Section 1.2

Buildings and Energy

Buildings and Energy

Our lives depend on energy...

We use energy to do just about everything in modern society: to go to work and travel; to operate heavy machinery for industry; to heat our homes and to power the increasing number of gadgets and appliances that life seems to demand.

The European Union and USA account for 12% of the world's population, but together they consume 40% of the world's energy. A large amount of this energy is wasted because it is not used efficiently. Of even greater significance is that some developing countries are rapidly increasing their own energy consumption at a time when the European Union is committed to increasing both energy efficiency and the generation of renewable energy.

This represents a real challenge because most of our energy currently comes from burning fossil fuels like coal, oil and gas. We're already using oil and gas faster than new reserves are being discovered, and these reserves are limited.

However, the main issue is the dramatic global rise of harmful carbon dioxide (CO_2) emissions caused by our use of fossil fuels. Emissions of CO_2 are widely regarded as the cause of global warming and climate change. So not only are conventional sources of fuel running out, but if we continue to use them at the current level, we could cause irreversible damage to our environment.

...so we need to make our energy consumption more sustainable

Sustainability focuses on providing the best outcomes for both the human and natural environments now, and into the indefinite future. Greater energy efficiency is a big part of sustainability, because it means we can reduce our dependence on fossil fuels and therefore reduce CO_2 emissions.

The European Union is committed to a reduction in CO_2 emissions of 20% by 2020 and the UK has an extended target of a 60% reduction by 2050. Reducing energy consumption in buildings is vital to achieving this target. There are a number of solutions, but they involve many different organisations and people working together – including Government, industry, families and individuals.

We must reduce our dependence on fossil fuels by generating electricity from renewable sources like solar and wind power. We must use the available fossil fuels more efficiently with cleaner technology like carbon capture.

However, our most important action must be to reduce the amount of energy we personally use through greater energy efficiency. Saving energy is the most sustainable way of reducing our consumption because it reduces the amount of energy we need to produce.

Buildings 40%

Transport 32%

Industry 28%

Breakdown of energy consumption by sector

Insulation in buildings is the easiest and most cost effective way to save energy

Buildings account for 40% of our energy consumption. A great deal of this energy is expended through heating and cooling. All buildings can have their energy efficiency significantly improved with insulation. It is fast to install and performs for the life of a building without a requirement for maintenance. Therefore, in the drive to reduce carbon emissions, regulators and designers are increasingly turning to insulation.

Some typical insulation products are shown below.

Insulation types pages 56-59

with ECOSE® TECHNOLOGY

Knauf Insulation mineral wool products with ECOSE® Technology benefit from a formaldehyde-free binder made from rapidly renewable bio-based materials instead of petroleum-based chemicals which is up to 70% less energy intensive. The technology has been developed for Knauf Insulation's glass and rock mineral wool products, enhancing their environmental credentials without affecting the thermal, acoustic or fire performance. Insulation products made with ECOSE Technology contain no dye or artificial colours – the colour is completely natural.

Earthwool® and Supafil® glass mineral wool

The world's most popular and widely used energy saving and acoustic insulation. Being made using recycled bottles, it's highly sustainable.

Earthwool® and Rocksilk® rock mineral wool

Made from volcanic rock, rock mineral wool has excellent fire, thermal and acoustic properties, and is ideal for specialist fire protection.

Polyfoam® ECO extruded polystyrene (XPS)

Made from polystyrene that is extruded into rigid foam boards, this type of insulation is ideal in applications where high compressive strength is required.

Building design ...the past

The design of buildings has evolved over time but the function of buildings has remained remarkably constant: the provision of shelter, safety and warmth. In recent years, however, the comfort level expected by occupants of buildings has become more demanding.

In the quest for higher comfort levels in buildings, most designers have been using 'mass produced' building materials and integrating energy supply (i.e. electricity and gas) distributed from a centralised power source. As a result, the environmental impact from human habitation in buildings has increased dramatically over the last 50 years.

Regulators now recognise the requirement for more sustainable building and energy generation. Consequently, Building Regulations are changing rapidly. In the UK, the proposed changes to Building Regulations between now and 2016 will require more improvements to energy efficiency, the use of renewable energy and the use of sustainable materials than any other period in history.

The objective is to increase comfort levels in buildings whilst reducing the environmental impact from both constructing and living in buildings.

Year 500 1000 1500 1900

2012

Party wall thermal bypass recognised in Building Regulations for new buildings.

2010

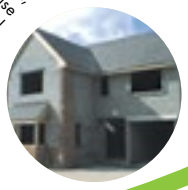
Knauf Insulation is the first company to receive Eurofins Gold Air Quality Award for insulation products.

2009

Knauf Insulation pioneer the use of ECOSE® Technology in their glass and rock mineral wool insulation products, a revolution in the way in which insulation is manufactured, with even better environmental credentials.

