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GET READY

UPGRADE YOUR HOME – INSULATION

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Printing:
Printing Company, Inc. Pty Ltd Plc.
12, Typographer Grove
12345 Colorswatchtown
Country

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FOREWORD

Energy consumption in buildings represents approximately 40 percent of energy use in the European Union. It is therefore essential to retrofit existing inefficient buildings using state-of-the-art technologies. Significant energy and financial savings can be achieved by such refurbishment, which will also reduce CO_2 emissions.

This brochure provides information for consumers on the advantages of insulating the different elements of their homes, including advice on materials and technical solutions. A checklist is included at the end to help readers assess how well their own homes are insulated.

1. While there are strict regulations governing the design and construction of new buildings in order to ensure their resource efficiency, the renovation of old buildings is also an ideal opportunity to improve energy performance. One of the most cost-effective solutions is insulation.
2. If you live in an old building it is worth analysing the amount of heat being lost and exploring ways to save energy and cut your fuel bills.
3. You can often achieve substantial energy and financial savings in the long term by making a small investment in insulating your home in line with high energy-efficiency standards.

BACKGROUND INFORMATION

Step 1. Analyse the amount of heat being lost from your home

Heat energy flows from warmer to cooler objects and areas. Solar radiation, or sunshine, is an essential factor in determining heat flow in a building structure: when it is warm outside heat flows into the building, but when it is cold outside the flow is reversed.

We heat our homes in order to maintain a constant interior temperature however cold it is outside, and this requires energy. The bigger the difference between the exterior and interior temperatures, the greater the heat loss, thus more energy is needed to heat the building.

Before retrofitting you will need to assess the heat loss from your home via the various elements and gaps in the building structure.

Heat loss through building elements such as windows, walls, roofs and floors depends on the U value of these elements. The U value is an energy efficiency indicator. It refers to the heat transmission coefficient (thermal transmittance) of a structure, describing the heat flow through the building element in watts per square metre at a temperature difference of one degree (K): W/m^2K . The higher the U value the lower its thermal resistance, therefore the more heat/energy passes through the building element.

Heat may be lost from a building in many ways. The illustration below shows the relative proportion of heat lost via the main features of a typical home.

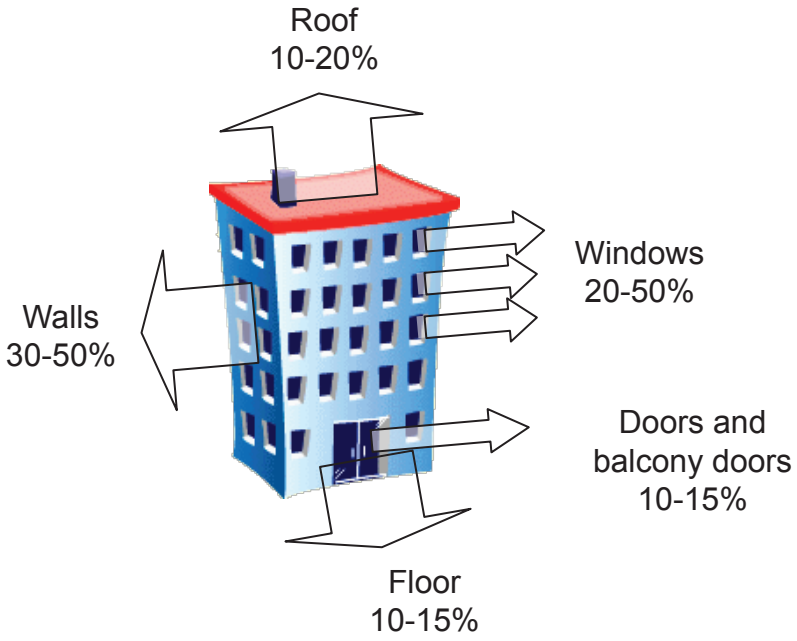

Fig. 1. *Source:* Application of small-scale renewable energy sources to the home to prevent climate change (www.kyotoinhome.info, 2006).

When analysing heat loss, so-called thermal bridges can be identified. These are areas in the building envelope that have a higher heat flow than their surrounding. A classic thermal bridge is an overhanging balcony joist through an insulated outer wall. Another would be a ceiling made of concrete and not insulated from outside. In addition to significantly higher heat loss, thermal bridges are also characterised by lower interior surface temperatures, which, in the worst case, can result in high levels of humidity in areas of the construction.

