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GET READY

HEATING YOUR HOME WITH RENEWABLE ENERGY SOURCES

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Foreword

Renewable energy sources include sunlight, wind, rain, tides and geothermal heat. These can all be used to produce heat directly without any conversion process, or can be converted into electricity. Energy consumption in buildings represents approximately 40 percent of energy use in the European Union (EU), while CO_2 emissions from buildings make up 36 percent of the EU total. The use of renewable resources can dramatically reduce these emissions.

This brochure provides information about the use of renewable energy sources for domestic heating and electricity production. A checklist is provided at the end of the brochure to help you explore the possible use of renewable energies in your home.

Greenhouse gas emissions over the past 200 years have led to an average rise in global temperature of 0.7 °C. Since the building-related consumption of energy produced from fossil fuels contributes significantly to global CO_2 emissions, increasing resources have been devoted to developing renewable energy sources over the past 20 years with the aim of promoting their use in households.

1. Fossil fuels (crude oil, natural gas and coal) are non-renewable resources: once they are exhausted they will not be replaced. The reduced availability of these non-renewable resources will also result in a significant rise in energy prices. The availability of local renewable energy sources reduces dependence on foreign energy sources, such as imported oil.

2. When you burn natural gas, oil or coal, your heating system emits the greenhouse gas CO_2 into the atmosphere, directly contribut-

ing to climate change. There are no greenhouse gas emissions from renewable energy sources, making them a far better choice for the environment.

3 Although renewable energy technologies are getting cheaper, your initial investment may well be higher than in the case of traditional systems. However, once the system is installed, your renewable energy is free of charge. The payback period on investments in renewables is now around 15 years, and as the technology becomes cheaper, the cost to the consumer will correspondingly decrease.

Background information

Step 1. How can renewable energy sources be used in the home?

Renewable energy sources are abundant, widespread, non-polluting and locally available. They can be incorporated into new constructions, as well as when renovating an existing structure. However, the use of renewable sources for heating is only efficient in buildings with a relatively low heat demand, which can be fitted with windows that have a U value of 1.1 W/m^{2}K or higher, appropriate insulation, and a modern or retrofitted heating system.

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^{2}K . The higher the U value the lower its thermal resistance, therefore the more heat/energy passes through the building element. (Encyclopedia of Alternative Energy and Sustainable Living, www.daviddarling.info/encyclopedia/U/AE_U-value.html.

Step 2. What are renewable energy sources?

Renewable energy technologies that make direct use of sunlight include solar panels, which absorb the sun's

heat to produce hot water; and photovoltaic cells that use sunlight to make electricity. Secondary solar-powered resources include wind turbines that generate electricity; biomass crops that require sunlight for growth and are burnt to produce heat; and heat pumps that concentrate the low-grade heat absorbed by the air, ground or water in summer to heat buildings in winter and cool them in summer.

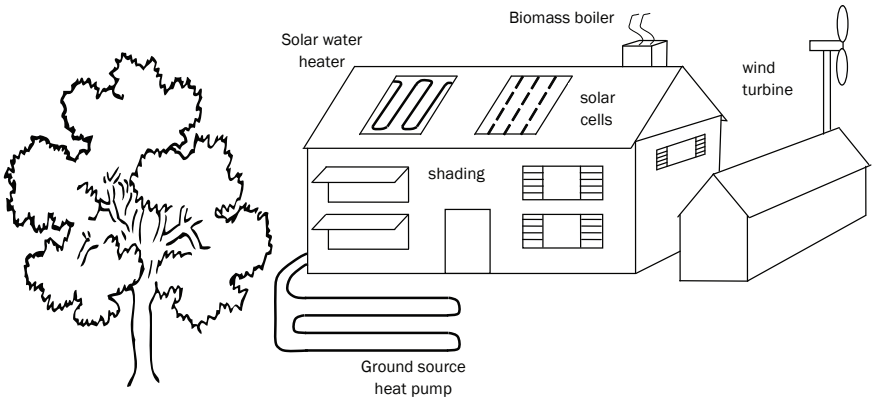

Fig. 1. Application of small-scale renewable energy sources in the home to prevent climate change <www.kyotoinhome.info> 2006. p.64

Possibilities

Step3.: Which renewable energy sources are relevant in your home?

