Retrofitting: A guide for non-residential buildings

Measures you can take to make your building cheaper to run, comply with carbon cutting legislation, and be more comfortable for the occupiers of the building.

BuildingFutures

SUSTAINABILITY EAST
incorporating Climate East

Contents

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Association for the Conservation of Energy

1 How will retrofitting benefit your organisation?

This module has been designed to advise both building owners and tenants how to retrofit their premises to save energy and water and build resilience to climate change impacts, such as overheating in the summer months. It also explains how retrofitting will benefit your business or organisation.

The module guides you through the whole retrofit process, from identifying which retrofit solutions would be suitable for your building to how much they would cost, what you need to do before installing the solutions, what funding is available and whether you need planning permission.

A separate retrofit database is available on the Building Futures website and is there to help you find suppliers and installers of retrofit services in Hertfordshire. This can be found here.

The Retrofit Resource, consisting of the module and database, has been developed with funds and assistance from the Climate Change Skills Fund, which has been managed by Sustainability East on behalf of Improvement East.

What is retrofitting?

All businesses are finding that energy and water costs account for a bigger proportion of their overheads year on year and this trend is set to continue. In fact, Ofgem predicts that energy bills will rise 60% between 2009 and 2016 as energy supplies become more volatile[i].

It is possible to make significant annual energy and water savings, and reduce greenhouse gas emissions through implementing solutions which improve the performance of existing buildings, and which make buildings more resilient to climate change. This process is known as retrofitting.

Benefits of retrofitting

Businesses are now required to reduce their energy consumption in order to comply with Government legislation. By taking action to retrofit your building now, you will put your business/ organisation in a favourable position as energy prices rise and as legislation tackling carbon reduction changes in the future. Retrofitting your building will also contribute to meeting Corporate Social Responsibility (CSR) goals.

The main benefits of retrofitting non-residential buildings are listed below.

Who has to take part in the Carbon Reduction Commitment?
The scheme is compulsory for large organisations using more than 6,000 MWh/year of electricity, which translates to roughly £500,000 in electricity bills. Its aim is to encourage these large organisations to reduce their energy consumption.

Compliance with legislation

The Climate Change Levy (which is added on to your energy bill and is charged per unit of energy that you consume) and, for larger energy users, the Carbon Reduction Commitment and European Union Emissions Trading Scheme are key carbon cutting initiatives. The solutions listed in this module will explain how you can take part in these initiatives, and be prepared for future carbon cutting legislation.

Save money

Retrofitting solutions can save thousands of pounds a year on your energy and water bills[ii]. Government funding initiatives are available to reduce the capital costs of these retrofit solutions. In addition, generating your own energy from renewable energy technologies such as solar panels will reduce fuel costs and can provide a return on investment of up to 7%. This is due to the support of Government incentive schemes such as 'Feed-in Tariffs' and the 'Renewable Heat Incentive'.

Enhancing business reputation

Going green really helps to improve a business's reputation and can contribute towards Corporate Social Responsibility goals. Having an environmental policy and taking steps to retrofit the building that you own or rent can help to demonstrate environmental credentials when tendering for contracts. This can also help you to gain accreditation under schemes such as ISO 14001.

Making your building easier to sell or rent out

With energy bills making a bigger impact on business profitability, energy efficiency is a significant consideration when choosing which building to buy or rent. Energy Performance Certificates (EPCs) are now compulsory when selling or letting a building, so it is therefore now very clear to see how well your building performs. This may influence a potential buyer's/ renter's choice of building.

Doing your bit to stop climate change

Last year, the UK Government became the first in the world to commit to an 80% reduction in carbon emissions by 2050. Scientists say that this will give us at least a chance of avoiding disastrous climate change. To help meet this target the Government will be spending £3 billion a year on initiatives to reduce the UK's carbon emissions.

Business emits half of the UK's carbon dioxide emissions, it is therefore vital that business plays its part in moving to a low carbon economy.

Buildings contribute 40 % to the UK's total carbon dioxide emissions.

Reducing our reliance on energy imports and water resources

In 2011 the UK remained a net importer of energy, continuing the trend set in 2004. Our reliance on imported gas has increased energy inflation significantly above normal inflation. Taking steps to reverse this trend will protect the UK from steep price increases that can have significant impact on businesses' profit margins.

As demand for water grows from housing and employment growth, water will become a scarce commodity, and in turn its price will increase.

2 How to plan your retrofit

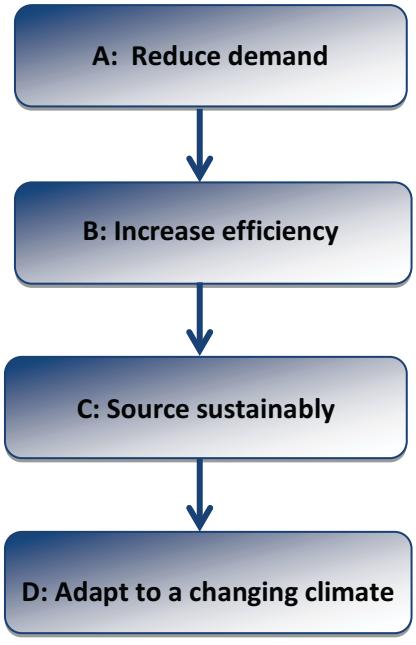
There are many ways in which a building can be retrofitted, this section will help you decide which approach is best for your building, considering its use, performance and available financing.

The ABCs of retrofitting can be used to inform your general approach. The comprehensive step by step guide to planning the retrofit then takes you through the process from choosing appropriate solutions, planning your retrofit, to legal/ procedural matters and lastly how to commission the work.

The ABCs of retrofitting

Successful retrofits follow a simple hierarchy to sustainable energy and water use, which in turn will contribute to adapting your building to climate change impacts. All retrofit solutions are set out in **Section 4**.

To maximise the savings on your energy and water bills for the least amount of capital outlay, undertake retrofitting solutions in the following order:



A. Reduce demand

Before doing anything else you should try to reduce your energy and water demand. This involves free and easy steps such as encouraging occupants to turn off equipment when they are not using it. A full list of free steps you can take to reduce your energy and water demand can be found in **Section 4**.

B. Increase efficiency

Once you have reduced your energy and water demand as far as possible you can then take steps to make your building more energy and water efficient. Focus on your building's largest energy users first, such as lighting if you are in an office. Devices exist which allow you to reduce the energy consumption of your existing equipment, for example motion sensors for lighting. You can also consider upgrading to more energy efficient equipment such as a new boiler.

C. Source sustainably

Only once you have achieved the maximum savings possible from turning off equipment and installing energy efficiency solutions should you consider generating some of your remaining energy demand from renewable energy. Likewise, after you have undertaken all the possible solutions to reduce your water demand you could also think about collecting your rainwater or recycling your water for flushing WCs.

D. Adapt to a changing climate

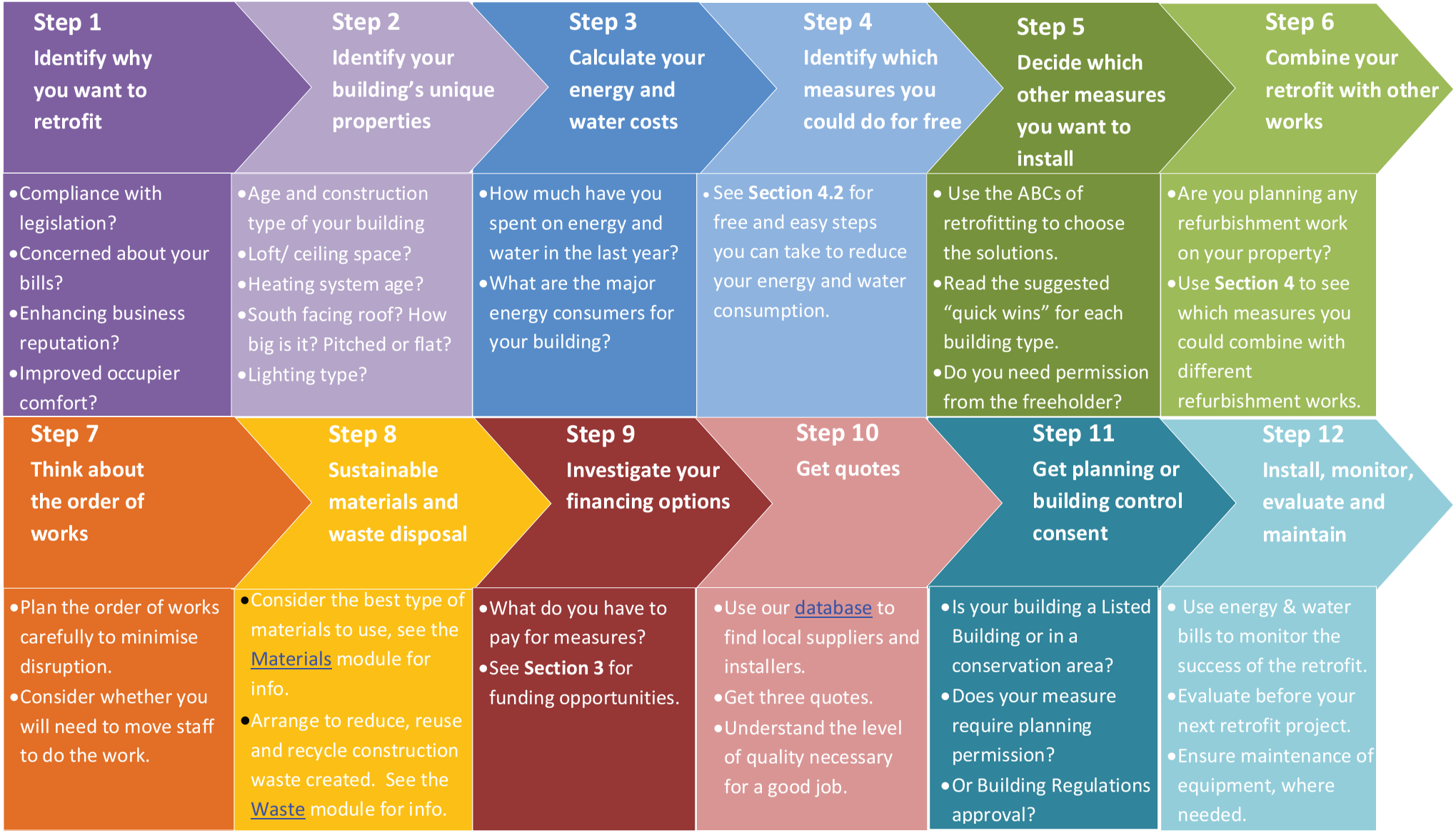
Addressing your energy and water consumption will make immediate improvements to your building and utility bills. However, it is also worthwhile adapting your building to the predicted changes in climate, in order to reduce the need for air conditioning and to prevent flooding. **Section 4** also contains a range of solutions which are available to do this.

With the ABCs of retrofitting in mind, follow the 12 steps in the flow diagram below for a step by step approach to retrofitting your building.

E. Monitoring

Once you have implemented your retrofit solutions, make sure you carry on monitoring your utility bills. This allows you to see how much you are saving and helps you to identify further opportunities to make savings.

A step by step guide to retrofitting



Step 1 Identify why you want to retrofit

What is your main motivation for retrofitting? Your reasons may affect which retrofit solutions you choose to prioritise. For example if you have very high energy bills you may want to identify where you are wasting energy to quickly reduce your bills. However, if you are more concerned about making your building more comfortable for the occupants, draught-proofing may be a priority.

