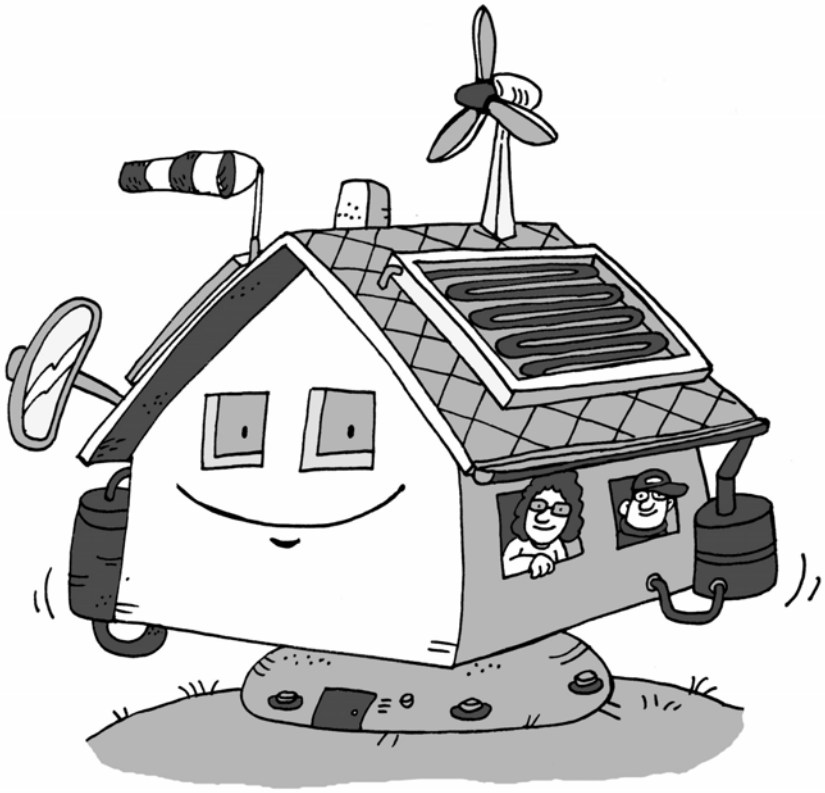

Kyoto in the home

Deliverable 3
Methodology for determining renewable energy sources for the home

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Methodology for determining renewable energy sources for the home

Executive summary

This report describes the third deliverable (D3) of the KITH project. This deliverable concerns the resources for families that have been developed during the project. These are web based resources providing information to encourage both a reduction in domestic energy demand and efficient and sustainable energy use. Passive solar techniques are described followed by renewable energy sources. A questionnaire has been devised to guide the user towards any renewable energy technology that may be suitable for their home. Unlike the resources for students, these resources are a stand alone information source and as such are self explanatory.

1. Scope

The resources for families differ from those for students in several ways:

- they are self explanatory as there is no teacher to explain difficult concepts or provide explanations
- the information is in a form that will be found useful
- ability to distinguish between various uses of energy such as space heating, hot water and electricity
- how the various renewable sources can meet these needs
- what is the potential for specific renewable energy sources in the home

A set of self contained modules have been devised, adapted and translated form English into 10 other European languages and are all accessible via the KITH Web site. These are listed in Table 1 and relate to and expand the text in the KITH handbook. Six of the modules consider how to save energy in the home and the other five describe the various renewable sources that can be attached to the home.

Table 1: Web based modules

reducing energy demand
sustainable use of energy
energy efficiency in the home
renewable energy sources
heat loss in buildings
passive solar
solar water heating
heat pump systems
biomass boilers
wind energy conversion
photovoltaic systems
advice and further information

2. Reducing energy demand from the home

The introductory module begins by explaining why it is important to start saving energy now (Box 1).

Box 1: Rationale for saving energy in the home

When climate change occurred in previous eras, plants, animals and human beings had time to adapt because the rate of change was slower, but with the much larger population and our ever increasing use of fossil fuels, the rate of change is occurring much faster and is human rather than geophysical in origin.