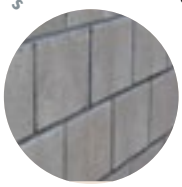
Modern methods of construction

Modern construction techniques and methods, coupled with knowledge of need to minimise climate change, propels construction toward maximum thermal and acoustic efficiency, along with minimum energy and CO_2 emissions.



1950's

Aircrete blocks.

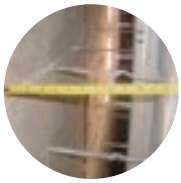


1952

Glass mineral wool insulation introduced.

1930's

Cavity wall construction begins on large scale.



Now:

we must reduce the environmental impact of buildings by increasing energy efficiency and using sustainable materials and renewable energy...

Key

Expected comfort level inside buildings

Environmental impact from constructing and living in buildings

2012 2016

Building design... the future

The terms 'passive housing', 'low carbon housing', 'low energy building' and 'green building' are now frequently used by designers and architects. This reflects the rapid changes that are occurring in the way buildings are being designed and constructed to reduce environmental impact. This book includes solutions for zero carbon buildings, constructed from sustainable materials with low embodied energy - the buildings of the future.

Diagrams and drawings in this book typically show a range of solutions for buildings incorporating systems to maximise energy efficiency.

The Code for Sustainable Homes (CSH)

Within the residential sector, the Code for Sustainable Homes integrates higher sustainability performance standards within the design of the house, which will mean that 'green' buildings become standard practice. The Code will reduce the environmental impact of the construction sector and form the basis for future Building Regulations in relation to CO_2 emissions and energy use in homes.

The UK Government is also considering applying similar stipulations to the non residential buildings sector.

Zero carbon

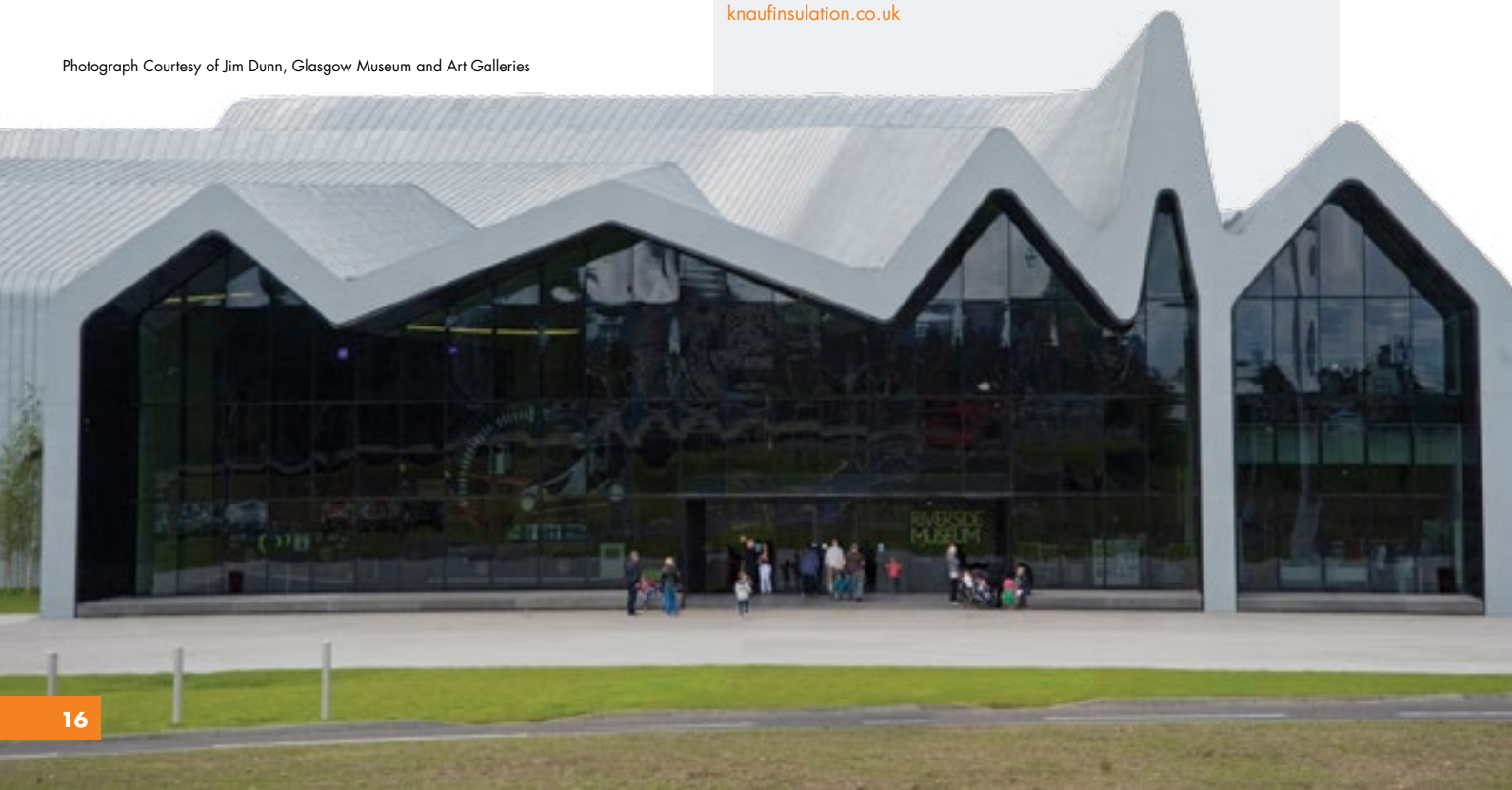
The Government's aim is that newly built dwellings should be 'zero carbon' (zero net emissions from all energy use) as standard from 2016. Understandably, increased energy efficiency is a vital part of the Code, but there are a range of other design considerations, including 'water', 'materials', 'waste' and the 'health and well-being of occupants'. The result will be a significant reduction in CO_2 emissions to help combat global warming and climate change.