Your choice of renewable energy resources will depend on the prevailing climatic conditions, the characteristics of your home, and the relative advantages and disadvantages of each renewable energy source.

All EU member states are required to have an action plan for the utilisation of renewable energy sources. Detailed maps of local and regional climatic conditions, including prevailing winds and hours of

sunlight, should therefore be available. This information can be obtained from your local municipality or regional energy agency.

The checklist at the end of this brochure will help you assess the characteristics of your building and make the most environmentally friendly choices. However, if you are planning to construct a passive house, or to retrofit an existing building, it is worth getting professional advice.
The following table summarises the relative advantages and disadvantages of renewable technologies.

Renewable technology	Advantages		Disadvantages
	Environmental	Energy-related	
Solar water heating	Can substitute fossil fuel–based water heating. No operational pollution, gaseous emissions, waste, or risk of physical accidents.	Can be applied just about anywhere (depending on the amount of sunlight). Requires very little maintenance. Size can easily be adjusted according to needs and available resources.	The building roof may not be correctly orientated (i.e. may not face south). The system must be complemented by other water heating technology when there is insufficient sunshine.
Heat pumps	Can be used for heating, cooling and producing hot water. Electricity and low-grade heat are available from a variety of sources. The electricity needed to operate the heat pump can come from renewable sources. Natural refrigerants are now being used that have zero or very low environmental impact.	Systems are available in all sizes, from those that heat one room to those that heat one or more dwellings. Systems have high overall efficiency and therefore low running costs.	Investment costs are relatively high. Sufficient space is needed if a ground source collector is used. The refrigerant needs to be recovered at the end of the system's life. The electricity used by the heat pump may still come from a power station using fossil fuel.

Renewable technology	Advantages		Disadvantages
	Environmental	Energy-related	
Biomass for heating	Can include wood waste (woodchips, pellets). Is a "carbon neutral" resource: burning it emits exactly the same amount of CO_2 as was absorbed by the living tree. Local sources can be used, reducing the need for transportation.	Relatively simple technology. Wide range of products and solutions. Relatively inexpensive.	Requires an appropriate chimney, which can increase investment costs. Flue gases may include toxic substances and particulates. Adequate storage space is needed for the fuel.
Photovoltaic cells	No operational pollution, gaseous emissions, waste, or risk of physical accidents. Depending on the number of hours of sunshine, can supply significant quantities of electricity. Can be integrated into construction materials.	No significant maintenance needed over a lifetime of 20 to 30 years. More efficient and cheaper products are appearing on the market. Electricity is produced locally, eliminating distribution losses. Size can easily be adjusted according to needs and available resources.	Relatively expensive technology, although the payback period is already down to around 15 years. The building roof may not be correctly orientated (i.e. may not face south). System should be connected to the grid to cover periods when there is insufficient sunshine.
Small wind turbines	No operational pollution, gaseous emissions or waste. Can complement a household photovoltaic system.	Electricity is produced locally, eliminating distribution losses.	An appropriate site is required, with adequate wind conditions.

Source: Application of small-scale renewable energy sources in the home to prevent climate change, 2006 <www.kyotoinhome.info>

Step 4. What are the available technologies?

Central heating is now the norm in family homes. Water is heated by a boiler that burns oil, coal, wood or, more typically, natural gas. Pipes and radiators then distribute heat around the home. As an alternative, there are conversion systems that can produce heat from renewable sources. Solar water heaters absorb sunlight to produce hot water; heat pumps concentrate the low-grade heat available in the ground, air and water; and biomass (wood or wood pellets) can be burnt to produce heat. All these systems can be incorporated into your home to produce part, or all, of the energy you need for heating. The choice of system will depend on the type of building, its orientation and its location. If you are thinking of installing such renewable energy technologies, you should obtain professional advice.