There is no time to be lost because the UN expert panel on Climate Change has concluded that the global emissions of greenhouse gases has to be stabilised by 2015 if irreversible changes in climate are to be avoided. Many of these changes have been documented by Al Gore in his film 'An inconvenient truth'.

It then introduces the four ways of reducing the energy demand

- reducing your energy consumption
- using less energy and using it more efficiently
- reducing your heat demand
- potential for using renewable energy sources

In each of these sections suitable advice is provided which is expanded in the modules.

Box 2: Analysing your electricity bill

On your bill, you will find the following information

- period of time covered by bill
- number of units in kWh used during this period
- applicable tariff(s) per unit
- service charge
- value added tax currently 10%

Comparison with an average family bill

If you have kept your previous bills then add these up for a full year and divide the total consumption by the number of days to give the average usage per day in kWh. If you only have the last quarter then divide this consumption by the number of the days it covers.

For an average 4 person family, the annual consumption is about 2700 kWh or 7 - 8 kWh per day. If you use electricity to also provide hot water then these figures will rise to 11-12 kWh. For an average unit cost of 0,19 €/kWh this will give a daily cost of about € 1,30 – 1,50 (or € 2,00 – 2,20 if hot water is produced) and an annual cost of about € 500 (or € 800) respectively

In the modules advice is provided on analysing the electricity and heating bills followed by advice on how to reduce consumption. Various ways to determine how energy might be saved are described; these include a virtual tour of the home, use of a current cost meter, and Excel spreadsheet to determine appliance use and ways of reducing the heat loss.

Box 3: How to reduce your electricity bill

In order to reduce your usage and bill it is important to know which appliances use the most electricity so you can focus on achieving the highest possible savings. If you have little time, look at the next section which illustrates where energy is used in each room and provides some hints on how to save energy. If you have more time undertake a survey of your consumption using the excel spreadsheet which can be downloaded from this Web site. This will identify not only the largest users but also where the greatest savings are possible.

Current cost meters

These are meters which measure and show the current electricity consumption at any one time interval so you can see the effect of switching on or off any appliance or lamp. You can therefore identify directly which appliances are big consumers and consider how you might be able to reduce their consumption. These devices are able to integrate this instantaneous consumption and convert this to costs per day, month or year. They also illustrate graphically how yesterday's consumption is split between night, day and evening. Such devices can be purchased and retail for about € 50 - 75. You should be able to save between 5% and 10% of your electricity bill by using the information that such devices provide and the hints on this Web site.

Some utilities offer these meters free of charge as part of the carbon emissions reduction programme which is funded by all electricity consumers.

Box 4: How to reduce your heating demand

Understanding your heating bill

If you use gas or oil to produce hot water as well as space heating, subtract 2,000 kWh/year for a typical four person family. If you use gas for cooking as well as for space heating, subtract a further 1000 kWh/year. The balance will be your heating demand.

For example (remember, roughly 1 mc of gas = 10 kWh)

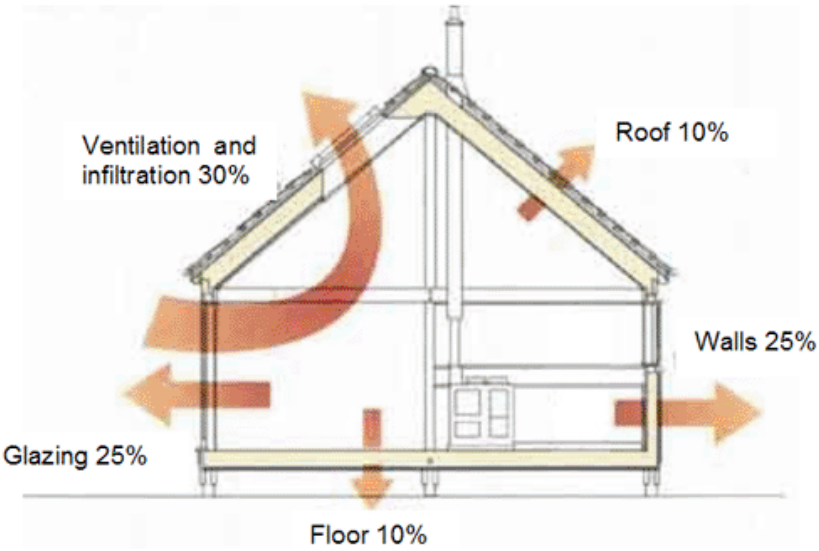
	kWh
annual gas bill	21,000
hot water	-2,000
cooking	-1.000
space heating	18,000