Step 2 Identify your building's unique properties

The things you need to identify in order to assess which solutions are suitable for your building are:

1. The age of your building, and whether it is listed or in a conservation area.
2. Whether the building is supplied by mains gas.
3. What type of roof (e.g. pitched) or ceiling (e.g. suspended) the building has.
4. The type of external walls and any internal walls separating heated from unheated spaces.
5. What type of heating/hot water system you have and how old it is.
6. Whether you have an air conditioning system, and if so its age.
7. The orientation of your roof and how big it is.
8. What sort of lighting you have.
9. Other potential opportunities for renewable energy, water and adaptation solutions, e.g large grounds for ground source heat pumps, permeable paving.

You could also get a professional to survey your building to identify what retrofit solutions you could install. Use the online database to find an energy surveyor near you.

Step 3 Calculate your energy and water costs

Calculating your annual spend on electricity and gas using your bills will help you identify how long it will take to recoup your retrofit investment and keep track of your savings year on year.

Knowing what your yearly bills are will also help you to prioritise what you should tackle first. For example, if your heating bill is much larger than your electricity bill, you may want to focus on solutions to reduce this first.

It is also helpful to identify the largest energy consumers in your building. Commonly these are lighting, heating and equipment. However, these will vary for different building types. For example, for a leisure centre this will be hot water for the swimming pool.

All landlords and property owners are required to provide an Energy Performance Certificate (EPC) when they construct, sell, lease or modify a building. The EPC will identify your yearly energy bills and carbon dioxide emissions. It will also have some recommendations as to what steps you could take to reduce your energy bills.

Step 4 Identify which measures you could do for free

There are lots of things you can do for free which will reduce your energy and water consumption, a full list of these can be seen in **Section 4.2.** These should be implemented before installing any retrofit solutions.

Step 5 Decide which other measures you want to install

With the ABCs of retrofitting in mind, begin to consider what other solutions you could implement. Section 4 provides details of possible retrofitting solutions you could use to make your building more efficient and resilient to climate change. You need to consider whether or not the solution is appropriate for your building type. For example, if you do not own or occupy the top floor of your building then it may not be possible to insulate the roof. The four boxes on the following page identify the likely priority issues and opportunities for four typical commercial buildings.

Once you have reduced your energy and water demand as much as possible through changing staff/occupier behaviour and implementing efficiency solutions, you could consider more sustainable sources of energy and water, for example by installing solar PV panels to generate electricity or rainwater harvesting for flushing.

Off the gas-grid?

It may be worthwhile thinking about renewable energy once you have installed energy efficiency measures, since this is likely to be a very cost effective alternative to oil or electric heating.

Are you at tenant?

The following measures can be installed without permission from your landlord:

- **New light bulbs**
- **Thermal films for windows**
- **Water and energy efficient appliances**
- **Low flow tap inserts**
- **Landscaping for cooling**

Section 4 contains information on the different renewable energy technologies available. It is important to assess the natural resources around your building when thinking about renewable energy generation. For example if you have a big south facing roof then solar panels to generate electricity or hot water may be appropriate. Alternatively if you have a very windy car park in an industrial estate then a small wind turbine might be a good option.

All of these solutions are explained in more detail in **Section 4.**

Quick Wins

Industrial

- **Heating:** 40% of the energy used by industry goes on process heating and drying. This can be reduced by 10% by installing heat recovery systems, ensuring pipes and boilers are insulated, and keeping your boilers well maintained.

- Compressed air: Inefficient systems could waste as much as 30% of the energy supplied to them. Make sure you find leaks and fix them. A 3mm hole could cost more than £700 per year in wasted energy.

Leisure Centre

- **Ventilation and air conditioning**: accounts for around 49% of the building's running costs. Systems need to be managed and maintained or energy consumption can increase by up to 60%.

- **Heating:** accounts for around 15% of the buildings running costs. Use heating controls to ensure that the temperature is managed in all areas. Maintain the boilers and pipework to ensure the system is working as efficiently as possible.

Care Home

- Heating: If your **boiler** is more than 15 years old it should be replaced.

- Hot water: Ensure that the it is set to 60 degrees. Higher temperatures waste energy and can scold.

- Lighting: Ensure that all the **light bulbs** in residents' rooms and communal areas are energy efficient.

- Kitchens: Ensure that kitchen staff turn off equipment such as fryers, grills and hobs when not in use.

Office

- Equipment: accounts for 15% of office energy use and vast savings (up to 70%) can be made by implementing good housekeeping measures (e.g. turning computers onto standby during lunch), regular maintenance, and upgrading to more energy efficient models.

- Heating: can account for up to 60% of office energy use. Ensure that your **boiler** is regularly maintained and, if it is more than 15 years old, consider replacing it with a more efficient model.

Step 6 Combine your retrofit with other works

If you are planning to do any refurbishment works to your building, it may be possible to combine these with some of the retrofit solutions to minimise disruption and costs. Building improvement works that could be undertaken alongside the retrofit solutions are listed under each solution in **Section 4**.

Step 7 Think about the order of works

Once you have decided what solutions to install, it is recommended you then think carefully about the order of work. For example, if you plan to do any redecorating *and* install internal wall insulation, it is best to decorate once the insulation has been installed. Also, identify if any of the tasks could be carried out at the same time, such as installing double-glazing at the same time as having external wall insulation done. Your installer will be able to advise you about this.

For some of the works such as internal wall insulation or new windows it may be necessary to move staff/ occupants from the building whilst the work is being completed. It is important to consider whether the staff could temporarily be accommodated in other parts of the building or at another site. It also may be possible to do the work in stages so only one part of the building is disrupted at one time.

Step 8 Sustainable materials and waste disposal

Often there will be a choice of materials to use for the retrofit work. Consider using more environmentally friendly and longer-lasting options. For information on material choice, please see the Building Futures Materials module here.

Many of the retrofit works will generate waste. Ensure that this is dealt with in a resource efficient and environmentally friendly manner. See the Building Futures Waste module and the Hertfordshire WasteAware website: www.wasteaware.org.uk for guidance.

Step 9 Investigate your financing options

There are a variety of funding sources available, please see the **funding section** for more detail. For each solution in **Section 4** funding opportunities are presented.

Step 10 Get quotes

You can use our online database to find local installers to undertake the work.
For any major works you should obtain three quotes to ensure that you receive the best deal.

It is important that you have a good understanding of each solution, particularly if it involves building work. It is easy for important issues to be overlooked. The installer should have carried out this type of retrofitting work before, and for renewable energy installations they should have Micro-generation Certification Scheme Accreditation. Any works undertaken using **Green Deal** finance should be done by a Green Deal qualified installer.

You should also ensure the installer does not forget about important details such as minimising air leakages from the building fabric and thermal bridging as these can have a significant impact on the success of your retrofit (see the boxes below for more information).

Thermal bridging

Thermal bridges exist where any material which conducts heat, such as metal or masonry, links the interior of the building to the exterior. The building's heat is thus lost to the outside along these thermal bridges.

Thermal bridges tend to exist along intermediate floors, window and door lintels (a horizontal piece of wood or stone above the window or door) and partition walls. They can often be identified because they cause surface condensation, mould growth or damage to the plaster where they meet the internal surface. Ensure that you do not forget to insulate these, and ensure that your contractor deals with any thermal bridges they create through retrofit works, for example by installing double glazed windows.

Preventing air leakage

In **Section 4** you will see how draught-proofing your building will reduce heat loss. Draughts can be found anywhere where the building envelope is punctured, for example, around door and window frames and where pipes and cables enter and leave the building.

Once you have stopped the draughts in your building, you want to make sure that any further retrofit work does not create more draughts. If you have double glazing fitted ensure that your installer takes care to make the windows airtight. Or if you have a new boiler fitted, or solar panels fixed to the roof, ensure that where the pipes/ cables enter the house they are well sealed.

Step 11 Get planning and/or building control consent

Some retrofit solutions (for example, solid wall insulation) are classed as "development" and are therefore subject to planning rules. This means that you would have to apply for **planning permission** in order to install these solutions. **Section 4** highlights the "development" solutions for which you would need to obtain planning permission.

Planning Permission

If your building is **Listed** (Grade I, Grade II or Grade II*) or in a **Conservation Area**, you may not receive planning permission for certain solutions or you may need to use particular solutions that blend with the unique features of your property. You can look on your local authority's website to identify whether you are in a Conservation Area (links to the relevant pages for each authority in Hertfordshire are listed at the **end of this section**). If you are in a Conservation Area or your building is Listed, you should contact the conservation officer at your local planning authority for advice on what you can and cannot do.

Some employment and industrial areas in Hertfordshire benefit from a relaxation in planning restrictions through Local Development Orders. For example, Elstree Way in Borehamwood benefits from a Local Development Order which allows replacement windows and other development without planning permission being required. Look on your local authority website to find out whether this applies to your building.

Building Regulations Approval

Regardless of whether planning permission or Listed Building Consent is needed, each retrofit solution must receive **Building Regulations Approval**. This ensures that certain standards have been met. Approval can be obtained from your Local Authority's Building Control team or an independent Building Control Body. Your installer will often deal with the approval process, and if they are part of a relevant competent person scheme they will be able to certify the work themselves.

For further information speak to your local Building Control team or visit www.planningportal.gov.uk.

If you do not own the freehold for your property you will also need to check the terms of your lease to ensure that you do not need permission from your freeholder. You may need to pay for permission if it is needed.

Step 12 Monitor the results of your retrofit and maintain

It is essential that you monitor the results of your retrofit. This will allow you to track how much energy, water and money you are saving and to ensure that you identify any problems with the commissioning of equipment or materials. If you are planning to roll out the retrofit works in other parts of the building or on other sites it is also important

to monitor the success of the retrofit solutions to know which ones would be worth repeating.

You should calculate your energy consumption prior to the retrofit and compare it to the energy consumption after the retrofit. For solutions that reduce heating demand you will need to wait until a full winter after the retrofit in order to observe the difference in energy use.

Contact your local authority's Planning and Building Control departments for further information, and to find out if your property is within a Conservation Area.

Local Authority	Building Control	Planning	Conservation Areas & Listed Buildings
Broxbourne	Tel: 01992 785510 http://www.broxbourne.gov.uk/environment_and_planning/building_control/building_control_service.aspx	Tel: 01992 785566 http://www.broxbourne.gov.uk/environment_and_planning/planning/development_control.aspx	Tel: 01992 785567 http://www.broxbourne.gov.uk/environment_and_planning/planning_policy/conservation,_green_belt,/conservation_areas.aspx
Dacorum	Tel: 01442 228587 http://www.dacorum.gov.uk/default.aspx?page=1643	Tel: 01442 228000 http://www.dacorum.gov.uk/default.aspx?page=3151	Tel: 01442 228176 http://www.dacorum.gov.uk/default.aspx?page=3119
East Herts	Tel: 01279 655261 http://www.eastherts.gov.uk/index.jsp?articleid=10776	Tel: 01279 655261 http://www.eastherts.gov.uk/index.jsp?articleid=15326	Tel: 01279 655261 http://www.eastherts.gov.uk/index.jsp?articleid=15427
Hertsmere	Tel: 020 8207 7456 http://www.hertsmere.gov.uk/planning/buildingcontrol/	Tel: 020 8207 2277 http://www.hertsmere.gov.uk/planning/developementcontrol/planningpermission.jsp	Tel: 0208 2077583 http://www.hertsmere.gov.uk/planning/conservation/conservationareas.jsp
North Herts	Tel: 01462 474000 http://www.north-herts.gov.uk/index/environment_and_planning/building_control.htm	Tel: 01462 474000 http://www.north-herts.gov.uk/index/environment_and_planning/planning/planning_advice.htm	Tel: 01462 474000 http://www.north-herts.gov.uk/index/environment_and_planning/planning/conservation_and_heritage/conservation_areas.htm
St Albans City & District	Tel: 01727 866100 http://www.stalbans.gov.uk/environment-and-planning/building-control/	Tel: 01727 819344 http://www.stalbans.gov.uk/environment-and-planning/planning/development-management/	Tel: 01727 866100 http://www.stalbans.gov.uk/environment-and-planning/planning/conservation/conservation-areas.aspx
Stevenage	Tel: 01438 242264 http://www.stevenage.gov.uk/planning/building-control/	Te: 01438 242838 http://www.stevenage.gov.uk/planning/planning-permission/	Tel: 01438 242255 http://www.stevenage.gov.uk/planning/other-planning-controls/42327/
Three Rivers	Tel: 01923 278304 http://www.swhertsbc.co.uk/	Tel: 01923 776611 http://www.threerivers.gov.uk/Default.aspx/Web/Do-you-need-Planning-Permission	Tel: 01923 776611 http://www.threerivers.gov.uk/Default.aspx/Web/ConservationAreas
Watford	Tel: 01923 278304 http://www.swhertsbc.co.uk/	Tel: 01923 226400 http://www.watford.gov.uk/ccm/navigation/environment-and-planning/planning/	Tel: 01923 226400 http://www.watford.gov.uk/ccm/navigation/environment-and-planning/conservation/
Welwyn Hatfield	Tel: 01707 357391 http://www.welhat.gov.uk/index.aspx?articleid=659	Tel: 01707 357000 http://www.welhat.gov.uk/index.aspx?articleid=1046	Tel: 01707 357000 http://www.welhat.gov.uk/index.aspx?articleid=1211

3 Funding your retrofit

Introduction

When deciding which retrofit solutions are best to take forward, it is important to consider how you will pay for them and which solutions will lead to the greatest reduction in your energy bill for every pound you spend. Currently, you can either use your own capital or take out a loan to pay for them. In addition, the Feed-in Tariff and the Renewable Heat Incentive schemes will pay you for generating renewable electricity and heat.