Fig. 2. Example of solar panel for water heating
Source: http://www.kyotoinhome.info/HU/solar_thermal/basic_principles.htm

Before installing a new heating system it makes financial sense to reduce your energy consumption. This will ensure that the smallest and most appropriate heating system is installed rather than one with excessive capacity, meaning both a lower initial investment as well as reduced running costs.

A solar water heater comprises one or more flat panels through which water flows and is directly heated by the sun. While most effective in the summer, solar heaters can still produce significant amounts of hot water in winter months (except in Northern Europe).

Solar panels, which typically measure 2 metres by 1 metre, are best mounted on south-facing roofs or in south-facing gardens.

The optimum angle is equal to the degree of latitude plus 15 degrees, which can easily be achieved on a flat roof. On a pitched roof, the collector is generally mounted parallel to the roof or, on a new build, can form part of the roof. Where there is a possibility to adjust the collector, the optimum angle is 30 degrees in the summer and 70 degrees in the winter, when the sun is lower in the sky.

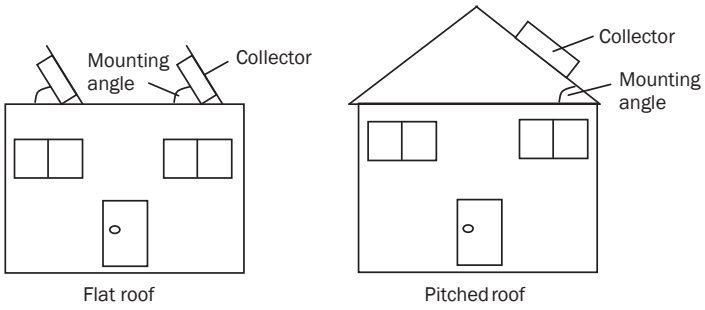

Fig. 3. Application of small-scale renewable energy sources in the home to prevent climate change, 2006, www.kyotoinhome.info

Heat absorbed by the earth during the summer is stored through the winter due to the earth's poor thermal conductivity and high thermal mass. Using a heat pump, low-grade heat (i.e. temperatures below about 18 °C) can be extracted from the air, ground or water and concentrate into useful heat for heating interior spaces and water. Electricity is required to concentrate the heat, but the heat output can be up to four times the energy input.

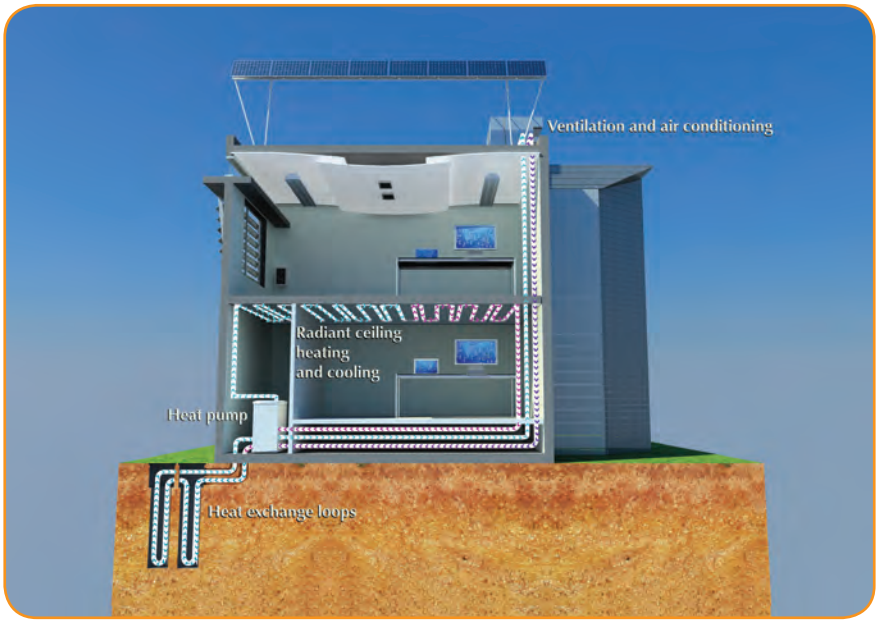

Fig. 4. Example of using a heat pump | Image: www.rec.org

Heat pumps can also be used to cool buildings during the summer months. In this process, high-grade heat is extracted from the building and converted into lower-grade heat that can be diffused back into the earth or atmosphere. A single system can thus produce heating and cooling and hot water.