Glasgow Museum of Transport

The key to Knauf Insulation's products being specified on this project was its ability to provide in-depth technical support, including complex three dimensional heat flow modelling calculations. This allowed Knauf Insulation to produce a solution that met all of the insulation requirements by using a double layer of 100mm Earthwool FactoryClad Roll 32. This is a flexible, lightweight roll of resilient glass mineral wool with exceptionally high tear strength and a thermal conductivity of just 0.032 W/mK.

Read more: Glasgow Museum of Transport
knaufinsulation.co.uk

Photograph Courtesy of Jim Dunn, Glasgow Museum and Art Galleries



Denby Dale Passivhaus

Excellent performing insulation is obviously fundamental to Passivhaus construction and the Denby Dale house has 300mm Earthwool DriTherm 32 Ultimate cavity slabs in the walls, 500mm Earthwool® CarbonZero Loft Roll 44 in the roof void (both of which incorporate ECOSE® Technology) along with 225mm of high-performing Polyfoam® Floorboard Standard insulation in the floor.

Read more: Denby Dale Passivhaus
knaufinsulation.co.uk

Low Energy House Refurb - Doncaster

Knauf Insulation undertook a project to internally insulate an 1890's Victorian mid terrace property to Part L 2006 energy standards. The aim was to install systems that could be undertaken by any competent builder to achieve an effective and efficient low energy refurbishment at a modest marginal cost over a normal refurbishment. The attractive brick frontage made the property less suitable for external wall insulation (EWI) but ideal for Knauf Insulation's ThermoShell Internal Wall Insulation (IWI) system using their patented EcoStud as a replacement for the more traditional timber stud framing.

Read more: Low Energy Whole House Refurbishment
knaufinsulation.co.uk

Knauf Insulation PPD Laboratory - St Helens

The ThermoShell EWI system is an ideal solution for upgrading existing solid wall constructions and delivering high levels of thermal performance.

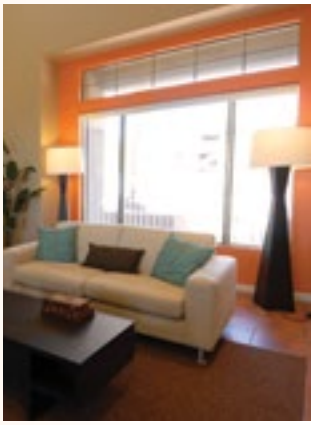
The system gives developers and installers a solution for improving thermal efficiency and can be designed to meet the particular requirements of each project.

