LEADER II

Renewable sources of energy, sustainable sources of energy

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Encouraging local initiative in the renewable energy sector

Intended for rural development players, this guide is a practical reference tool to determine the local potential for renewable energy, to study the economic, environmental and social impact of a renewable energy scheme on an area and, if appropriate, to facilitate the implementation of this scheme.

There are many renewable sources of energy, and this guide will focus on the technologies (solar power, wind power, biomass and smallscale hydropower) which seem to offer the best economic prospects in certain rural areas of Europe. The factsheets in this guide provide basic information on these different technologies and their application in rural areas but mainly deal with small to mediumsized projects.

To determine whether a renewable energy development scheme is appropriate in a given area, it is first necessary to identify:

- the local renewable energy resource,
- demand and the potential market for this type of energy,
- the advantages of implementing a renewable energy scheme,
- the cost and impact of the scheme, and
- the possibilities available to fund and support the scheme.

Once this has been done, a table can be prepared listing the opportunities and risks of such a scheme, and it can be decided whether the capital outlay required is justified. Some of this information can be obtained from local sources, but outside resources and probably specialists will be needed to help.

In some areas, harnessing renewable energies is not necessarily practical at the moment, even if equipment costs are going down everywhere and public aid is steadily rising. Having said this, if it is decided that the conditions are there and that as a result the scheme can go ahead, it will be necessary to:

- mobilise the local community from the start,
- develop relations with the appropriate groups and bodies,
- hire experts to perform a detailed technical study, and
- draw up a financial plan.

For the most part, developing a renewable energy scheme is not much different from developing any other project, but there are some particular pitfalls that need to be avoided. In this respect, the guide tries to provide practical and sensible advice and walks the reader ‘step by step’ through the preparation of the scheme. The experience of the LEADER groups that have been involved in actions like these across Europe is given as an example.

The purpose above all is to facilitate the development of renewable energy schemes, adapted to their geographical location, as part of a sustainable economic diversification strategy.

Harnessing renewable energies as part of a sustainable development strategy

Technologies to harness renewable energy are being taken into consideration more and more in a bid to promote sustainable rural development in Europe. Interest in these technologies is growing because of the environmental and social advantages they offer but also because they are becoming less expensive.

A renewable source of energy that can be tapped is an asset for a rural area. Depending on the region, this can offer the following advantages: harnessing local resources helps improve the economic situation by exporting energy or lowering supplies from external sources; skilled jobs are created; the burden on the environment is reduced, namely by lowering carbon dioxide emissions (CO_2), the principal cause of the greenhouse effect, and sulphur dioxide, the principal cause of acid rain, and other rural development initiatives are stimulated because of the involvement of the local community and the activities that the energy scheme generates.

For many years now, air quality has been a political priority of the European Union and it will remain so. At the Rio Earth Summit in 1992, the Union pledged to stabilise its CO2 emissions in the year 2000 at the 1990 level. In Kyoto in 1998, it agreed to reduce this level by 8% for six greenhouse gases between 2008 and 2012. This Kyoto Protocol should have farreaching effects on energy policy in the decades to come.

All signs indicate that renewable energies will play a growing role in our supply of energy. The European Commission in particular considers these sources of energy capable of making a significant contribution to the agreed reduction of greenhouse gases.

The table below shows the contribution of each renewable source of energy in the countries of the European Union (in total 6% of the Union's energy consumption).

Production of renewable energy in the EU (1995) *(thousands of tonnes oil equivalent)*

Country	Hydro	Wind	Sun	Geothermal	Biomass	Others	Total
Belgium	30	1	1	1	372	107	512
Denmark	3	98	4	1	1308	0	1414
Germany	1591	123	36	9	4375	0	6133
Greece	223	3	98	4	1398	0	1727
Spain	2408	15	24	7	3876	0	6330
France	6822	0	14	129	9781	0	16746
Ireland	79	2	0	0	162	0	243
Italy	3840	1	7	2312	3548	91	9798
Luxembourg	10	0	0	0	41	0	51
Netherlands	9	23	3	0	933	0	968
Austria	3070	0	0	0	3034	0	6104
Portugal	916	1	14	37	2368	0	3338
Finland	1013	0	0	0	4898	0	5912
Sweden	5082	6	0	0	6564	0	11652
United Kingdom	438	29	6	1	934	0	1409
Total EU	**25535**	**302**	**208**	**2500**	**43593**	**199**	**72337**

Source: Commission of the European Communities, "Energy for the future: renewable sources of energy – White Paper for a Community strategy and action plan", COM (97) 599 final, Brussels 1997.