At the end of 2012 the Government's Green Deal programme will start, which will allow owners of commercial properties to install energy efficiency solutions and renewable energy technologies at no up-front cost, with the cost being recouped from your energy bill savings.

Is my retrofit solution a good investment?

As you will see in **Section 4**, the costs of the different retrofit solutions range from affordable to very expensive. When deciding which solutions to install it is important to consider the payback period. This is a calculation of how long it will take before the reduction in energy bills created by the retrofit solutions equals the initial cost of the solution.

Payback periods for different retrofit solutions are included in **Section 4**. Please be aware that these are indicative only. Actual payback periods will vary from building to building, depending on the costs of the solution, how much energy you currently use and if you are taking out a loan the rate of interest you are paying. Do also bear in mind that payback periods will become shorter as fuel and electricity prices rise. Solutions that have a long payback period may have other benefits that make them worthwhile, for example solid wall insulation has a long payback period but it will make it significantly easier to heat the building to an adequate temperature for occupants.

With the payback period in mind, you can then assess the best way to finance the solution, taking into account how much capital you have as well as the funding streams and loans available.

Current financing options for retrofit

Energy Efficiency Financing Scheme

The Energy Efficiency Financing scheme was set up by Carbon Trust Implementation Services and Siemens Financial Services to offer leases, loans and other financing options to organisations who wish to install solutions to reduce their energy consumption. The financing is designed so that the repayments are offset against the anticipated energy savings. An energy assessment of your building is required to ensure that this will be the case. Financing can be arranged for sums of £1,000 or more. Go to the Carbon Trust's dedicated website to find out more: www.energyefficiencyfinancing.co.uk.

Enhanced Capital Allowances

The Enhanced Capital Allowance scheme provides businesses with enhanced tax relief for investments in equipment which meets published energy saving criteria. Normal capital allowances allow businesses to claim back a certain percentage of tax relief on equipment bought. The *enhanced* scheme allows businesses to claim 100% tax relief on investments in certain energy saving equipment, against the taxable profits of the period of investment. To find out more, and to see which equipment qualifies, go to http://etl.decc.gov.uk/etl/default.

Feed-in Tariffs

F**eed in Tariffs (FiT)** provide payment for electricity generated from renewable energy technologies, for example, solar photovoltaic panels. The Government will pay you up to 31p for every unit of electricity (kWh) you generate even if you use all the electricity to power your building. The tariff varies depending on the technology and its size. In addition, for every unit of electricity that you generate but do not you use you will also receive around 3p/kWh for the electricity that you export to the national grid (for example, if you have a wind turbine that generates a lot of energy over night when electricity is not being used by your building). Payment is made via your electricity supplier.

The combination of reduced energy bills *and* payment for generating electricity can make renewable energy technologies an attractive investment with rates of return up to 5 %[iii].

The Renewable Heat Incentive

The **Renewable Heat Incentive (RHI)** for non-domestic buildings was launched in November 2011. This works in a similar way to the Feed-in Tariff, except that it is for renewable energy systems that produce heat, such as solar thermal panels, wood-burning boilers or a ground source heat pump. You can earn up to 8p per unit of heat (kWh) that you generate from your renewable energy system. The Renewable Heat Incentive Payment is paid through Ofgem.

Future financing options for retrofit

The Green Deal

I am a landlord, is the Green Deal suitable for me?
Yes! It allows you to install energy efficiency measure without bearing the upfront costs. The loan will be repaid via your tenant's fuel bills. However, you will be responsible for the loan.

The Green Deal is a new Government initiative that will help businesses to finance retrofit, which is due to launch in the autumn of 2012. It provides a framework that will provide loans for energy efficiency solutions, which will be paid back via the electricity bill. Energy efficiency solutions which meet the "Golden Rule" will be eligible. The "Golden Rule" states that the monthly saving in the energy bill resulting from the installed solution must be equal to or greater than the monthly cost of paying back the loan over a standard loan period, e.g. 25 years. The loan stays with the property and the new owners will continue to repay the loan as they will also benefit from the reduced energy bills. It therefore does not matter if you sell your building before the solution has paid for itself.

I am a tenant, can I take advantage of the Green Deal?
Yes! You can ask your landlord to take out the loan, and you will pay it back through your energy bill. From 2016 it will be illegal for the landlord to refuse any request to implement energy efficient measures.

When deciding if the Green Deal is right for you, consider how much capital you have to use and the solution's payback period. The interest paid on a Green Deal loan is likely to be similar to rates paid on a commercial loan. This means that if you have sufficient capital and intend to be in your building long enough for the savings in your energy bills to have paid off the solution, then it would be better to pay using your own capital rather than a Green Deal loan. The Green Deal loan will be worthwhile in situations where you would like to install a solution, but do not have the upfront capital to do so, or if you are not sure if you will be in your building long enough to recoup the cost of the solution from the savings on your energy bill.

Please see the tables on the following pages which summarise the different funding schemes. In the **solutions** section specific funding opportunities for each solution are listed.

Energy efficiency funding

	Funding opportunity	
	Energy Efficiency Financing Scheme	**Green Deal**
Which solutions are applicable?	• Air conditioning • Heating and controls • Heat recovery • Lighting • Solar thermal systems • Refrigeration • Some industrial process technologies	Any solution which meets the "Golden Rule", i.e. the cost of paying back the loan on the solution is lower than the energy bill savings.
Who is eligible?	For businesses who have been trading for at least 36 months. The savings from the solution(s) must be more or equal to the cost of paying back the loan.	All businesses. If you rent your building you can ask your landlord to install the solution(s) (you will pay back the loan through the savings on your energy bill).
How much funding is available?	Minimum £1,000, no maximum.	Depends on whether the solution(s) will pay back in a standard financing period.
What is the deadline?	No deadline.	Due to start in October 2012. No deadline.
Where to get more information	www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/financing/pages/financing.aspx or call 0800 988 3718.	The Carbon Trust website will have information when it becomes available www.carbontrust.co.uk

Renewable energy funding

	Funding opportunity	
	Feed in Tariffs (FiTs)	**Renewable Heat Incentive (RHI)**
Which solutions are applicable?	• Solar photovoltaic panels • Wind turbines • Micro CHP • Anaerobic digestion • Micro-hydro power	• Ground source heat pumps • Biomass boilers • Solar thermal panels
Who is eligible?	All organisations, for systems with a capacity of up to 5MW.	All non-domestic organisations.
How much funding is available?	Varies depending on the technology installed. See the individual technology pages for more detail.	Varies depending on the technology installed. See the individual technology pages for more detail.
What is the deadline?	No deadline, but the later you install the technology the lower the tariff you receive.	No deadline, but the later you install the technology the lower the tariff you receive.
Where to get more information	The Carbon Trust's website (www.carbontrust.co.uk)	The Carbon Trust's website (www.carbontrust.co.uk)

[i] BBC. (2009). (http://news.bbc.co.uk/1/hi/8297882.stm)
[ii] The Carbon Trust (http://www.carbontrust.co.uk/cut-carbon-reduce-costs/reasons/why-save-carbon/pages/why-save-carbon.aspx)
[iii] DECC (2011) *Consultation on Feed in Tariffs for solar PV* (www.energysavingtrust.org.uk%2Fcontent%2Fdownload%2F32568%2F391030%2Fversion%2F1%2Ffile%2FLAHA_FiTs_consultation_briefing_note.pdf&ei=CnYiT7-XJMm70QXltfTOCg&usg=AFQjCNHsxOGttUjUzSODvtmglqsODLTJ_w)

4 Solutions to retrofit your building

There are a wide range of solutions that can be carried out to reduce a building's running costs and improve its performance. On the following pages you will find information on how to reduce energy and water use, renewable energy technologies, and ways to adapt your building to the changing climate.

For each solution the costs of installation, work involved and the potential savings you can expect are examined. Considerations such as planning restrictions, funding opportunities and accreditation schemes are also covered. Use the key below to find the improvement measures you are interested in

Energy saving solutions

Renewable energy solutions

Water saving solutions

Climate change adaptation solutions

For each solution symbols are provided to make it easy to find the information you are looking for. An explanation of what each symbol denotes is provided on the next page.

Financial issues

Provides the typical capital and installation costs of the solution.

Provides the percentage savings on your utility bill that you could achieve each year by installing the solution. This is based on current utility prices. So it is likely that the savings will increase year on year as utility prices rise.

For solutions that save water this shows the amount of water saved.

Indicates for a typical building how long it takes to save as much money from your utility bills as you have spent on buying and installing the solution(s).

Identifies the different funding opportunities there are for each solution. You can click on the name of the funding source for more information.

Planning issues

Many of the retrofit solutions need planning permission or building control approval. Advice is given as to whether permissions might be needed.

If you have a building that is in a Conservation Area or is Listed then different planning rules apply. This symbol provides more information on this for each solution.

Before starting work

It is often possible to reduce the disruption and costs of retrofitting by combining your retrofit solution with other refurbishment works on your building. This section identifies what other refurbishment projects you could do alongside each solution.

For renewable energy solutions and water recycling technologies the expected maintenance requirement is provided.

Other information

Provides the accreditation body you should look for when procuring a contractor or installer to undertake the work.

Provides links to further information.

Reduce your utility bills for free

Before reading about the different retrofit solutions which exist, please see below for some ways of reducing your building's utility bills for free.

Care Home

- Maintain boilers regularly to keep them operating at maximum efficiency. During the summer, turn off any unnecessary boilers.
- Check the hot water temperature is no hotter than it needs to be. 60°C is sufficient.
- Try not to obstruct air ducts and radiators.
- Check the heating programme is appropriate for the home's schedule. For example, communal areas do not need to be heated overnight.
- If you have a zoned heating system, you can set a lower temperature in the kitchen and laundry room than in other areas.
- In the summer try and use windows to cool the building as far as possible, before employing the air conditioning.
- Check that the refrigeration equipment is well maintained, for example, check that no door seals are damaged and ensure that the evaporator coils are not covered by ice.
- Defrost freezers every six months.
- Items that produce heat such as hot plates, ovens and ventilation fans consume large amounts of energy so ensure kitchen equipment is only turned on when it needs to be.
- Fix drips and leaks.
- Ensure staff turn off taps when not in use.
- Try to use microwaves as much as possible for re-heating food.