Read more: Knauf Insulation PPD Laboratory
knaufinsulation.co.uk

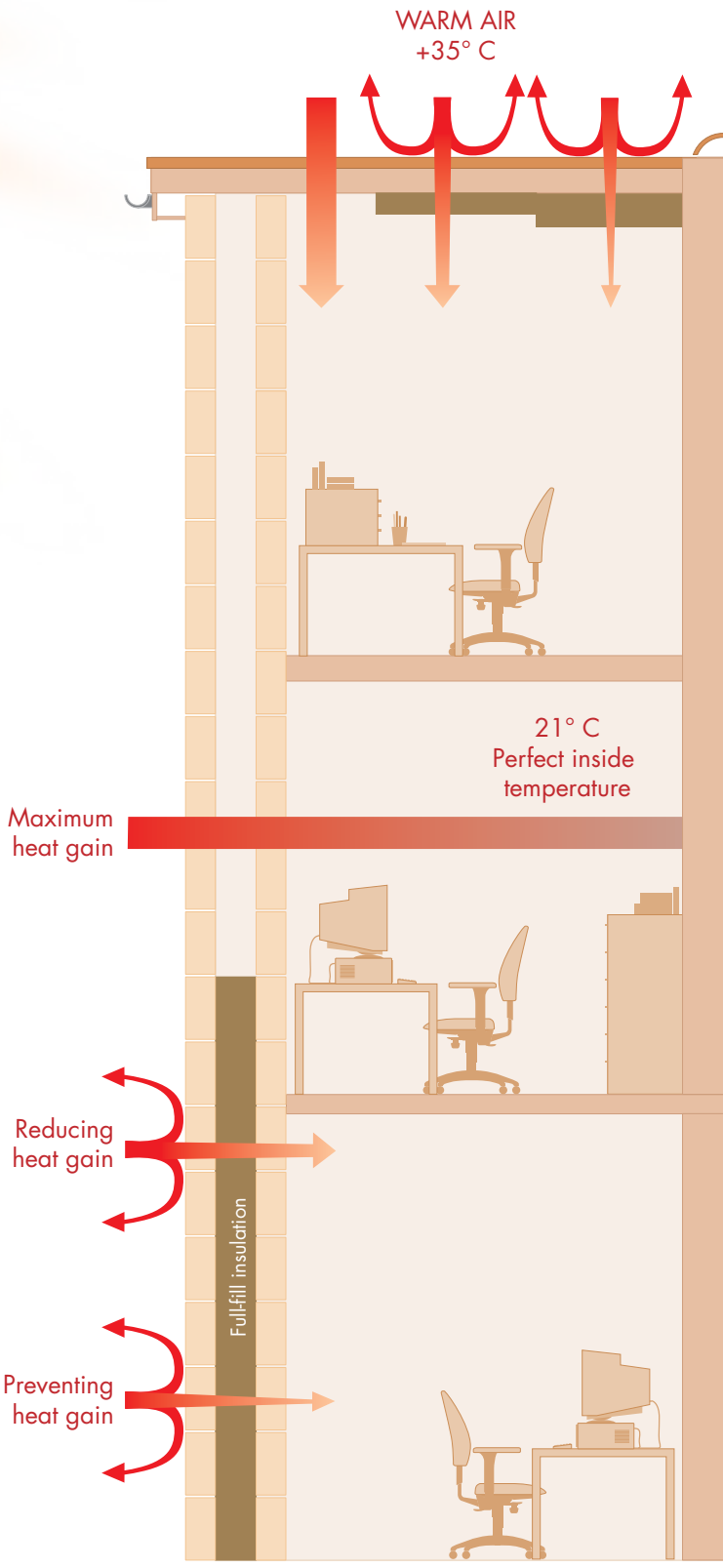
Energy efficiency: insulation is the key

The energy saving properties of insulation keeps buildings warm in winter and cool in summer.

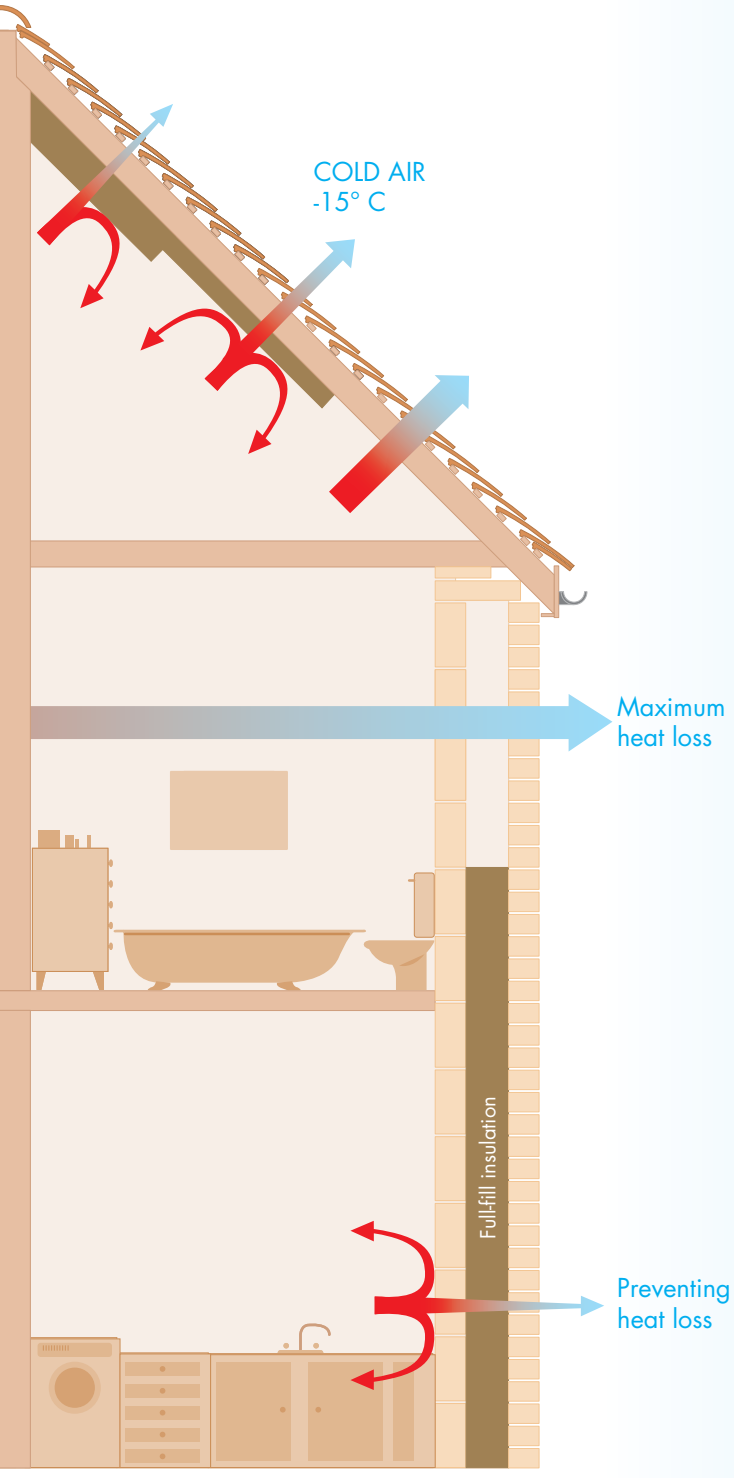
The bigger the temperature difference between the inside and outside of a building, the faster the building will lose heat in winter and gain heat in summer. Insulation helps maintain a stable inside temperature by slowing heat transfer by convection, conduction and radiation.