In the White Paper "Energy for the future: renewable sources of energy published in 1997, the European Commission proposes that renewable energies represent 12% of the Union's gross domestic consumption in 2010 (the current figure of 6% includes the large hydropower plants, *see table above*). The White Paper presents a global strategy and an action plan to achieve this objective. This includes a "campaign to launch renewable sources of energy" which sets out the targets to be achieved by 2003 in each key sector of renewable energy: 1 million photovoltaic systems; 15 million square metres of solar thermal panels; 10000 megawatts generated by wind turbines; 10000 megawatts generated by biomass installations; 1 million biomass-heated dwellings; 1000 megawatts generated by biogas installations; 5 million tonnes of liquid biofuels.

It is clear that the major renewable energy resources Europe has are going to play a growing role in its energy supply. Renewable energies also offer rural areas opportunities to diversify based on sound and sustainable longterm prospects.

What is the purpose of this guide?

- **To illustrate the possibilities that renewable energies offer rural areas as part of a sustainable development strategy.**
- **To inform the layman about the main technologies available and serve as a basic reference for more detailed information.**
- **To help determine the potential and practicality of renewable energies in a given area.**
- **To promote the development of local initiatives that take advantage of renewable sources of energy.**

How to use this guide

The primary aim of this guide is to help the local action groups (LAGs) of the LEADER programme and their local partners to decide whether a given renewable energy scheme is a conceivable option for their area. The guide indicates, where appropriate, what they can do themselves and when they need outside help for the scheme.

There are 13 factsheets and 4 case studies in the appendix, and these can be used in two different ways. They can either be treated as a whole and read to have a complete understanding of the role of local players in tapping into renewable sources of energy, or individual factsheets can be consulted depending on the information needed.

It is nonetheless recommended that factsheets 1 and 7 be consulted in their entirety. These discuss the challenges of renewable energy in Europe and the steps to be followed to prepare a scheme.

The guide comprises thirteen parts presented in the form of factsheets:

1 - Renewable energy, new opportunities in rural areas
2 - Answers to typically asked questions
3 - Solar energy
4 - Wind power
5 - Hydropower
6 - Energy from Biomass
7 - The main steps of a scheme
8 - Assessing local energy consumption
9 - Involving the local community
10 - Costs and funding opportunities
11 - A checklist for implementing an energy scheme
12 - Useful publications
13 - Key sources of further information

Four cases studies are provided in the appendix:

- "Baywind", a wind turbine cooperative (Ulverston, England, UK)
- Building one's own solar heating system (Styria, Austria)
- Using renewable energies in remote rural areas: the "sun road" leads to the Local Energy Agency (Sierra de Segura, Andalusia, Spain)
- Combined biomasssolar heating system for an entire village (DeutschTschantschendorf, Burgenland, Austria)

This guide is the outcome of a seminar organised by the LEADER European Observatory from 27 to 31 May 1998 in Hensbacka in the LEADER area of Norra Bohuslän (Munkedal, Sweden).

Several case studies were prepared for the seminar.

They concern different types of renewable energy:

> solar power, biomass, straw, energy savings and tips (Nordliches Waldviertel, Austria);
> solar thermal, photovoltaics, biomass (Terres Romanes, LanguedocRoussillon, France);
> solar power, advice and public relations (Föhr Island, SchleswigHolstein, Germany);
> olive stones as fuel to heat greenhouses (Sitia, Crete, Greece);
> using waste from the forestry industry to heat private homes (Darlana, Sweden);
> a wind turbine cooperative (Ulverston, England, UK);
> building one's own solar heating system (Styria, Austria);
> using solar energy in a remote rural area (Sierra de Segura, Andalusia, Spain);
> combined biomasssolar heating system for an entire village (DeutschTschantschendorf, Burgenland, Austria).