Leisure Centre

- Review the building's heating schedule to check that it is appropriate, and not on at unnecessary times.
- Check the domestic hot water temperature is no hotter than it needs to be. 60°C is sufficient.
- Prevent water evaporation from pools by ensuring that the surrounding air temperature is a couple of degrees warmer than the water.
- Use pool covers when the pool is not in use to retain heat. Ensure that pool heating schedule is appropriate.
- Keep filters, grilles and vents clean to allow good air flow.
- Maintain boilers regularly to keep them operating at maximum efficiency. During the summer, isolate or turn off any boilers that are not required.
- Fix drips and leaks.

Industrial

- It is possible that your heating's schedule may not be appropriate. Check that it only comes on when necessary.
- Turn the thermostat down by a degree or two. This could lower your energy bill by at least 10 %.
- Ensure that staff keep doors closed as much as possible.
- Use high frequency inverters for fork lift truck charging.
- Check that areas are not artificially lit when there is sufficient daylight.
- Ensure that any skylights are kept clean.
- Switch off equipment when not in use.
- Fix drips and leaks

Office

- ! It is possible that your heating's schedule may not be appropriate. Check that it only comes on when necessary.
- ! Turn the thermostat down by a degree or two. This could lower your energy bill by at least 10 %.
- ! Check the hot water temperature is not too hot. 60°C is sufficient for all domestic uses such as hot taps in the WCs.
- ! Ensure lights are turned off when a room is left unoccupied. A poster campaign or reminder stickers could help to raise awareness amongst staff.
- ! Set photocopiers/printers to be automatically on sleep mode after 5 minutes of not being used during the day. This could save £125 per year per photocopier/ printer.
- ! Put computers on stand-by over lunch and turn them off at the plug at night. This could save around £180 per year per computer.
- ! Ensure that staff turn off taps when not in use.

Energy Saving solutions

Energy saving measures

In line with the ABCs of retrofitting, it is best to first concentrate on measures which reduce the amount of energy you need. This section outlines the following solutions that help reduce your building's energy needs for space heating.

- **Roof insulation**
- **Wall insulation**
- **Draught-proofing**
- **Floor insulation**
- **Replacement windows**
- **Secondary glazing**
- **Replacement doors**

Energy efficiency measures

Once you have reduced your building’s energy needs, the next step is to make it as energy efficient as possible. This section details the following solutions that will help you achieve higher energy efficiencies:

- **Lighting**
- **Lighting controls**
- **Heating and hot water (gas or oil fired)**
- **Ventilation**
- **Appliances**
- **Voltage management**
- **Building management systems**

Case study: B&Q

In 2010 B&Q invested £2.3 million into increasing the efficiency of the lighting across 39 stores. Key initiatives included upgrading the old fluorescent lighting to the more efficient T5 variety and installing daylight sensors which turn off half the lighting once daylight has reached adequate levels. These initiatives have achieved a 20 % reduction in electricity consumption and an annual saving of £900,000.

Case study: Sutton Business Centre

Sutton Business Centre provides office and storage space. They decided to replace their old, inefficient gas boiler with two new "A" rated condensing boilers. They are now set to be saving around £1,000 per year, which means the payback period is only two to three years.

Case study: Woodhouse College

Woodhouse College is a sixth-form college in North London. The college wanted to protect itself against its steeply rising energy costs and so installed a number of energy saving measures which have reduced its energy consumption by 20 %. Hot water pipes were insulated, lighting was upgraded, computers were set to turn off automatically and an energy awareness campaign was run amongst the students. These measures have led to an annual saving of £10.000.

Draught-proofing

What's involved?

Up to 15% of building's heat can be lost through draughts. The different things you can do to reduce this are listed below. Once you have a draught-free building you will be able to make further savings because the building will still be warm at a lower temperature. For more information please see www.carbontrust.co.uk. The costs below are for the materials only, this could be a DIY job or you could pay for a professional draught-proofer to do the work.

	General information	Costs
Windows and skylights	Fit foam, brush or wiper strips around the edges of the window frame to fill the gap. For sash windows you should use brush strips only. Hang heavy curtains to keep the heat in.	Around £20 per window.
Doors	1. Use a letterbox flap or letterbox brush 2. Use a brush or hinged flap draught excluder to prevent draughts coming in through the bottom 3. Fit foam, brush or wiper strips like those used for windows around the edges of the door frame. 4. Buy a purpose-made cover that drops a metal disc over the keyhole	Letterbox draught-excluder: around £10. Brush for bottom of door: around £10. Strips for side of door: around £5. Key-hole cover: around £6.
Floors and skirting boards	Block cracks using filler that you squirt into gaps. You need a filler that will not crack as the floorboards move. Suitable fillers are: • Decorator's caulk • Flexible fillers usually containing silicone • Mastic-type products You can get fillers in different colours to match the floor.	Around £5 per metre.
Pipework	Fill small gaps around pipework with silicon fillers, similar to the fillers used for skirting boards and floorboards. Fill larger gaps with expanding polyurethane foam. This is sprayed into the gap, expands as it dries, and sets hard.	Around £10 per metre.
Draught-Lobby	A lobby can be installed inside the entrance to the building or constructed like a porch outside of the entrance. The lobby prevents heat being lost from within the building when the entrance is used.	Varies depending on size of entrance, and if lobby is inside or outside of entrance.

Roof insulation

What's involved?

Over 20% of a building's heat is lost through the roof. Improving insulation levels in this area can often be cost effective.

Pitched roof insulation: you can install insulation at ceiling level ('cold roof') where insulation is placed between and on top of the joists. Alternatively, you can install insulation at rafter level ('warm roof') where rigid foam boards or dense mineral wool slabs are fixed to the rafters. 'Warm roof' insulation tends to be more expensive, but allows the space in the roof to be converted for use.

Flat roof insulation: flat roofs can be insulated from above or below. A layer of rigid insulation board can be added either on top of the roof's weatherproof layer, directly on top of the timber roof surface with a new weatherproof layer on top of the insulation or below the roof using a stud ceiling.

Suspended ceiling insulation: if there is a thin void between the ceiling and the roof, this can be insulated relatively cheaply and easily by blowing in insulation.

Industrial building roof insulation: the roof can be insulated by spraying insulating material into the interior of the roof. This is a good option for warehouses.

Financial issues

Costs

- Pitched roof: around £14/m^2
- Flat roof: around £17/m^2
- Suspended ceiling: around £10/m^2
- Industrial ceiling: around £30/m^2

Savings

Up to a 10% reduction on the heating bill.

Payback period

- Pitched/ flat roof: 1 to 4 years.
- Suspended ceiling: 3 years.
- Industrial ceiling: 15 years.

Funding

Green Deal.

Before starting

Before starting

- Pitched 'cold roof': ensure that roof space is ventilated and any water piping and ducting are insulated to prevent condensation and freezing.
- Suspended ceiling: ensure any electrical cables in the void will not overheat.

Other work

- Pitched 'cold roof': standalone job.
- Pitched 'warm roof': re-roofing.
- Flat roof: repairing or re-roofing.
- Suspended ceiling: standalone job.
- Industrial ceiling: standalone job.

Planning issues

Permissions

Planning permission not required. Insulation must meet the energy efficiency standards set in the Building Regulations Approved documents.

Conservation or listed

Old buildings need to breathe so you may want to consider using natural materials, such as sheep's wool insulation, to prevent damp.

Other information

Accreditation

National Insulation Association: www.nationalinsulationassociation.org.uk/householder/index.php?page=installer-members

More information

Carbon Trust guide: How to implement roof insulation (CTL064)

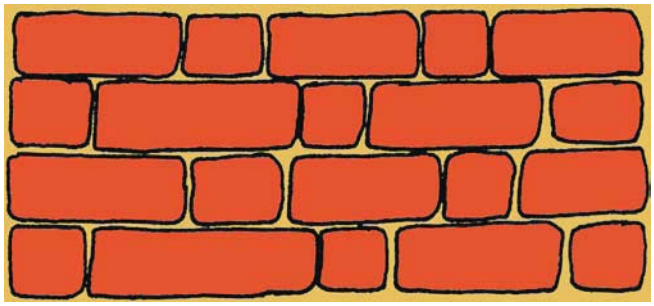
Walls

What type of wall does your building have?

Your building could be of solid wall, cavity wall or a more modern construction such as metal cladding, steel or glass. Insulating the more modern wall types is a very specialised job, so this guide has focussed on solid walls and cavity walls which are insulated differently. First, you need to identify which type you have.

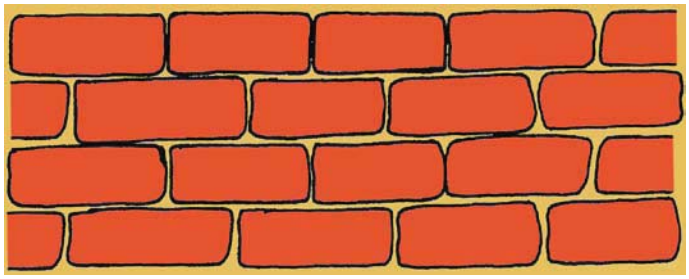
Solid wall

This is where the wall consists of one layer. Layers of bricks in solid walls tend to alternate between the long and short end of the brick, as you can see in the diagram below. Solid walls are generally found in buildings built before the 1920s.



Cavity wall

Cavity walls have a small gap in between two layers of bricks. In cavity walls the bricks are normally laid in a regular pattern as shown below. Cavity walls are generally found in buildings built after 1920. Buildings built after 2001 will already have an insulated cavity. Buildings built before 2001 are likely to have an empty cavity that could be filled.



What type of insulation?

Cavity walls

You will be able to install cavity wall insulation.

Solid walls

If you have solid walls, you can either install insulation to the interior face of the walls or the exterior facade. More information about the two approaches and the advantages and disadvantages of each approach are listed below:

Internal insulation

There are two types of internal insulation: rigid internal insulation and flexible insulated lining, the latter is a more affordable, simple version of the rigid internal insulation which you apply like wall paper.

Advantages	Disadvantages
Will not affect the building's external appearance	More disruptive to install
Requires redecoration of the wall and possibly the room.	Slightly reduces the area of the room
	Not quite as effective as external wall insulation.

External insulation

An insulating board attached to the external face of the wall with render over the top. A cheaper but less effective alternative is to use insulating render.

Advantages	Disadvantages
Less disruptive than internal insulation	Can change the external appearance of the building.
Can improve the external appearance of the walls.	More expensive than internal insulation.
Solves **thermal bridging** problems.	Roof may need to be extended to accommodate extra thickness of walls.

If your building has a different construction from those mentioned above, such as metal clad walls, you will need to speak to a specialist regarding the best way to insulate these.

Cavity wall insulation

Energy saving measures

What's involved?

An installer drills small holes at regular intervals of around one metre in the outside wall of your building. With specially designed equipment, they then blow insulation into the cavity. Once all the insulation is in, the installer fills the holes in the brickwork so they are barely visible.

Financial issues

Costs — Around £4.50 per m^2

Savings — 5% to 15% reduction in heating bill.

Payback period — 4 to 9 years.

Funding — **Green Deal.**

Before starting

Before starting — Any problems with damp in the walls should be remedied before installing the insulation.

Other work — Stand-alone job.

Planning issues

Permissions — Planning permission not required, but it is notifiable building work (the installer will submit a building notice to your local Building Control department).

Conservation or listed — Conservation Area: no issue.

Listed Building: it is unlikely that you will have cavity walls, but if you do you should contact your local planning office before proceeding.

Other information

Accreditation — National Insulation Association: www.nationalinsulationassociation.org.uk/householder/index.php?page=installer-members

Cavity Insulation Guarantee Agency: www.ciga.co.uk/installers.html

More information — www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/building-fabric.aspx

Solid wall insulation - internal

What's involved?