Generally speaking, the larger the temperature difference between the inside and the outside of a building, the thicker the layer of insulation needs to be to reduce heat flow.



Non-residential



Residential

Insulation is critical across all sectors

A vast amount of energy is lost through the fabric of the UK`s buildings. Insulation incorporated into fabric can make a profound contribution to the building's long term energy saving.

Increasingly, designers have the responsibility of improving a building's energy efficiency by designing an envelope to achieve maximum thermal performance according to building function and activity. Different sectors have different requirements - for example, balancing heat retention **and** cooling in public and commercial buildings is often a key consideration, whereas for residential buildings, higher insulation and heat retention alone have a direct impact on the carbon emissions (and bills) associated with heating, and is the overriding design parameter.

The climate in Sweden is much colder than in most of Europe, but the average energy consumption of their buildings is much lower, mainly due to thicker insulation.

Saving costs by saving energy – Residential

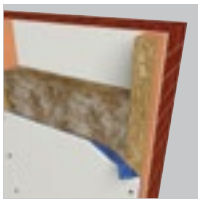
In a typical uninsulated home, approximately half of the heat generated internally is lost through the walls and roof, making them the two biggest causes of heat loss. Insulating these two elements is the most efficient and cost effective way of reducing fuel bills.

Walls

Over 30% of the heat lost from an un-insulated home is lost through un-insulated external walls.

Cavity wall insulation is a highly effective and efficient way to significantly reduce the amount of energy needed to heat a home: the average house could save around £135 a year on fuel bills by installing cavity wall insulation. Many existing houses can easily have their cavity walls upgraded. A three bedroom semi-detached house, therefore could save up to 0.55 tonnes of CO_2 a year.

External wall insulation is more expensive than cavity wall insulation but it could save around £475 a year on energy bills. It has the added benefit of providing a new external appearance. A three bedroom semi-detached house, therefore could save up to 1.9 tonnes of CO_2 a year.