The last four case studies are presented in the appendix of this document; the others can be obtained from the LEADER European Observatory or on the Internet: **http://www.ruraleurope.aeidl.be**

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SUMMARY

FACTSHEET 1
RENEWABLE ENERGY, NEW OPPORTUNITIES IN RURAL AREAS

Reliable sources of energy, needed to meet our demands for warmth, lighting and mechanical power, are central to the workings of our society and to our wellbeing. Renewable energy, which has been harnessed in Europe for thousands of years, is now playing a growing role in meeting these needs.

The dispersed nature of renewable energy sources, particularly biomass, hydropower, solar power and wind power, establishes them as a key asset in rural areas, where they are able to:
> improve the economic situation,
> create local, skilled jobs, and
> help reduce environmental pressures.

The demand for energy from renewable sources of energy is likely to see strong growth over the coming decades, and so, once developed, a renewable energy scheme is likely to find a secure market, providing long lasting benefit to a region.

RENEWABLE ENERGY IN EUROPE

There are several technologies that are widely recognised as being proven and mature:

> hydropower and biomass are used extensively in countries such as Sweden and Austria;
> wind power makes a significant and growing contribution to electricity demand in Denmark;
> solar water heaters are used in many parts of southern Europe.

Renewable energy accounts for approximately 6% of all energy consumed in the European Union.

THE ROLE OF RENEWABLE ENERGY IN THE EUROPEAN UNION (% OF ENERGY FROM RENEWABLE SOURCES)

Country	1990	1995	Objective
Sweden	24.7	25.4	
Austria	22.1	24.3	
Finland	18.9	21.3	
Portugal	17.6	15.7	
Greece	7.1	7.3	
Denmark	6.3	7.3	
France	6.4	7.1	
Spain	6.7	5.7	
Italy	5.3	5.5	
Ireland	1.6	2.0	
Germany	1.7	1.8	
Luxembourg	1.3	1.4	
Netherlands	1.3	1.4	
Belgium	1.0	1.0	
United Kingdom	0.5	0.7	

POTENTIAL FOR RENEWABLE SOURCES OF ENERGY ACROSS EUROPE

Europe has vast untapped renewable energy resources which can make a significant contribution to meeting growing energy needs. The European Commission's Directorate for Energy (DG XVII) has produced scenarios which show renewable energy contributing between 10% and 15% of total primary energy supply by 2020 (accounting for the single largest indigenous source of primary energy production within the European Union). Energy obtained from the wind, sun and biomass is expected to witness the most growth.
The Commission's White Paper "*Energy for the future: renewable sources of energy*" sets out a strategy to obtain 12% of energy in the EU from renewable sources by 2010.

ESTIMATED CONTRIBUTIONS FROM EACH SECTOR IN 2010

Type of energy	1995	2010
Wind power	2.5 GW	40 GW
Hydropower	92 GW	105 GW
Photovoltaics	0.03 GWp	3 GWp
Biomass	44.8 Mtep	135 Mtep
Geothermal (electric)	0.5 GW	1 GW
Geothermal (heat)	1.3 GWth	5 GWth
Solar thermal	6.5 million m^2	100 million m^2
Passive solar	-	35 Mtep
Others	-	1 GW

Source: *White Paper "**Energy for the future: renewable sources of energy**", European Commission, 1997.*

The investment needed to achieve this goal is projected to be ECU 165 billion. It is forecast to lead to an estimated 500,000 new jobs (net figure allowing for losses of jobs in other parts of the energy sector), save ECU 21 billion in fuel costs, reduce imported fuels by 17.4% and reduce CO_2 emissions by over 400 million tonnes per year by 2010.

JOBS

Each renewable energy technology has its own characteristics in terms of the quality and the quantity of employment generated. Biomass creates large numbers of jobs during the production and collection of the raw material. Photovoltaics and solar water heating systems create large numbers of installation, operation and maintenance jobs, as individual installations are generally small and dispersed. In general, the employment potential of a renewable energy scheme is typically several times greater than that for energy produced from fossil fuels or nuclear power, for example, including employment associated with extracting and transporting the fuels.

