Further services from the Carbon Trust

The Carbon Trust advises businesses and public sector organisations on their opportunities in a sustainable, low carbon world. We offer a range of information, tools and services including:

Website – Visit us at www.carbontrust.com for our full range of advice and services.

Publications – We have a library of publications detailing energy saving techniques for a range of sectors and technologies.

Case Studies – Our case studies show that it’s often easier and less expensive than you might think to bring about real change.

Carbon Trust Advisory – Delivers strategic and operational advice on sustainable business value to large organisations.

Carbon Trust Certification – Delivers certification and verification services to companies and runs the Carbon Trust Standard and Carbon Reduction Label.

Carbon Trust Implementation – Delivers services to business in support of implementation of energy efficient equipment and energy efficiency financing.
The Carbon Trust is a not-for-profit company with the mission to accelerate the move to a low carbon economy. We provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. By stimulating low carbon action we contribute to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

We help to cut carbon emissions now by:
- providing specialist advice and finance to help organisations cut carbon
- setting standards for carbon reduction.

We reduce potential future carbon emissions by:
- opening markets for low carbon technologies
- leading industry collaborations to commercialise technologies
- investing in early-stage low carbon companies.

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