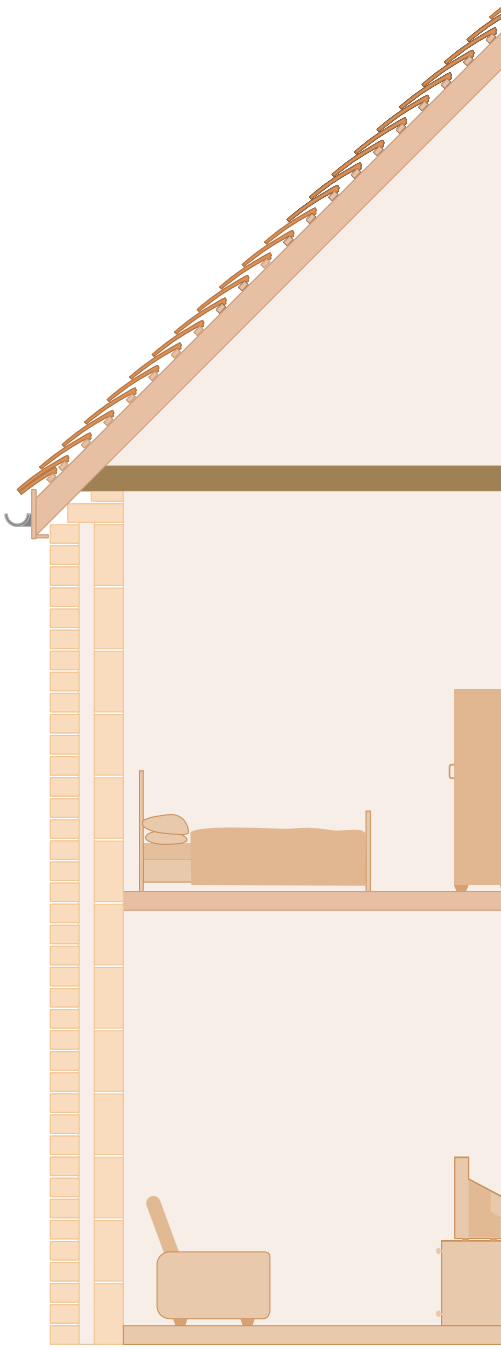
Internal wall insulation is an economical option and could save around £445 a year on energy bills. A three bedroom semi-detached house could save up to 1.8 tonnes of CO_2 a year.

Table 1 - Wall insulation costs, savings and paybacks

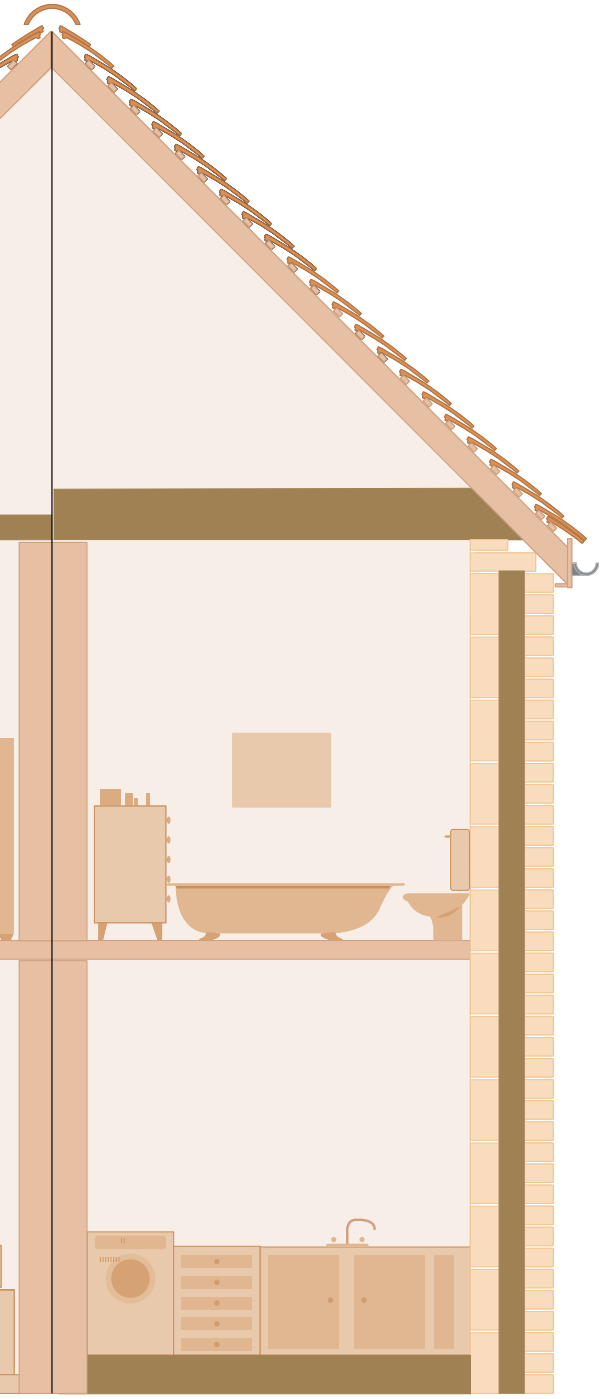
Measure	Annual saving per year (£)	Installed cost (£)	Payback time	CO_2 saving per year
Cavity wall insulation	Up to £135	£100 - £350	Less than a year to 3 years	Around 550kg
External wall insulation	Around £475	£9,400 to £13,000	-	1.9 tonnes
Internal wall insulation	Around £445	£5,500 to £8,500	-	1.8 tonnes

Source: The Energy Saving Trust, October 2011 (www.energysavingtrust.org.uk)

All costs are approximate and exclude VAT



Typical minimally insulated old housing stock



Insulation to Part L1A 2010

Lofts

A house with no loft insulation having had the recommended thickness of glass mineral wool loft insulation (270mm) installed, will not only save up to £175 worth of heating bills per year but also nearly 720kg of CO_2 each year.