The European Wind Energy Association (EWEA) estimates that between 190,00 and 320,000 jobs can be created if the European Commission target of 40 GW of installed wind power capacity is reached by 2010. Already more than 30,000 jobs have been created in the wind power sector in Europe. The European Photovoltaic Industry Association (EPIA) estimates that achieving the 3 GW peak of capacity will create approximately 100,000 jobs. And the European Solar Industry Federation (ESIF) estimates that 250,000 jobs will be created in order to meet the target for solar collectors. Moreover, the European Biomass Association (EBA) believes that employment in the sector will increase by up to 1,000,000 jobs by 2010 if the biomass potential is fully exploited. On top of this, an annual export business of ECU 17 billion is projected for 2010, which could create an additional 350,000 jobs.

It is quite clear that as renewable energy schemes are most suited to rural areas, a proactive move towards promoting these energy sources will lead to significant new rural employment opportunities.

RURAL BENEFITS

Renewable energy schemes can play an important role in regional development by injecting a valuable and sustainable source of income into rural areas. The Commission's White Paper '*Energy for the future: renewable sources of energy*', stresses the importance of renewables in providing a focus for cohesion and development in less favoured (particularly Objective 1) regions, stating that: "*regional funds invested in renewable energy sources development could contribute to increased standards of living and income in less favoured, peripheral, island, remote or declining regions in different ways:*

> *favouring the use of local resources and therefore indigenous development;*
> *being usually labour intensive, they could contribute to the creation of local permanent jobs;*
> *contributing to reduce the dependence on energy imports;*
> *reinforcing energy supply for local communities, green tourism, preserved areas, etc.;*
> *contributing to develop the local R&TD and innovation potential, through the promotion of specific researchinnovation projects adapted to local needs.*"

The White Paper goes on to add that: "*New incentives should also be undertaken in the tourism sector as the great potential of renewable energies in this area is still largely unexplored.*" Renewable energy is also likely to play an increased role in Europe following changes to the Common Agricultural Policy.

INVESTMENT AND PARTNERSHIP

Initiatives which have a good regional identity, involving rural enterprises working in partnership with companies from outside the region, can be particularly beneficial to a rural area. A renewable energy scheme is well suited to forming part of a sustainable development strategy for an area, providing leverage and in some cases a focus for other development initiatives. Many Local Agenda 21 groups are considering how to incorporate renewable energy into their plans for their local area.

Support and funding for renewable energy schemes are increasingly being made available at the regional, national and EU level. The White Paper on renewables states that: "*With the future rural development policy, the Commission will encourage Member States and regions to give renewable energy projects a high priority within their programmes for rural areas.*" Liberalisation of the electricity and gas sectors, which is opening up the market to competition, is also creating opportunities for renewable energy generators to sell energy directly to customers.

Harnessing solar energy, biomass and hydropower is already cost effective in many situations across Europe and in some areas renewables can be the cheapest form of energy. In many areas, however, it should be stressed that a renewable energy scheme may still not be a viable proposition at the present time. Nevertheless, the cost of renewable energy has fallen drastically over the last decade and is set to continue to do so in most parts of Europe. Electricity from wind power, for example, which was being developed for ECU 0.15/kWh in the UK in 1990, can now be developed for below ECU 0.04 ECU/kWh.

GENERAL AND ENVIRONMENTAL BENEFITS

The political will to conserve energy and develop renewable energy is growing, in part due to concerns over global warming. Renewables are also seen as offering opportunities for diversification, increased security of supply, reduced dependence on imports, improvement to the national balance of payment and preservation of national raw materials.

In its 1996 Energy Policy White Paper, '*An Energy Policy for the European Union*', the European Commission stated that: "*Given that renewable energy suppliers have few hidden costs (they produce little or no pollution) and are in many cases readily available, an increased share of renewables in the Community's energy balance would make a contribution to both its security of supply and environmental protection.*"

FACTSHEET 2
ANSWERS TO TYPICALLY ASKED QUESTIONS

Any renewable energy scheme will be met with a whole number of reactions ranging from scepticism, or even hostility, to great enthusiasm. This factsheet will try to answer some key questions to help plan the scheme in a realistic way.