An insulation board is fixed to the inside of the wall, or a stud wall (timber frame over which plasterboard is laid) is built and filled with mineral wool fibre. Internal insulation is more disruptive to install and slightly reduces the area of the room, however it does not affect the appearance of your building and does not require planning permission. Also bear in mind that internal insulation requires redecoration of the wall and possibly the room.

Financial issues

Costs: Around £100 per m^2

Savings: 10% to 30% reduction in heating bills.

Payback period: 15 to 30 years.

Funding:
Green Deal.
Enhanced Capital Allowances.
Energy Efficiency Financing Scheme.

Before starting

Before starting: Any problems with damp in the walls should be remedied before installing the insulation.

You will need to decant staff in order to do this. So you will need to consider whether this is possible. It will take around a week to complete for a floor of an average office building.

Other work: Refurbishing any of the rooms. The radiators, window edges and skirting boards will need to be removed and reapplied after applying the insulation.

Planning issues

Permissions: Planning permission not required.

Insulation must meet the energy efficiency standards set out in the Building Regulations Approved documents.

Conservation or listed: Conservation Area: Planning permission not required.

Listed Building: will need to apply for Building Consent.

Other information

Accreditation: National Insulation Association: www.nationalinsulationassociation.org.uk/householder/index.php?page=installer-members

More information: www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/building-fabric.aspx

Solid wall insulation - external

What's involved?

A layer of insulation material is fixed to the wall, which is then covered with a special type of render (plasterwork) or cladding. The installation of external wall insulation is less disruptive than internal insulation but will change the appearance of your building unless you already have a render finish to your external walls.

Cross-section of external wall insulation (credit: BioRegional)

Financial issues

Costs: Around £175 per m^2

Savings: 10% to 30% reduction in heating bills.

Payback period: 15 to 30 years.

Funding: **Green Deal.**

Before starting

Before starting: Any problems with damp in the walls should be remedied before installing the insulation.

Other work: Re-pointing of brick walls, rendering damaged render, painting the windows, new roof, installation of solar panels (make the most of the scaffolding that is required).

Planning issues

Planning issues: Planning permission required.

Insulation must meet the energy efficiency standards set out in the Building Regulations Approved documents.

Conservation or listed: Conservation Area: You will need to planning permission.

Listed Building: You would need to apply building consent. However, it is unlikely that you would receive consent as the external facade of the building will be altered.

Other information

Accreditation: National Insulation Association:
www.nationalinsulationassociation.org.uk/householder/index.php?page=installer-members

More information: www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/building-fabric.aspx

Floor insulation

What's involved?

Typically 15% of a building's heat is lost through the ground floor.

Most non-residential buildings will have a concrete floor. The existing floor covering must be pulled up and rigid insulation placed between it and the concrete, a layer of chipboard is then put over the insulation before reinstating the floor covering.

Older buildings may have suspended timber floors. Insulation can be laid between the joists (the planks of wood which lie horizontally under the floor boards).


Source: Halfwayupamountain

Financial issues

Costs: Around £40 per m^2

Savings: 2% to 8% reduction in gas bill (depending on how large your ground floor is compared to the rest of your building).

Payback period: More than 25 years.

Funding: **Green Deal.**

Before starting

Before starting: Suspended: ensure that the joists are in good condition before insulating.

Solid: if a rigid layer is being added to an existing concrete floor, doors will need to be trimmed to make room for the raised floor.

Other work: Concrete: replacing upper flooring layer or concrete floor.

Suspended timber: replacing floor covering and rewiring.

Planning issues

Permissions: Planning permission is not required.

Insulation must meet the energy efficiency standards set out in the Building Regulations Approved documents.

Conservation or listed: Many older buildings have air bricks on the outside walls below ground level for ventilation. Ensure that insulation does not block the air bricks.

Other information

Accreditation: National Insulation Association. www.nationalinsulationassociation.org.uk/householder/index.php?page=installer-members

More information: www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/building-fabric.aspx

Replacement windows
Double and triple glazing

Energy saving measures

What's involved?

Double-glazed windows have two sheets of glass with a small gap between them, to create an insulating barrier which stops heat escaping outside. This is sometimes filled with a gas which increases how insulating they are.

Triple-glazed windows have three sheets of glass, but are not always better than double-glazed windows. Other factors such as the frame and the filling of the window will have an impact on performance; to choose the most energy-efficient window look for the British Fenestration Rating Council (BFRC) rating.

Installing new windows will also reduce draughts from ill-fitting windows.


Source: BioRegional

Financial issues

Costs: £150 to £500 per window.

Savings: Around 6% of heating bill.

Payback period: 10 to 30 years.

Funding: No funding available.

Before starting

Before starting: Make sure that the windows have been measured properly to ensure a close fit.

Other work: Standalone job or could be done when refurbishing, redecorating or installing internal wall insulation.

Planning issues

Permissions: Planning permission is required.

The new windows must meet the Building Regulations' insulating requirements.

Conservation or listed: Conservation Area: planning permission is required.

Listed Building: planning permission is required but unlikely to be given.

Other information

Accreditation: Glass & Glazing Federation (GGF).
www.ggf.org.uk/directory/

Fenestration Self Assessment Scheme (FENSA).
www.fensa.co.uk/asp/member_search.asp

More information: www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/building-fabric.aspx

Secondary glazing

What's involved?

There are three types of secondary glazing that can be used to prevent heat loss from your windows:

Pane of glass and frame: fitted inside the window recess. This looks and behaves like a normal window.

Plastic pane: Fixed to the existing window frame using adhesive magnetic strips. This is used in the winter then taken down and stored during summer. This is a cheaper option however, if you wanted to open the window during the winter you would have to remove the pane of plastic first, which is easy to do.

Thermal films: This is similar to a layer of cling film which is fixed to the inside of the window using double sided sticky tape. It is not possible to open the windows when it is in place, so this needs to be installed in the winter and removed in the summer. This is the cheapest option but unlike the plastic which can be used year after year, new thermal film would need to be applied each winter, therefore in the long term this may not be the best investment.

These are all good options if you have a building where double glazing is not permitted.

Financial issues

Costs

- Window & frame: around £500/m^2
- Plastic pane: around £60/m^2
- Thermal film: around £1/m^2

Savings

Around 4% of heating bills.

Payback period

- Window & frame: around 30 years.
- Plastic pane: around 5 years.
- Thermal film: around 2 years.

Funding

No funding available.

Before starting

Before starting

Consider whether staff will need to be put in temporary accommodation before the work commences.

Other work

Standalone job.

Planning issues

Permissions

This is not considered "development" so planning permission is not required.

Building Control approval is also not required.

Conservation or listed

These are good options if you want to retain your existing windows, and for when double glazing is not permitted.

Other information

Accreditation

Glass & Glazing Federation (GGF).
www.ggf.org.uk/directory/

Fenestration Self Assessment Scheme (FENSA).
www.fensa.co.uk/asp/member_search.asp

More information

www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTV014&respos=0&q=building+fabric&o=Rank&od=asc&pn=0&ps=10

Replacement doors

What's involved?

A building's heat can be lost through external doors as well as windows, so it is worth considering upgrading these too.

	General information	Costs	Savings	Payback period
Replacement door	If you have an external door which lets a lot of heat out (it may not fit in the frame very well, or is thin) you could consider replacing it with a well-insulated version. Funding is not currently available for new doors. In a conservation area or for Listed Buildings changing your door is likely to need planning permission. Look for the Fenestration Self Assessment Scheme (FENSA) when choosing a supplier or installer.	Around £300.	Around 1% of heating bill.	Varies between buildings.
Automatic roller door for industrial buildings	Many warehouses, factories and garages have large doorways fitted with roller shutter doors. These doors tend to get left open in busy periods because they are time consuming to open and close. Installing automatically controlled roller doors on heated buildings can reduce heating costs. It may be possible to access a Carbon Trust loan for an automatic roller door. If you already have a roller door then planning permission or Building Control approval would not be needed. More information can be obtained from the Carbon Trust guide: How to implement rapid roll doors (CTL061)	Around £9,000 for a 20m x 5m door.	Around £1,500 (if this reduces the time that the door is open to a 6th of the time it was previously open).	Around 6 years.

Lighting

What's involved?

There are lots of savings to be made by changing your lighting as this is typically one of the biggest energy users in non-residential buildings. However, before spending any money, think about minimising the need for lighting through the following actions:

- Open blinds when they are not needed to reduce glare
- Ensure skylights are kept clean
- Install lighting controls

You could also consider retrofitting sun pipes into your building, which enable daylight to enter through the roof.

Funding for new light *fittings* is available from the **Green Deal**, **Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme**. Building Control Approval or Planning Permission would not be required. For more information see the Carbon Trust's fact sheet: Lighting technology overview (CTV049)

	General information	Costs	Savings	Payback period
Compact Fluorescent Lamp (CFLs) (to replace tungsten filament lamps) 	These use 80 % less energy than a standard incandescent bulb and they can last up to 10 times as long. The colour rendering from these bulbs has significantly improved, so the difference between CFLs and incandescents is now negligible. There are now varieties to suit all types of light fittings.	Around £5 for a 9W CFL (equivalent to a 40W incandescent bulb).	Around £3 per year for each bulb.	Around 2 years.
LEDs (Light Emitting Diode) (good for directional lighting) 	These are even more efficient than CFLs (they use 90 % less energy than an incandescent bulb). They cost more than CFLs but, over the lifetime of the bulb, they will save more money. They last 50 times longer than incandescent bulbs. Because LEDs emit a very bright, direct light, they are best used when replacing down-lighters. In the future it is expected that they will be suitable to replace all types of lighting.	Around £10 (for a 6W LED bulb, equivalent to a 50W halogen bulb).	Around £4 a year (if replacing a 50W halogen down-lighter with a 6W LED).	Around 2 years.
Fluorescent lighting (to replace T12 and T8 lamps)	Old fluorescent T12 and T8 lamps can be upgraded to new T5 lamps (60% more efficient) by replacing both lamps and control gear; it may be necessary to update the optics too.	Around £15 per fitting to convert T12 to T5 light fitting.	Around £50 per year.	1 to 2 years.

Lighting controls

What's involved?

Lighting controls can significantly reduce your energy consumption by ensuring that lights are switched off when they are not needed. Automatic lighting controls fall into three categories:

- Movement sensor: for switching off lights in unoccupied spaces
- Daylight sensor: for switching off lights when there is enough natural daylight
- Time sensitive: for switching off lights outside of opening hours

In buildings without set occupancy hours, time sensitive lighting is unlikely to be successful unless over-ride switches for occupants are easy to locate.

Funding for lighting controls is available from the **Green Deal, Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme**.

Planning permission would not be needed for installing new lighting controls. However, the installation would need to be compliant with the Building Regulations, your installer will submit a building notice to your local planning department.

For more information please see the Carbon Trust's How to Implement Lighting Controls (CTL161) fact sheet.

	General information	Costs	Savings	Payback period
Movement sensor	This turns lighting on and off, depending on whether it senses someone is in the area. This is achieved through a Passive Infra-Red detector. The sensor needs to be sited so that it is not activated by people passing by through to another area that the sensor does not control, e.g. not near a hallway (unless being located in the hallway itself). The system can be designed to turn on and off automatically or just turn off automatically, so that it does not come on if it is not needed.	Around £80 each.	Up to a 30% reduction in lighting related electricity consumption.	Around 2 years.
Daylight sensors	This turns lighting on and off depending on whether there is a sufficient level of natural daylight illuminating the area. The sensor can either detect light levels inside or outside to modulate the artificial lighting.	Around £200 for each sensor.	Up to 20% reduction in lighting related electricity consumption.	1-4 years.
External lighting	LED lamps should be used for all external lighting to minimise energy use. However, to prevent the lights being left on when not required it is important to have motion sensors on the lights.	£15 - £50 per light.	Around 80% reduction in energy for external lighting.	Around 1 year.