To convert this to the heat demand multiply by 0.9 (conversion efficiency for a gas boiler in very good working order)
i.e. heat demand = 18,000 x 0.9 = 16,200 kWh
Dividing by the floor area of your home (say 90 m2) gives a heat demand per unit area
16,200/90 = 180 kWh/ m2

reducing heat loss

The heat loss of a home depends upon a number of factors including -
- type of dwelling such as detached, semi-detached or attached or whether it is an apartment
- number of stories
- condition of the fabric such as doors and windows
- level of insulation

Heat can be lost in many different ways from the home and the sketch shows the relative heat losses from the major building elements for a typical home. These losses could well be different for each home depending upon the type of dwelling and its age.



heating system age and efficiency

If it is more than two years since your heating system was checked, it is worth arranging a service visit. Servicing your system will also allow the service engineer to undertake a 'health' check to ensure your system is operating safely and at optimum efficiency. This will minimise your heating bill and save the environment.

renewable energy sources

When it becomes necessary to rep lace your existing boiler you should consider whether a renewable heating source like a heat pump or biomass boiler would not be more cost effective. A survey form is attached which can be used to identify which renewable source might be more suitable.

3. Passive solar techniques

The great advantage of these techniques is that they are in general not expensive and incur NO running cost. During the summer, such methods can reduce the solar gain and increase natural ventilation which becomes more important the further south the building is situated. The use of blinds, shutters and external overhangs are discussed.

During the winter, the converse situation applies and the aim is to retain heat and maximise solar gain; again passive solar techniques such as solar windows can be used.

4. Renewable energy sources

The most common sources are described in a way that will enable each family to decide which is most suitable for their home (Table 2).

Table 2: Format of information on renewable energy sources

Description basic principles advantages and disadvantages effect of climate change economics further advice

Each module describes how the source works and the advantages and disadvantages of each source (Box 4).

Box 4: Description of a solar water heating system

Description

The heat from the sun can be used to provide hot water. The simplest way of heating the water is to have it flowing in tubes which are exposed to sunlight. These tubes are enclosed in a flat box called a solar water panel which can be mounted on the roof. The infra-red component of sunlight induces heating when it strikes an absorber. If the absorber is a series of tubes in which water flows, then this solar heat is transferred to the water producing solar water heating. As a typical panel is 2 metres long by 1 metre wide, such panels are easiest mounted on the roof of a building if it is favourably orientated to receive sunlight during most of the day.

Advantages

The advantages of solar water heating are:

- the only external energy required is to pump the water through the solar collector
- captures energy from sunlight which otherwise would not be utilised
- negligible environmental emissions
- depending upon location. can produce up to 60% of hot water needs

Disadvantages

- possible visual impact on surroundings
- less hot water in winter than summer
- output dependent on weather conditions

Criteria are then described for deciding the suitability of this source for a home (Box 5).