WHAT IS "RENEWABLE ENERGY"?

Energy which can be harnessed from a naturally recurring resource which is not depleted through use is known as "renewable" energy. The most commonly used forms include:

> hydropower harnessing energy from the flow of water,
> biomass energy obtained from burning, or producing fuels from animal wastes and from plant materials such as wood, vegetable oils, etc.,
> wind power energy generated by the wind, and
> solar power capturing energy from the sun.

Other forms of renewable energy (which are not covered in these factsheets) include geothermal power (heat from the earth), tidal power and wave power.

WHAT CAN RENEWABLE ENERGY BE USED FOR?

Renewable energy can be used to fulfil all the same needs as other forms of energy.

Energy is used in virtually all spheres of life and its availability is often taken for granted. Our need for heating, lighting, electrical appliances, industrial processes, transport and many other aspects of modernday life all rely upon a source of energy.

Renewable resources can be used to generate electricity, or to produce fuels, both of which can be used in exactly the same way as other resources such as coal, nuclear power, or gas. Renewable energy can provide power to farms, to rural enterprises, to homes and to offices. It is used for industrial processes, for heating, for powering electrical machinery, for transport, for lighting in fact anything which requires energy.

IS RENEWABLE ENERGY RELIABLE?

Renewable energy is a very reliable source of energy. Some forms of renewable energy are, however, intermittent. For example, energy is only produced by a wind turbine when there is sufficient wind and obviously a solar panel does not produce energy during the night. Biomass, on the other hand, can be used at any time, and smallscale hydropower schemes which have a degree of water storage can generally be used as and when energy is required.

Having an intermittent source of energy is not necessarily a problem. A scheme can be connected to a system which stores the energy for use when required (for example, by using large batteries); or can form part of a system combining intermittent and nonintermittent sources of energy to provide energy on demand (for example, by combining wind power, solar power and biomass, or by connecting a scheme to the national/local electricity grid). Schemes which are connected to the grid will be able to supply surplus electricity to the grid and import electricity when there is no electricity being generated by the scheme. Most large renewable energy schemes are connected to the electricity grid.

While intermittent energy sources on their own do not provide power on demand, the supply may correlate well with demand. For example, power from a wind farm will be highest when the wind is strongest which is typically in winter when there is a greater demand for energy.

If a scheme is being developed to supply an isolated local need for energy, it will be important to try to match the supply of energy available to the demand for energy ***(see factsheet 8)***. If an intermittent renewable energy source is being used in such a situation, the scheme will usually need to be connected with a battery storage system and possibly a secondary source of power, for example from a backup power supply.

Where a system includes battery storage, either the output can be supplied as direct current (DC) or an inverter is required to convert the output from the battery to alternating current (AC) to be used by standard appliances. Solar panels and some small wind generators produce DC electricity, while other generators typically produce AC.

IS RENEWABLE ENERGY MORE EXPENSIVE?

The cost of energy from renewable sources has fallen rapidly over the last few years. In rural areas which are isolated from the grid, renewable energy may well be the cheapest source of energy. The cost of renewable energy varies from region to region and from technology to technology, but there are many cases where it is no more expensive than other forms of energy.

A thorough analysis of the locally available resource and the costs will need to be carried out on a sitebysite basis to determine whether a renewable energy scheme will be cost effective. National energy policies are undoubtedly one of the most decisive factors, particularly in terms of the structural and financial support available.

HOW DO WE DETERMINE WHETHER THERE IS A GOOD LOCAL RENEWABLE ENERGY RESOURCE?

Before being able to determine whether it will be economically feasible to develop a scheme, it is necessary to establish whether one is technically feasible. This will be dependent upon many factors: average wind speed, hours of sunshine, soil conditions and water flow rate, which are all obviously important. However, planning, local land uses and environmental issues are just as significant. ***An overview of how to assess the available local resource is given in factsheets 3, 4, 5 & 6***.

DO WE NEED TO INVOLVE PROFESSIONAL EXPERTS?