The lofts in many houses already have some loft insulation in place, but not the recommended thickness. When a loft with 100mm of glass mineral wool loft insulation is increased to 270mm, it pays for itself in 2 to 4 years* and the annual saving in CO_2 is 110kg.

If everyone in the UK installed 270mm loft insulation, we could save nearly £500 million – and 2.7 million tonnes of carbon dioxide every year, the equivalent of taking nearly 100,000 cars off the road.

* Estimated cost of loft top up, if work is carried out under an energy company subsidised scheme or DIY installation.

Table 2 - Loft insulation costs, savings and paybacks (professional versus DIY)

Loft insulation	0-270mm	100-270mm
Annual saving per year	Up to £175	£25
Professionally installed cost	£100 - £350	£100 - £350
Professionally installed payback	Up to 2 years	From 4 years
DIY cost	£50 to £350	£50 - £350
DIY payback	Up to 2 years	From 2 years
CO_2 saving per year	Around 720kg	Around 110kg

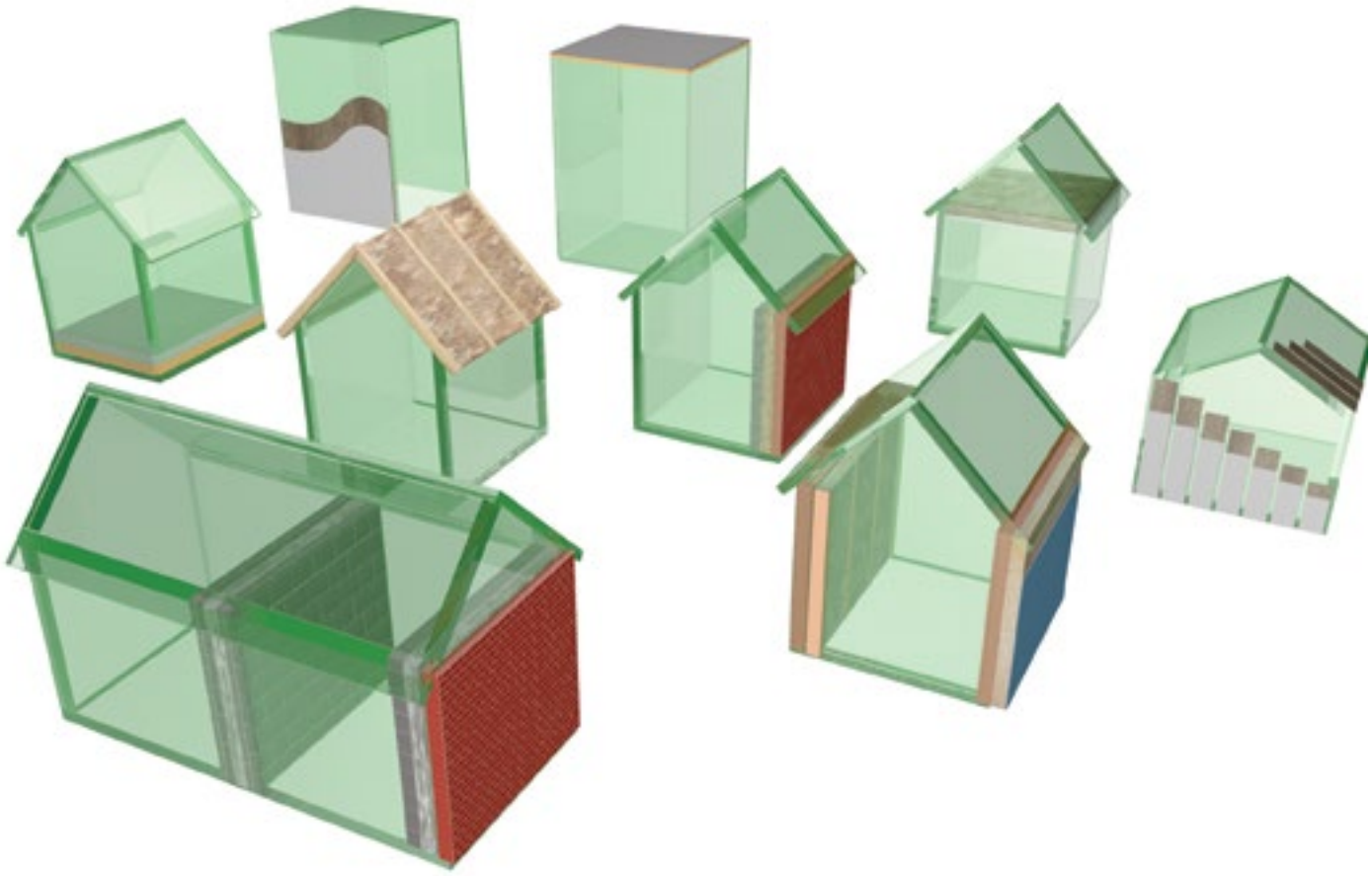
Source: The Energy Saving Trust, October 2011 (www.energysavingtrust.org.uk)