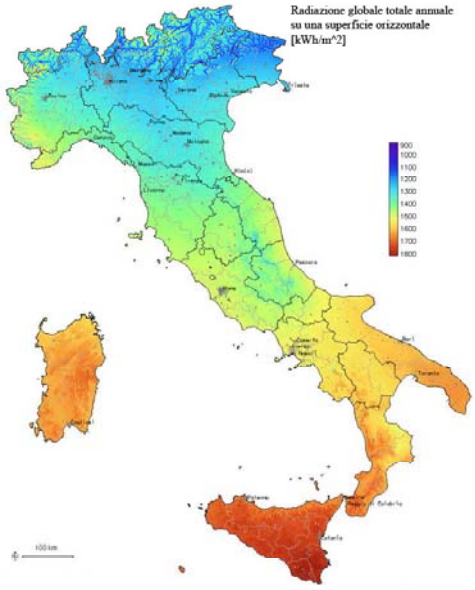
Box 5: Suitability criteria for solar water heating

Application to the home

Solar thermal heating is possible if

- the roof orientation is south or south west
- there is little shadow during the day i.e. no tall trees or high buildings to shade the array from direct sunlight for any appreciable part of the day
- the roof structure is able to carry the extra load of the installation
- the new system is able to connect to the existing hot water system

Effect of climate



The amount of radiation depends upon the position of the sun in the sky as the lower the position the more energy is absorbed by the earth's atmosphere. This gives rise to the observed temperature variations during the day, between summer and winter and between the north and south of any country. The annual mean solar radiation for the Italy is shown above.

Some indicative costs are also provided (Box 6).

Box 6: Indicative costs for solar water heating for a 4 person household in Italy

The principal components comprise the

- solar water heater panel
- dual coil hot water cylinder
- water pump
- temperature controller to ensure that the hot water is available at the appropriate temperature

The principal installation costs are

- mounting the collector on the roof

- replacing the hot water cylinder containing a single coil with one containing a double coil
- modifying the plumbing

When sizing the system, it is most cost effective to size according to summer needs; for a four person household, from one to two panels 2m by 1 m would be typically required.

Costs

A typical installation would cost between Euro 1.700 and Euro 4.000 provided that the solar panels can be easily installed.

The amount of energy saved would typically be 900 - 1400 kWh/year; this would cost about Euro 228/year by electricity and about Euro 100/year if supplied by gas.

5. The survey form

The survey form will aid the decision to install renewable energy sources in the home. The survey form is either given to the student and (s)he is asked to bring in the home or is given to a the family to fill in the form. When the form has been completed the user should be able to identify which source may be suitable for the home and to then consult the relevant KITH module for further information. Following that, an energy adviser or installer should be consulted; alternatively the utility helpline could provide further information.

It is generally more cost effective to reduce the energy demand than install renewable energy sources.

Part I of the survey form considers not only the type of dwelling, but also the current method of heating and cost of the heating and electricity bill- If either of these bills is too high, then the form prompts the reader to consider the options to reduce them.

Part II of the form relates parameters such as orientation and type of home, its location an prevailing wind direction to which is the most suitable renewable source.

The survey form is shown on the following pages

6. KITH Web site

The KITH Web site is available in 11 languages: (English, Spanish, French, Italian, Polish, Czech, Romanian, Estonian, Slovak, Hungarian, Catalan).

The KITH Web site (www.kyotoinhome.info) provides:

- suitable information to encourage everyone to do something in their home to reduce energy consumption;
- how to reduce the heat loss during the winter and minimise solar gain during the summer;
- a method for deciding which renewable energy source might be suitable;
- information on the nature and characteristics of each renewable source.

A web-based methodology which will enable families to assess how RES can be incorporated into energy efficient homes was accomplished.

The KITH web application comprises a systematic rationale of each RES under the following headings:

- Description,
- Advantages,
- Disadvantages,
- Basic principles,
- Climatic and environmental criteria,

- Installation,
- Economics,
- Further advice.

The Web site “KYOTOINHOME” helps the citizens to identify what they can do to help their community meet the Kyoto target for greenhouse gas reductions and prevent global warming. This application provides useful information on how the citizens can use renewable energy sources in their home to provide space heating and cooling, hot water and electricity.

7. Conclusions

A comprehensive source of information has been provided for families which will help to determine the most suitable way for reducing the energy demand from the home. In times of rising energy prices, it is appropriate to start with reducing energy use and subsequently to consider passive solar techniques and the application of small scale renewable energy sources.