Solutions for gas or oil-fired heating

What's involved?

Heating and hot water typically accounts for 50% of a building's energy consumption. However, there a number of steps you can take to reduce the costs of heating and hot water. Funding for heating equipment is available from the **Green Deal, Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme**. When contracting the work, look for an installer who belongs to the Chartered Institute of Plumbing and Heating Engineers (CIPHE).

You should maintain your heating system regularly to ensure that it is running efficiently. It is also important that you do not overheat the building. The following Carbon Trust guide provides appropriate temperatures for different buildings and more information on improving your heating system: Heating, ventilation and air conditioning technology overview (CTV046).

	General information	Costs	Savings	Payback period
Thermostatic control	Thermostats allow you to set the temperature of each heating zone in the building. They turn the heating on until the desired temperature is reached and turn the heating off until the temperature drops. More advanced thermostats are available called optimiser-compensators that learn how long the building takes to warm up and cool down and set the heating to come on accordingly.	Around £300 per thermostat.	8-10% reduction in heating costs.	Around 1 year.
Heating programmer	A full heating and hot water programmer allows you to set different times for the heating and hot water for multiple heating periods in a day.	£300-£500 based on building size.	10-15% reduction in heating costs.	Around 1 year.
Insulate hot water pipes	Insulating material is placed around hot water pipes to prevent heat being lost as the water circulates around the system.	Around £10.	Around £15.	Around 1 year.
Insulate hot water tank	An insulating jacket (at least 70mm thick) is placed around the tank, reducing the amount of heat lost.	Around £15.	Around 6% on heating.	Around 6 months.
Thermostatic Radiator Valves (TRVs)	TRVs allow temperature control of different areas of the building. They fit onto radiators, turning them on until the desired temperature is reached, and then turning them off until the temperature drops.	Around £50 per radiator.	Around a 15% reduction in heating costs.	2-5 years.
Direct flame gas heaters	If you heat your building using direct flame gas heaters it will be worth upgrading these if they are over 15 years old.	Around £20,000 for a new large unit.	Around a 20% reduction in heating.	10-15 years.
Radiator panels	The panel sticks to the wall behind the radiator and reflects heat back into the room instead of being transferred into the wall.	Around £2.50 each.	Around £5 each.	Around 6 months.
New boiler	If your boiler is more than 15 years old it is worth upgrading to a new, A-rated model. If you have a listed building you will need to contact your local planning department before installing a new boiler.	Around £2,500.	10% - 20%, depending on original boiler.	8 to 25 years.

Ventilation

Introduction

If you intend to refurbish your ventilation system, make sure you opt for an energy efficient replacement. Funding for ventilation equipment is available from the **Green Deal, Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme**. Planning permission will not be required. However, Building Regulations Approval is needed and Listed Building Consent may be required.

	General information	Costs	Savings	Payback period
Extract fans with heat recovery	This acts like a regular extract fan but it recovers the heat from the air before it leaves the building. It would not be worthwhile installing this except when you need to replace the existing fan or if you do not already have a fan as the energy savings are not very high.	£350 per fan	2% reduction in heating costs	Heavily dependent on the number of fans
Mechanical ventilation with heat recovery	This acts as a normal mechanical ventilation system, but recovers the heat from the air before it leaves the building.	Variable	Variable	Variable
Variable speed drive for air handling unit fan	For air conditioning systems that ventilate buildings with a variable occupancy variable speed drives can significantly reduce the amount of energy required to run the air conditioning system. They work by varying the speed of the motor that runs the system according to how much air is required, which will depend on occupancy. They are suitable for buildings such as offices, schools, hospitals and leisure centres	£200-£3,000 depending on the number required.	20 % reduction in electricity demand	1 to 5 years

Equipment and appliances

Introduction

Depending on your building type and use, electronic equipment and appliances can consume a significant proportion of your building's total energy consumption. Funding for efficient equipment is available from the **Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme**.

Appliances

When replacing your appliances, aim to get the most energy efficient models possible. If you're buying a domestic item, most of these must now carry the EU Energy rating label (shown on the right), which will guide you in choosing the most energy efficient model.

Look for A-rated appliances, but be aware of the different "A" ratings which exist. As appliances have become more energy efficient since the first labels in 1995, the ratings have changed. For example, an "A++" rated fridge is more efficient than an older "A" rated fridge, so you may need to read the small print to determine which model is best. This also varies between different appliances.

Office equipment

Office equipment may account for 15% of your electricity bill. This is from PCs, monitors, photocopiers and fax machines. Below are some easy ways to reduce the energy consumption of these machines:

- Put things that are infrequently used on sleep or stand-by mode during the day. A photocopier set on sleep mode when not in use can save £125 a year
- If appliances are not in use overnight, switch them off. A computer turned off each night can save £170 per year. Plug-in timers can be used to ensure that equipment is turned off at night
- Minimise lighting in vending machines – it is often possible to remove one of the fluorescent tubes
- When purchasing new equipment look out for energy efficiency labels (shown to the right).

Voltage optimisation

What's involved?

In the UK the voltage varies around the average of 240 V. All electronic appliances are designed to operate at the lower voltages which are sometimes received. A voltage optimisation system takes advantage of this and regulates the incoming voltage to be in the lower range, thus reducing energy consumed by the appliances. All appliances will work as normal, but you will be able to make savings on those which are voltage dependent, for example, mains frequency fluorescent lighting and motors running on low loads.

How to assess if it is right for your building

Installing a voltage optimisation system is worthwhile if your building contains a high proportion of voltage dependent loads, such as mains frequency lighting which you do not intend to upgrade for the next few years, or motors which run on low loads. Calculate what proportion of your equipment is voltage dependent and contact a voltage optimisation provider to identify what savings you could make.

Financial issues

Costs: Varies depending on the size of your building.

Savings: Around 10% saving on electricity bill.

Payback period: Around 3 years.

Funding: **Energy Efficiency Financing Scheme.**
Enhanced Capital Allowances.

Before starting

Before starting: Ensure that voltage optimisation is compatible with your equipment.

Other work: Stand-alone job.

Planning issues

Permissions: Planning permission not required.
The system will need to meet Building Regulation requirements.

Conservation or listed: None.

Other information

Accreditation: Building Controls Industry Association (BCIA).
www.feta.co.uk/membership/memberslist.php

More information: www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTG045&respos=0&q=voltage+optimisation&o=Rank&od=asc&pn=0&ps=10

Building management systems

What's involved?

Building Management Systems (BMS) provide a central control for heating, ventilation, cooling and lighting, according to changing requirements. This ensures that energy is not wasted by two systems (such as heating and air conditioning) competing with each other.

BMS are well suited to larger buildings that have different heating and cooling requirements in different areas. They can also be used to control energy in multi-building sites. However, the cost of BMS for small buildings has reduced in recent years, so if you are replacing your controls it may be worth considering a BMS.

Because BMS provide localised temperature and ventilation control that is adjusted to the temperature outside they will make your building more comfortable. They also monitor how much energy is being used in the building and where, which can help to identify where and how energy can be saved.

Financial issues

£10,000 to £25,000.

10% to 15% of a building's energy bills.

4 to 10 years.

Energy Efficiency Financing Scheme.
Enhanced Capital Allowances.

Before starting

Ensure that your building services are correctly sized for your building as the BMS will not remedy this.

A building management system could be installed alongside the installation or upgrading of any new system such as lighting, heating, ventilation or cooling.

Planning issues

Planning permission is not required. Any installation must comply with the Building Regulations.

Listed buildings will be subject to building restrictions to ensure BMS are visually discreet and will not damage the fabric of the building.

Other information

Building Controls Industry Association (BCIA).

www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTL149&respos=0&q=building+management+system&o=Rank&od=asc&pn=0&ps=10

An introduction to renewable energy solutions

Renewable energy describes energy which is generated from resources which are replenished naturally. Renewable energy technologies which can be used at the building scale are:

- **Solar panels** - photovoltaics for electricity, thermal for hot water
- **Wind turbines** – for electricity
- **Wood-fuelled boilers** – for heating and hot water
- **Heat pumps** - ground, air or water, for heating and hot water

Renewable energy technologies can be expensive to install, but once in they will provide you with free or lower cost energy, and you may be able to earn money from the energy you generate. If your building is off the main gas grid, then a renewable heat measure could be particularly beneficial, since it would remove the reliance on costly oil-fuelled or electric heating.

For larger non-residential buildings combined heat and power systems may also be appropriate. These generally run on natural gas so are not renewable. However, they are an efficient way of generating heat and electricity.

In some situations, there may be the opportunity to connect to a community heating scheme. These are an efficient way of providing heating. If a district heating network exists in your area then you could investigate connecting to it.

Solar thermal

What's involved?


Source: Richard Blanchard

Solar thermal panels are fitted to your roof and generate hot water for your building. They collect energy from the sun and use it to heat up water which is stored in a hot water cylinder. A boiler or immersion heater is used for back-up and to heat the water further if necessary.

There are two types of panels: evacuated tubes and flat plate collectors. Evacuated tubes are generally better performing, however flat plate collectors are sometimes preferred because they are less visually intrusive, are more robust and are cheaper.

The system will produce around 60% of your building's hot water needs. It is important to assess how much hot water your building consumes in the summer to ensure that you size the system to meet that demand only. Over-sizing the system can break the system as it will overheat in the summer. For this reason solar thermal is not suitable for buildings that are not occupied in the summer such as schools for example.

Financial issues

Costs

A system for a small office would use around 4m^2 of roof space, this would cost around £4,000.

Savings

Around £400 per year for the system above. You would also earn an additional £1,055 from the Renewable Heat Incentive.

Payback period

Around 10 years (without Renewable Heat Incentive).

Around 3 years (with Renewable Heat Incentive).

Funding

Green Deal Renewable Heat Incentive:
You will earn 8.5p/kWh for every unit of heat you produce.

Enhanced Capital Allowances.

Energy Efficiency Financing Scheme.

Before starting

Before starting

You need roof space which faces south and is free from shading such as trees or other parts of the roof. Roofs facing south of east or west are also suitable but with reduced output.

The panels can also be fitted to a frame on a flat roof. Not compatible with a combination boiler.

Other work

Heating replacement.

Roof repairs.

Anything that requires scaffolding.

Maintenance

A maintenance visit is required every 5 years, and will cost around £150. A well-maintained solar panel can last over 25 years. The tubes on evacuated tube system may break during this time and will need replacing.

Planning issues

Permissions

Planning permission required.

Must meet standards set out in Building Regulations.

Conservation or listed

Conservation Area: contact your local planning department.

Listed Building: need to apply for Listed Building Consent.

Other information

Accreditation

Product and installation must be certified under the Microgeneration Certification Scheme to receive the RHI.www.microgenerationcertification.org/mcs-consumer/installer-search.php

More information

Carbon Trust: Technology information leaflet: Solar thermal technology: A guide to equipment eligible for Enhanced Capital Allowances (ECA770)

Solar photovoltaic panels

What's involved?

Solar photovoltaic panels generate electricity from sunlight. However, they even generate on cloudy days. The power of the photovoltaic panel is measured in kilowatts peak (kWp) which describes the rate at which it generates electricity at peak performance (full direct sunlight in the summer). The panels come in an array of shapes and sizes. A small office could generate 20% of its electricity with 40m^2 of panels. Most systems are made up of panels that fit on top of an existing roof, but you can also buy solar tiles which are more expensive.


Source: BioRegional

Financial issues

Costs – Around £19,000 (for a small office). For large installations around £2,100 for every kWp (6m^2).

Savings – Around 20% of office's electricity bill.