A significant amount of heat can be lost through leaks, holes and gaps, which are generally to be found where the different elements of a building structure meet — for example between the windows or doors and the wall; between the wall and floor; or between the walls

and the roof. You may feel draughts entering your home at these spots in winter. Professionals refer to the airtightness of a building when assessing heat loss through such gaps. In a totally airtight building no air can enter or leave through leakages. To measure airtightness, the blower-door test is used to indicate how many times the internal air is exchanged over one hour.

Fig. 2. Avoiding thermal bridges during construction accounts for a large part of the later saving potenital of the building. | Image: © M. Tvrdoň

Step 2. Identify the leakages

Depending on the age and structure of your building, heat loss through leakages can range between 5 and 30 percent. If you have only a small amount of money to invest, insulating such leakages is one of the most cost effective solutions.

First of all you will need to identify the air leakages, and the checklist at the end of this brochure could help you.

Step 3. Insulate the leakages

In most cases you will be able to insulate the air leakages on your own using materials readily available in the shops.

There are a variety of easy-to-use products on the market that will enable you to tackle different types of air leakages yourself. Tapes and seals can insulate leakages between the panes and frames of windows and doors; acrylic-based fluids are ideal for insulating small cracks; and polyurethane foams are perfect for bigger cracks and holes.

Step 4. Insulation of building elements

Since new buildings have a far higher standard of insulation, the amount of work you need to do to reduce heat loss will largely depend on the age of your building. In some cases, you will need the help of a specialist. The table below gives summarises the insulation possibilities for each building element.

Solutions

Walls	The biggest thermal energy savings can be achieved by internal or external wall insulation. Internal insulation is less effective and as such is recommended only when external insulation is not possible (for example in historical buildings). In the case of internal insulation, it is important to address several aspects of the building structure (including humidity), thus you should always consult with an expert. External insulation is less straightforward and generally needs to be installed by a technical specialist with access to scaffolding, who can also ensure weather proofing. This will require a bigger investment, but if it is done properly it will significantly reduce heat loss from your building. Depending on the building structure, insulation with a thickness of a minimum 15cm is recommended but it can goes up to 35cm for a passive house standard.
Windows	Glass is not a good insulating material, thus a lot of heat can be lost through windows that are not properly insulated. The U value of standard double glazed windows is around 2.8 to 3.0 W/m^2K, while modern windows have a U value of between 1.1 and 1.4 W/m^2K. Triple-glazed windows have U values of around 0.6 to 0.8 W/m^2K. Although changing your windows requires a big investment, it will be paid back in the form of lower energy bills. The amount of energy lost via modern triple-glazed windows is three to five times lower than the energy lost via one glazed windows. In some cases it may be possible to retain the window frames and change only the glass: consult with an expert before you decide.
Roof	On average, 10 to 20 percent of heat is lost from a building via the gap between the ceiling and the roof. If you have access to your loft space, you will be able to check the level of insulation in place. Loft spaces are cheap and easy to insulate. The recommendation is to use insulating material that is at least 30 cm thick in order to achieve optimum savings. If the building has no loft space, insulation can only be inserted below a flat roof or where the ceiling height allows. Such solutions are more complicated and require a bigger investment and professional assistance.
Floor	Only recently built houses are required to have insulation between the floor and the ground beneath. If you are not the first owner of your house you may not have information about this. Houses with under-floor heating are likely to have a layer of insulation between the heating element and the ground. It is difficult to insulate the floors of older houses, since the insertion of insulation will raise the floor level and can only be managed in the course of larger-scale renovations. If you have under-floor heating and your insulation is not appropriate, your investment will be even bigger as you will need to change the heating pipes as well. If your building has a cellar, you can insulate the ceiling of the cellar with approximate 6cm until 20 cm

Step 5. Insulation materials

There are already several types of insulation material available on the market, and new technological solutions are constantly emerging.