Potential for renewable energy sources Part II

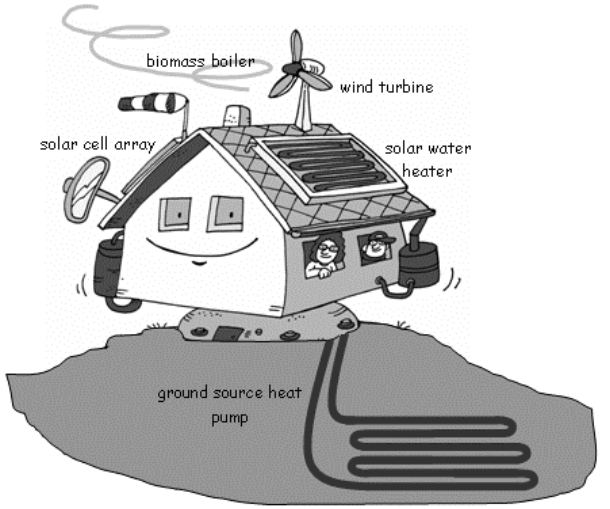
Name:
Address:

	Characteristic	Factor	yes	Possible renewable source
1	orientation of roof	south or south west		*If 'yes' to 1 to 3:* consider a roof mounted solar water heater or photovoltaic system.
2	shadow of buildings or trees	none		
3	roof construction to mount solar collector	strong		
4	prevailing wind direction	south or south west		*If 'yes' to 4 to 6*: consider a wall mounted small wind turbine
5	buildings or trees in prevailing wind direction	none		
6	external wall to mount wind turbine	yes		
7	clean air zone	none		*If yes to 7 to 10:* consider a biomass boiler to replace existing boiler
8	locally available biomass	yes		
9	storage space	at least 2 m^2		
10	chimney or flue	available or could be fitted		
11	space to drill vertical borehole			heat pump with vertical heat collector
12	space to lay horizontal collector			heat pump with horizontal heat collector

It is important to complete Part I of this form to characterise the building and its fabric.

KITH home energy survey form
Potential for renewable energy sources

To reduce your energy bills, it is useful to survey your energy use and the potential for saving energy. Part I of this form will help you do that. The second part of the survey, considers the potential for renewable energy sources in your home.



When you have completed this form, please return to the address below. You could also show a copy to your local energy adviser. For further information consult www.kyotoinhome.info.

Please return to:

KITH home energy survey form
Potential for renewable energy sources Part I

Name:
Address:

	Characteristic	Factor	yes / no	Action (If no to question 1-13, consider the following actions)
1	building type	detached or semi-detached		requires collective action by other residents
2	age	less than 30 years		may be necessary to improve the fabric first (Q5)
3	number of families	1 or 2		requires collective action by other residents
4	ownership	self owned		complete survey form and discuss with owner of the rented property
5	condition of fabric (walls, windows, roof)	good		it is important to improve the building fabric before investing in renewables
6	fuel for heating system	electricity, oil		oil and gas are likely to increase in price due to the imbalance between supply and demand; if electric heating is used then a heat pump could be cost effective
7	heat distribution system	under floor, warm air		contact the owner of the district heating system and suggest they consider using renewable energy sources
8	floor area	length x width of each floor (m^2)	m^2	
9	heating bill	cost 1 year	€	
10	heat demand	Is cost per m^2 floor area more than € 11 (answer to 8 divided by answer to 9)		if heat demand is greater than kWh 14/m^2 it is cost effective to have your boiler serviced and to consider adding insulation to your dwelling
11	age of boiler	more than 15 years		if the boiler is greater than 15 years old, it is worth getting a quotation from an installer for a new boiler and asking him to consider installing a suitable renewable energy source
12	electricity bill	cost 1 year	€	
13	electricity demand	is cost divided by the number of persons less than € 150?		if electricity demand per person is greater than 100 it is worth considering investing in energy efficient appliances and low energy light bulbs

If yes to all questions, consider now the potential for installing a renewable energy source. If yes to more than five questions including question 1 and 4, it is worth considering the potential for renewable energy at some future time by completing the second part of this form overleaf.