Payback period – Around 30 years.

Funding – **Green Deal Feed in Tariff.** Current rates are 21p/kWh for all the energy that you generate plus 3p/kWh for any electricity that you export to the grid.

Your building will only be eligible for the FIT if the building EPC is rated D or above.

Before starting

Before starting – You need roof space which faces south and is free from shading (such as trees, satellite dishes and other parts of the roof). Roofs facing south of east to west are also suitable but a lower output will be achieved. Ideally the roof should be sloped at a 30° angle but you can put panels on a flat roof using an A-frame.

Roof needs to be surveyed by a building surveyor to ensure it can carry the additional load.

Other work – Roof repairs.

Any work that requires scaffolding.

Maintenance – A maintenance visit is required every 5 years, and will cost around £150. A well-maintained solar panel could last over 25 years but you may need to replace the inverter every 10 years which would cost around £500/kWp.

Planning issues

Permissions – Planning permission required.

Must gain Building Regulations approval.

Conservation or listed – Conservation Area: contact your local planning department.

Listed Building: need to apply for Listed Building Consent.

Other information

Accreditation – Installation will need to be registered with the Micro-generation Certification Scheme to ensure it qualifies for the Feed in Tariff www.microgenerationcertification.org/mcs-consumer/installer-search.php.

More information – www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/renewables/pages/solar-electricity-photovoltaics.aspx

Small wind turbines

What's involved?


Source: Farm4

Wind turbines use large blades to catch the wind. As they move round, they drive a turbine which generates electricity. The stronger the wind, the more electricity is produced.

There are two types of small scale wind turbine: pole mounted and building mounted. Pole mounted turbines are free standing and are placed in a suitably exposed position. They usually have a capacity of around 6kW. Building mounted turbines are smaller (1kW to 2kW) and fix to the roof. It is not recommended installing building mounted turbines in urban or built up areas due to low and disturbed wind flows. They can also cause disturbance to the building structure due to the vibration caused by the turbine.

Financial issues

Costs: Pole-mounted (6 kW) = £22,500.

Savings: Around £3,200 a year (for a well sited 6kW turbine, including Feed-in Tariff earnings).

Payback period: Around 7 years (6kW turbine).

Funding: **Green Deal Feed in Tariff** (FIT). Currently 28p/kWh for all the electricity that you generate plus 3p/kWh for any electricity that you export to the grid.

Before starting

Before starting: Ensure that your site is windy enough, that there are no obstructions such as tall buildings or trees. You can estimate how windy your site is using this tool from the Carbon Trust:
www.carbontrust.co.uk/emerging-technologies/current-focus-areas/offshore-wind/_layouts/ctassets/aspx/windpowerestimator/windpowerestimatorterms.aspx

Other work: Standalone job.

Maintenance: Maintenance checks required every few years (around £150). A well-maintained turbine should last around 20 years, replacement inverter may be needed which costs ~£1,500.

Planning issues

Permissions: Planning permission required.
Must meet standards set out in Building Regulations and gain Approval.

Conservation or listed: Conservation area: contact your local planning department.
Listed: contact your local planning department.

Other information

Accreditation: Product and installation must be registered with the Micro-generation Certification Scheme to ensure it qualifies for the Feed in Tariff:
www.microgenerationcertification.org/mcs-consumer/installer-search.php

More information:
www.carbontrust.co.uk/emerging-technologies/technology-directory/wind/pages/wind.aspx
www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/feedin_tariff/feedin_tariff.aspx

Woodfuel heating

What's involved?

Wood-fuelled (biomass) heating systems burn wood to create heat. A wood-fuelled boiler provides hot water and central heating. These systems are generally designed to use pellets, wood chip or logs. They can also be designed to use biomass in other forms which may be a by-product on your site, for example, wood cuttings or sawdust. Wood chip is the cheapest fuel, however it is only suitable for larger boilers. Pellet requires the least amount of maintenance but is the most expensive woodfuel.

Financial issues

Costs

Around £250/kW. A small office would need a 20kW boiler.
Pellet cost: around 3.6p/kWh.
Wood chip cost: around 2p/kWh.

Savings

For a small office:

Replacing gas heating: no savings

Replacing electric heating: around £580 a year.

Replacing oil heating: around £280/year.

Payback period

For a small office: 3 to 9 years.

Funding

Renewable Heat Incentive: You receive 7.9p/kWh generated for 15% of the energy you generate and 2p/kWh for all subsequent energy generation.

Enhanced Capital Allowances.

Energy Efficiency Financing Scheme.

Before starting

Before starting

Make sure you have room to store the fuel. You will need to check where you can obtain woodfuel from; only use woodfuels produced in the UK to reduce transport impacts. See www.biomassenergycentre.org.uk/portal/page?_pageid=77,681226&_dad=portal&_schema=PORTAL for local suppliers.

Make sure that the boiler is well-sized to match the heat demand of your building.

Check if your building is in a smoke control area (only certain fuels are permitted in these areas).

Other work

Installing new radiators.

Changing the boiler.

Maintenance

Large systems (over 50kW) will need to have someone on site who can attend to the boiler. For smaller systems an annual maintenance visit is required as well as de-ashing around once a month.

Planning issues

Permissions

Planning permission may be required.

Must comply with Building Regulations and Clean Air Act legislation.

Conservation or listed

Conservation Area: check with your local planning department.

Listed Building: check with your local planning department.

Other information

Accreditation

The product and installation must be certified under the Microgeneration Certification Scheme to receive RHI. www.microgenerationcertification.org/mcs-consumer/installer-search.php

More information

www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTL090&respos=1&q=biomass+&o=Rank&od=asc&pn=0&ps=10

Air source heat pumps

What's involved?


Source: BioRegional

Air source heat pumps absorb heat from the outside air and uses it to provide central heating and/ or hot water. They can also run in reverse to produce cooling. Air source heat pumps are a good option if you currently have electric heating, but if you have gas heating they may not save you any money.

Even when it is cold outside, it can still extract heat from the air. The pump has running costs associated with it because it requires electricity to run. If it performs well then it will produce a lot more heat energy than the electrical energy it uses and so the running costs will be relatively low. Field tests show that a typical pump runs at 220% efficiency.

Financial issues

Costs

£5,000 to £10,000 (for a 5kW to 10 kW system, sufficient for a small office).

Savings

Compared to gas heating: none.

Compared to electric heating: around a 50% reduction in electricity use.

Compared to oil heating: around a 25% reduction in heating bill.

Payback period

No savings.

Electric: 16 to 26 years.

Oil: Over 25 years.

Funding

Enhanced Capital Allowances.

Energy Efficiency Financing Scheme.

Before starting

Before starting

You need a space outside your building where the pump can be fixed to the wall.

Your building must be well insulated and draught-proofed.

They work best with under-floor heating or large radiators.

Other work

Replacing heating system.

Maintenance

Very little maintenance is needed. They should be serviced as often as your gas boiler would be.

Planning issues

Permissions

Planning permission is required.

Must comply with Building Regulations and gain Approval.

Conservation or listed

Conservation Area: contact your local planning department.

Listed Building: contact your local planning department.

Other information

Accreditation

Microgeneration Certification Scheme for the product and the installer: www.microgenerationcertification.org/mcs-consumer/installer-search.php

More information

www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/renewables/pages/air-source-heat-pumps.aspx

Ground source and water source heat pumps

What's involved?


Source: BioRegional

A ground-source heat pump uses pipes which are buried in the ground to extract heat from the ground to provide central heating and/ or hot water. The length of piping needed depends on the size of your system and the amount of heat needed. If space is limited, a vertical borehole can be drilled instead which is more expensive than a horizontal length of pipe. Ground source heating is a good option if you currently have electric heating, but if you have gas heating it may not be a good investment.

The pump has running costs associated with it because it requires electricity to work. If it performs well then it will produce a lot more heat energy than the electrical energy it uses and so the running costs will be relatively low. Field tests show that a typical pump installed in a well-insulated building runs at 300% efficiency. The financial data below is based on this.

If you have a course or body of water such as a river or a lake next to your building you could install a water source heat pump, which runs on a similar principle as a ground-source heat pump.

Financial issues

Costs

Around £15,000 for a 20kW system which would heat a small to medium office.

Savings

Compared to electric heating: around a 66% reduction in heating bill.

Compared to oil heating: around a 35% reduction in heating bill.

Payback period

Replacing gas: No savings.

Replacing electric: around 5 years.

Replacing oil: around 15 years.

Funding

Renewable Heat Incentive: You will receive 4.5p/kWh of heat generated. Paid for 20 years & is index linked.

Enhanced Capital Allowances.

Energy Efficiency Financing Scheme.

Before starting

Before starting

Make sure your building is well insulated and draught-proofed.

Works best with under-floor heating or large radiators.

Other work

Replacing heating system.

Any landscaping works to the grounds of your building.

Maintenance

Very little maintenance is needed. They should be serviced as often as your gas boiler would be.

Planning issues

Permissions

Planning Permission is required.

Must comply with relevant Building Regulations and gain approval. The Environment Agency may need to be informed.

Conservation or listed

Conservation Area and Listed Building: Seek advice from local planning department.

Other information

Accreditation

Product and installation must be certified under the Microgeneration Certification Scheme to receive RHI: www.microgenerationcertification.org/mcs-consumer/installer-search.php

More information

www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/renewables/pages/ground-source-heat-pumps.aspx

Combined heat and power

What's involved?

A combined heat and power (CHP) system generates electricity (usually from natural gas) in an engine and the heat that is produced as a by-product is then utilised for heating one or more buildings. This is more efficient than generating electricity at a power station as the waste heat can be used instead of being released into the atmosphere.


Source: Vital Energi

A combined heat and power system is only suitable for buildings that have a significant and continuous heat demand throughout the day and the year. Buildings such as hospitals, leisure centres that have a swimming pool and large hotels could consider this technology.

CHP can be attached to a district heating network to supply heat to a number of buildings, which can also help balance out the demand for hot water. Electricity can be exported to the grid and electricity and heat sold to other customers.

Financial issues

Costs

Around £1,000 per kWth for larger installations.

Savings

20-40% reduction in heating bills.

Payback period

Dependent on the building type.

Funding

Enhanced Capital Allowances.

Energy Efficiency Financing Scheme.

Renewable Heat Incentive (if fuel is renewable, not for gas CHP).

Before starting

Before starting

You must ensure that you have a good site (constant high heat demand) for a CHP system to ensure that it will work efficiently. You can use the following CHP assessment tool:

http://chp.decc.gov.uk/CHPAssessment/%28S%28eqp4gnibumrox4kiwrbxy2za%29%29/Default.aspx

Other work

Heating replacement.

Maintenance

Regular maintenance is required. A member of staff will need to be trained to look after the system.

Planning issues

Permissions

Planning permission required for the flue.

Must meet standards set out in Building Regulations and gain approval.

Conservation or listed

Conservation Area: contact your local planning department.

Listed Building: need to apply for Listed Building Consent.

Other information

Accreditation

Combined Heat and Power Association:

www.chpa.co.uk/member-directory_42.html

More information

www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/technology-advice/pages/combined-heat-power.aspx

http://chp.decc.gov.uk/cms/tools/

Water saving measures

This section focuses on how you can reduce your water consumption.

In line with the ABCs of retrofitting, the first page explains how to reduce your demand and make your water appliances as efficient as possible. This could help you save money. The second and third pages explain how you can re-use your water. Not only could this save you money, but it will also save on the energy used to treat mains water.

- **Save water**
- **Irrigation**
- **Water re-use**

For further information please see the Building Futures Water and Climate Change Adaptation modules.

Case study: Watford leisure centre

In 2002 Watford leisure centre decided to tackle its water consumption. Measures such as leak detection and repair were implemented and controls to reduce water consumption were installed. The water bills were monitored before and after the measures in order to assess the impact. Together with 16 other council buildings a massive 22 % reduction in water bills was achieved.