It is important to choose a heat pump of an appropriate size, depending on the amount of heat lost from the building. In buildings that are more than 20 years old, it is always cost-effective to add further insulation to reduce heat loss. Since the temperature of the hot water will be lower than that produced by fossil-fuel boilers, the same size radiators will only be effective if the building insulation is improved.

The general recommendation is to choose a heat pump that produces about 90 percent of the required heat output, and in really cold periods to use an additional source of heat, such as an electric radiator or wood fire.

Biomass is the oldest and the most commonly used renewable energy source. It can be burned in a suitable boiler to produce either hot water or heat. The type of boiler used largely depends on the type of biomass (i.e. firewood or logs, or briquettes and pellets produced from wood waste).

The possibility of installing a biomass boiler in an old building will depend on the heating system already in place, the available space, the existence of a suitable flue or chimney for removing the combustion gases, and the availability of a reliable, preferably local biomass supply.

From an environmental viewpoint, biomass is carbon neutral. However, the flue gases may include nitrogen and sulphur oxides as well as particulates, depending on the quality of the combustion. The use of biomass boilers may therefore be restricted in urban areas with clean-air zones.

Step 5. Cost-benefit analysis

For many years the main argument against the installation of renewable energy technologies was the high investment cost. However, as these technologies become more widespread, the costs will decrease. While initial investments in renewable energy systems are still

higher than for traditional heating systems, it is important to evaluate your options in terms of long-term operational costs and savings. As traditional systems become increasingly expensive to run with the rising price of fossil fuels (oil and natural gas), the cost of operating a renewable energy system is constantly falling. The payback period on investment in renewable technology is already down to around 15 years, and the systems are operational for up to 30 years.

Step 6. Where can you get financial support?

Funds have recently become available to support the increased utilisation of renewable energy technologies, even in individual households. The EU is supporting the use of renewable energy sources through its Structural Funds, while in many cases national funds are also available. Income from the European Union Emissions Trading Scheme (ETS) is also allocated for this purpose in several countries. (http://en.wikipedia.org/wiki/Emissions_trading)

Monitoring

Step 7. Monitor your energy consumption

After installing a renewable technology, it is a good idea to check your electricity and gas meters regularly and keep a record of energy consumption per month and per year. A comparison of the before and after figures will indicate the savings you are making by installing your new system. You may find it useful to discuss your findings with an energy expert.

Using an Internet carbon calculator, you can also calculate the carbon footprint of your house before and after installing your renewable energy technology: http://www.carbonfootprint.com/calculator.aspx

Using the simple table and evaluation below you can assess the possibilities for using renewable energy sources in your home.

		YES/ NO	Evaluation
Solar energy	Do you have a south-facing or southwest-facing roof?		If you ticked YES to all these questions, it is worth considering installing solar panels or photovoltaic cells on your roof.
	There are not any buildings and/or trees overshadow your roof.		
	Is your roof sturdy enough to bear the weight of the system?		
Small-scale wind turbine	Is there a strong prevailing wind?		If you ticked YES to all these questions, it is worth considering installing a small wind turbine.
	There are not any buildings and/or trees in the general direction of the wind.		
	Is there adequate space to securely install a wind turbine?		
Biomass	Do you have a separate, fireproof room at least 3m^2 for storing biomass?		If you ticked YES to both these questions, it is worth considering using biomass for heating.
	Do you have an existing chimney or can one be built?		
Heat pump	Is there an appropriate place in which a hole can be drilled into the ground?		If you ticked YES to any of these questions, it is worth considering installing a heat pump.
	Is there sufficient space for a horizontal collector pipe system (i.e. at least a medium-sized garden)?		
	Is there already a well in the garden?		

For your notes