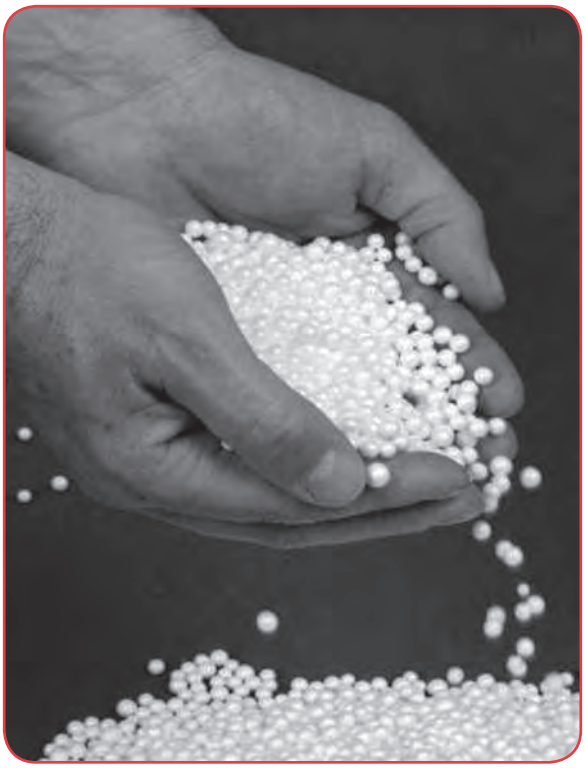

Fig. 3. Expanded polystyrene (EPS) is a synthetic insulation material | Image: © Nikecell

Three main materials are used to insulate walls, roofs and floors. The most common roof insulation material is fibreglass, or glasswool, made from molten glass. Mineral (or rock) wool is made from molten rock and is increasingly being used to insulate roofs and floors. In recent years synthetic insulation materials have also been developed, which are slightly cheaper than fibreglass and mineral wool and can

be used to insulate all building elements. However, materials such as extruded polystyrene foam, expanded polystyrene foam and polyurethane foam may present a fire hazard and should be used with caution. Before deciding which material to use, you should get expert advice.

Fig. 4. Cellulose fibre | © W. Walther

Step 6. Think about comfort and security

Once you have insulated the air leakages, your home will be more energy efficient and more comfortable. However, it will also mean that the air exchange rate in the building is reduced, so you may need more ventilation to ensure good indoor air quality. The ideal way to ventilate your home is to briefly open your windows fully at least twice a day. Just three to five minutes, depending on the outside temperature, is sufficient time to change the air while not allowing the walls and furniture to cool down.

Ventilation will also affect the relative air humidity, which is closely correlated with air temperature. The thermal comfort will be the same in humidity of between 50 and 65 percent and a temperature of 19 to 21°C; or in humidity of 30 percent and a temperature of 23°C. However, the first example saves 12 to 15 percent of thermal energy.

In homes where fuel is burned it is essential to ensure that, once insulation has been installed, there is still sufficient airflow for the burning process. If not, dangerous combustion gases (such as carbon monoxide) will circulate inside the home. Consult with an expert and buy a carbon monoxide meter to provide protection.

MONITORING

Step 7. Monitor your energy consumption regularly

After installing insulation, you should regularly monitor the energy consumption of your home. Check your electricity and gas meter regularly and record your consumption per month and per year. Remember to include other resources (e.g. biomass). Compare the consumption figures over a full year before and after installing insulation and discuss the results with an expert.

Using an Internet carbon calculator, you can also calculate the carbon footprint of your house with and without insulation: http://www.carnonfootprint.com/calculaor.aspx

CHECKLIST FOR BUILDING OCCUPANTS

Using the simple table and evaluation below you can locate and tackle the air leakages in your house.

		YES	NO
Doors and windows	You can feel cold air with your hand around the window frames.		
	You can feel cold air with your hand around external door frames.		
	The doors of non-heated rooms (e.g. pantry, attic, cellar) in your home are not insulated.		
	You have a letterbox on your entrance door.		
Junctions	You can feel cold air with your hand where the walls and floor meet.		
	You can see cracks where the walls and ceilings meet (connected to non-heated areas).		
	You often find ants and other insects inside your home.		
Penetration points	You can see cracks or feel cold air where pipes go through the walls and at electric outlets.		
	There are air leakages around wall- or window-mounted air conditioning units or extractor fans.		
	There are air leakages around the chimney.		
Thermal bridges	You have an overhanging balcony plate without special insulation.		
	Your concrete cornice is not insulated from outside		

EVALUATION

If you answered YES to between 9 and 12 questions: You need to take action! You are losing approximately 30 percent of your thermal energy through air leakages. You can achive substantial energy and financial savings by some of the straightforward, do-it-yourself measures described in this brochure.

If you answered YES to between 5 and 8 questions: The situation is not so bad, but you can still make significant energy and financial savings by following some of the simple measures outlined in this brochure.

If you answered YES to between 0 and 4 questions: Congratulations! Your home is relatively airtight. Make sure you ventilate adequately and try to eliminate any remaining problem areas.

For your notes