Source: Building Futures

Saving water

What's involved?

There are a few relatively easy measures which can be installed to significantly reduce your water consumption. You can also make sure that you are not wasting water from leaking taps or urinals. A 5mm drip from a leaking tap can cost £900 per year. For more information see the Building Futures Water module

	General information	Costs	Savings	Payback period
Aerated taps	Tap aerators can be installed in your taps. These reduce the flow from the tap but because the water is aerated the user will not notice the difference in flow rate.	Low flow tap inserts: around £5 per tap.	Around £13 per tap per year.	Less than 6 months.
Timers and sensors for taps	Taps are often accidently left running when no one is using them. Two types of taps are available that prevent this: • Push-button: Only run for a limited period. • Motion sensor taps: Only run when hands are detected beneath the tap.	Motion sensor: Around £100 per tap. Push-button taps: around £50/ tap.	50% reduction in water use.	Depends how often taps are left running.
Dual flush WCs	If you refurbish the WCs in the building you should opt for those that have two different flush volumes. Dual flush devices can also be retrofitted to WCs. A cheaper option is to put a hippo or save-a-flush device in the cistern which will save a few litres each flush.	Dual flush insert: Around £50/WC. Hippo: free from water company.	Saves around 6 litres of water every flush. This would save over £100 per year.	Less than a year.
Controls for urinals	Urinals that do not have controls will flush 24 hours a day including when the building is unoccupied. Different types of control are available either using movement detection or timers.	Around £100 per urinal.	50-90% reduction in water use for the urinal (saves between £50 and £90 per year).	Around 1 year.
Waterless urinals	Waterless urinals do not need any flushing. The lack of water actually makes the urinals less prone to issues such as: • Odour – often caused by limescale. • Water leaks and flooding.	£90-£300 per urinal.	Around 65,700 litres per year for each urinal (saves around £100/year/ urinal).	Less than 1 year.
Water efficient appliances	When replacing appliances which use water, such as a dishwasher, make sure you choose a model with a good water consumption rating. In addition to energy consumption, **the EU energy symbol** also rates domestic appliances such as dishwashers and washing machines according to their water consumption. Visit www.sust-it.net for information on domestic appliances.			

Irrigation

What's involved?

If your building has grounds which are maintained, you can reduce the amount of mains water used for watering them with the following steps. For more information see the Building Futures Water and Climate Change Adaptation modules.

	General information	Costs	Savings
Water butt  Source: BioRegional	If you have access to a drain pipe from the roof you can save a significant amount of mains water by installing a water butt and using the water collected in this for irrigation. Water butts with lids are available to prevent leaves and other debris contaminating the water.	Around £20 per water butt.	Each year an average roof collects around 85,000 litres of water - enough to fill 450 water butts a year.
Planting to reduce irrigation  Source: Tony Rodd	Choose plants which require less watering, for example those with silver/grey leaves. For a list of drought-resistant plants go to http://apps.rhs.org.uk/advicesearch/profile.aspx?PID=396 Use mulch (a layer of loose material which covers the cultivated soil) to help the soil to retain moisture. When planting, make sure you do so when the plant is still small and that you thoroughly water them, this helps to reduce how much water they need in the longer term.		

Water re-use

What's involved?

Once you have reduced your building's water consumption, you could then consider meeting some of the remaining demand through water re-use. There are two main options to do this, both of which reduce the amount of water drawn from the mains supply, thereby saving you money. In both cases, you would still require mains water for drinking, washing and cooking. For more information see the Building Futures guide on water. Water re-use systems do not require planning permission. However, the system will need to comply with Building Regulations and Building Control approval will need to be sought (your installer should be able to do this for you). Funding is not currently available for water re-use systems.

	General information	Maintenance	Costs	Savings
Rainwater harvesting	Rainwater is collected in a tank (which can be above or under ground). The water is filtered to remove any debris and then is used for both irrigation *and* toilet/urinal flushing. Your building will need a reasonably sized roof to make this worthwhile. To give an indication 100m2 of roof space would be needed for an office with 20 employees. More information is available from: www.wrap.org.uk/media_centre/press_releases/free_advice_to_help.html	The system needs to be inspected regularly to reduce any contamination risk.	£2,500-£4,000 for a small system.	30-50% of water use.
Grey-water recycling	The grey waste water from showers and wash-basins is collected in a tank (which can be above or below ground). Contaminated water from WCs, washing machines, kitchen sinks and dishwashers is not collected. The water is treated so that it can be used again for toilet/urinal flushing and irrigation. More information is available from: www.wrap.org.uk/media_centre/press_releases/free_advice_to_help.html	Regular maintenance from a specialist is required. There should also be periodic sampling of the water to ensure it is not contaminated.	Approximately £3,000 for a small system.	30-50% of water use.

Climate change adaptation solutions

When thinking about making your building more energy and water efficient, it is a good idea to also make it more resilient to the changing climate. This section focuses on the following three areas:

Managing run-off from storms

During heavy rain, flash floods are often caused because roads and areas of hard standing prevent the water from soaking into the ground. Instead the water quickly makes its way into streams and rivers or overwhelms the drainage system, causing floods. Hertfordshire has the highest number of buildings situated in flash flood areas in the east of England.

Preventing overheating and cooling

The average poorly insulated UK building is difficult to heat in the winter; it is also hard to keep cool in the summer. With summer temperatures set to increase, it is worth considering taking steps to help your building remain cool.

The solutions listed will not produce immediate savings in your bills like the energy and water saving solutions. They will, however, help to reduce the risks to your staff, property and operations. For further information please see the Building Futures guide on Climate Change Adaption.

Case study: Grosvenor House

Source: Building Futures

Grosvenor House used to be a run-down office building in Luton. It has now been thoroughly retrofitted with many of the solutions mentioned in this module, including solar PV panels, air source heat pumps, energy efficient lighting, rainwater harvesting systems and water efficient appliances. However, one of the most visible elements of the retrofit project was the installation of a green wall. This has not only helped to keep the building cool in the summer, but it has also benefitted the surrounding environment, such as improving local air quality. Grosvenor House is now an attractive and comfortable place to work. It offers office and event space for local businesses and start-up enterprises.

Managing water run-off from storms

What's involved?

You can protect your building and surrounding buildings from flash floods by taking steps to make it easier for water to soak into the ground.

If a lot of your grounds consist of hard standing, an excellent way of doing this is to replace this with permeable surfaces, such as a gravel bed or grass.

If paving is necessary, for example in a car park, then you could consider using permeable paving. You can also collect the rainwater for useful purposes such as irrigation or for flushing WCs.

General information

Permeable paving

Source: Tomy Lees

Surface flooding can be avoided by installing a surface that is permeable. The rainwater can then permeate down through the layer of paving and gravel, either directly into the ground or into a channel or other water body.

The different types of permeable paving are:

- Gravel
- Interlocking brick pavers (no mortar is used)
- Grass reinforcement to prevent mud

Pollutants in the water (for example oil) are filtered out as the water passes through.

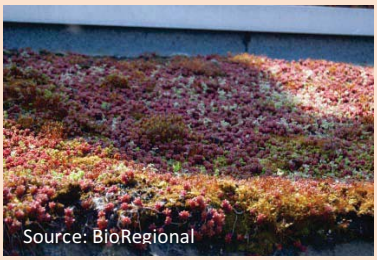
More information is available from:
http://apps.rhs.org.uk/advicesearch/Profile.aspx?pid=738

Planning permission may be required to install paving.

Rainwater harvesting

Collecting rainwater is another great way of reducing surface run-off during storms. For more information please see the **Water Re-use** or **Irrigation** sections.

Green roofs



Source: BioRegional

A roof is made green by placing on top of the roof a medium in which vegetation can grow. A waterproof layer is placed between the roof surface and the growing medium. Green roofs absorb rainwater as it falls on the roof, reducing the amount running directly off the building and into the drains. Green roofs also help to keep the building cool in the summer and warm in the winter, and promote biodiversity.

Before installing a green roof you need to check that your building's roof is strong enough to support the extra weight.
Visit www.thegreenroofcentre.co.uk/green_roof_code for further information.

Sustainable drainage systems

Source: BioRegional

If you are undertaking landscaping at your premises you could consider incorporating sustainable drainage systems, which will not only help to prevent flooding but will also promote biodiversity. Techniques include:

Infiltration trenches: Trenches filled with gravel that store water.

Swales and basins: Depressions in the grass that either direct water to a water-course or store the water temporarily.

Ponds: Ponds can be designed to hold additional water during storms.

Preventing overheating

What's involved?

The first step to prevent overheating in your building is to make the most of any passive ventilation which is available. Ensure that enough windows are open to allow air to flow through the building (for example, by opening windows at opposite sides of the building). You could then consider the following:

	General information	Costs
Louvers or blinds  Source: Marcus Lyon	External louvers or internal blinds allow light into the building but keep out direct sunlight, this helps to reduce overheating on sunny days. They can be adjusted to allow more light in on overcast days. You can also incorporate solar PV cells into your windows to help with shading. Planning permission would be required for the installation of any external shading device. They would also need to comply with the Building Regulations.	Cost of fixed solar shading: around £6,000 for a medium sized office.
Green walls and other planting  Source: BioRegional	Plants are well known for their cooling effect. If your building is surrounded by lots of vegetation, it will remain cooler than a building surrounded by paving, so think about growing plants, in pots if you don't have access to the ground. If your building is in a built up area and planting in this way is not possible, you could consider planting a green wall. You could have a "green façade", where climbing plants (for example, ivy) grow up the wall. Or you could have a "living wall", whereby plants are grown in a medium which is attached to the wall. Living walls require greater maintenance than a "green facade". More information is available from: http://apps.rhs.org.uk/advicesearch/profile.aspx?PID=547	
Landscaping for cooling	A well-designed landscape can reduce your heating and cooling costs. On average, landscaping for energy efficiency provides enough energy savings to return an initial investment in less than 8 years, by including features which create shading such as deciduous trees that prevent overheating in summer, but still allow light to enter the building in the winter.	

Cooling

What's involved?

If your building requires cooling then it is likely that savings can be made by upgrading the existing equipment or replacing it with newer, more efficient technologies. In the meantime, ensure that your current cooling system is well maintained as this will keep it running as efficiently as possible. In particular you should make sure that any condensers for your air conditioning units remain un-obstructed and free from dust.

Energy efficient cooling measures can be funded through **Enhanced Capital Allowances** and the **Energy Efficiency Financing Scheme.**

More information is available from the Carbon Trust Guide: Air conditioning technology guide (CTG005).

Upgrade air conditioning	If you have an old air conditioning unit, consider replacing it with a new, more efficient model. This can result in a 25% reduction in energy demand for cooling. For a central air conditioning system this would payback in 3-5 years. For an individual system the payback period would be 10-20 years. Planning permission for upgrading an air conditioning system would not be required. However, it would need to comply with the Building Regulations.
Chilled beams	Chilled beams are placed just below the surface of a ceiling. Cold water runs through them and, as it does so, it cools the surrounding air which then sinks to the floor. Warm air then rises causing a cycle of convection which keeps the air circulating. Chilled beams use less energy for cooling than air conditioning units or ceiling fans. They can also be used for heating. This solution would not require planning permission. However, the installation would need to comply with building regulations.
Absorption cooling	Absorption chillers use a heat source to provide the energy required to operate the cooling system. This can be an efficient way of providing cooling if it uses heat produced by existing equipment such as computer servers or an industrial process. More information is available from the **Carbon Trust Guide: An introduction to absorption cooling (GPG256)** (http://www.carbontrust.co.uk/publications/pages/publicationdetail.aspx?id=ADDo01). This solution would not require planning permission unless a flue is needed. However, the installation would need to comply with Building Regulations.