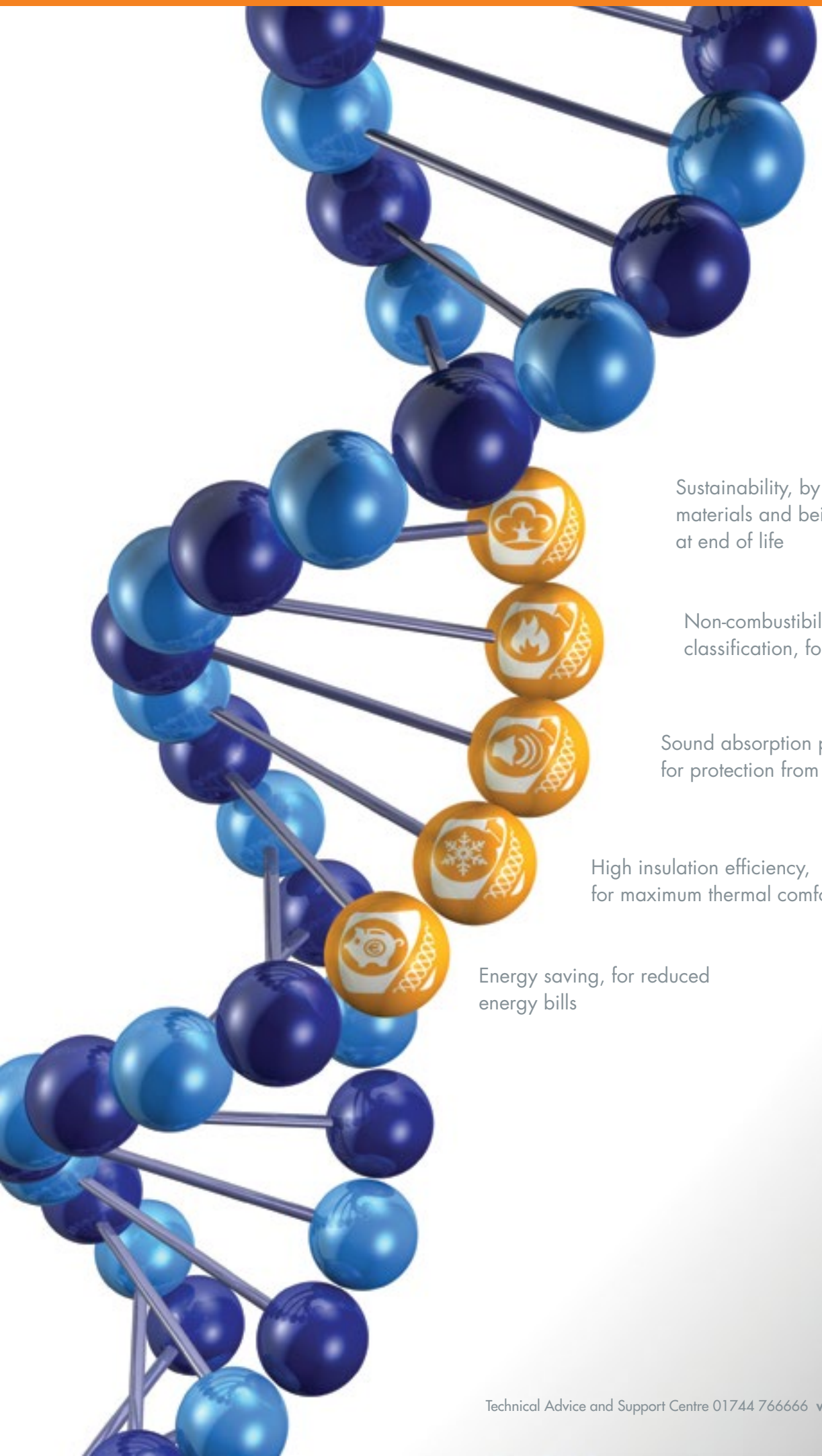
All costs are approximate and exclude VAT

Insulation – part of a building's DNA

Insulation has played a vital part in the evolution of buildings and is an essential building component, especially as energy prices increase.

It not only offers excellent opportunities for thermal insulation (along with the benefits of energy saving, cost saving and combating climate change) but contributes to acoustic improvement and fire safety, enhancing the quality of life, fitness for purpose and performance of buildings in which it is installed.





Sustainability, by using recycled materials and being recyclable at end of life

Non-combustibility and A1 fire classification, for enhanced safety

Sound absorption properties, for protection from noise

High insulation efficiency, for maximum thermal comfort

Energy saving, for reduced energy bills

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