Virtually all projects could benefit from early professional advice. The four case studies presented in the appendix illustrate the advantages of expert knowhow.

There are, however, some things which can be done without employing professional support. An initial assessment of the local resource can be undertaken, for example, to determine whether there is a local source of wood waste. The measurement of water flow in a river and drop in height between the proposed water extraction point and possible turbine site is also easily measured to give the approximate power output at a potential hydropower site. In addition, country studies may be available giving a rough indication of the available wind or solar resource.

Before committing significant finance to the design and construction of a renewable energy scheme, however, it is highly advisable that independent professional advice be obtained. Also, all systems will need to be fully tested and commissioned by a qualified person.

It is highly recommended that professional advice be obtained at an early stage in site development. An initial site visit and discussions with the developer and others will enable an experienced professional to determine whether a site is worth considering further.

CAN WE SELL RENEWABLE ENERGY?

For both electricity and other fuels it will be important to establish the prospects for selling fuel early on. Particularly for small schemes, however, it is usually beneficial to try to match the generation of electricity with the local demand as closely as possible. Where there is a local electricity grid connection it will often be possible to sell electricity back to the grid. In many cases the price paid for the electricity will be low, but in some regions a good price can be obtained (an average EURO 0.086/kWh in Germany in 1998). At present this is highly variable from country to country *(see table below)* and it is vital that those considering developing a scheme obtain updated information from their regional or local distribution company.

PRICE OF RENEWABLE ENERGY SOLD IN 9 COUNTRIES OF THE EUROPEAN UNION (AUGUST 1997)

Country	EUR/kWh
Germany	0.086
Italy	0.083
Denmark	0.079
Spain	0.068
France	0.056
Portugal	0.053
Belgium	0.052
United Kingdom	0.049
Netherlands	0.036

Source: *European Commission,* ***"Electricity from renewable energy sources and the internal electricity market"****, European Commission working document, 1999.*

ARE THERE SOURCES OF FINANCIAL SUPPORT AVAILABLE?

There are many national and European Commission programmes which provide funding for renewable energy projects ***(see factsheet 10)***.

HOW DO WE DEVELOP A SUCCESSFUL PROJECT?

There are several factors which appear decisive in making a project successful ***(see factsheet 7)***, including:
- > obtaining good initial information,
- > having an adequate local resource,
- > establishing a core team to take the ideas into fruition,
- > ensuring that the project fits in with the identity of the region.

WHAT WILL THE IMPACT BE ON THE REGION?

Just like many other developments renewable energy schemes can create or secure jobs in a region, help to improve people's standard of living and be a catalyst for further regional development projects.

All types of project have an impact of some sort. In many cases it is believed that renewable energy projects help to improve the image of a region, particularly those schemes which have a strong educational element.

WHERE CAN WE OBTAIN FURTHER INFORMATION?

There are many good sources of information available for very little or no cost. *The organisations listed in* ***factsheet 13*** *are a good first point of call.*

FACTSHEET 3
SOLAR ENERGY

The sun is the source of the vast majority of the energy which we use each and every day. The direct heating effect of the sun, the wind and waves, and even fossil fuels have derived their energy from its rays. There are many different ways in which to utilise solar energy the most appropriate will be dependent upon the local situation.

Buildings can be designed to utilise the direct heating and lighting effects of the sun in order to reduce the amount of energy needed. Passive solar techniques aim to make the best use of energy from the sun through, for example, large southfacing windows in northern latitudes and heat storage walls. In the agricultural sector solar energy is used primarily to heat greenhouses and to dry harvested crops using simple technology to harness low temperature heat.

Solar energy is also widely used for heating water, particularly in parts of the Mediterranean. A solar water heater consists of a panel through which water is passed, with the heat of the sun on the panel warming the water. Such a system can provide hot water directly or for use in a central heating system. On a much larger scale solar water heating has been used for district heating and for heating swimming pools.

Photovoltaic (PV) panels are able to general electricity from the sun's rays. Most people will be familiar with this concept from solar powered calculators which use a few photovoltaic cells to convert light into electricity to power the calculator. On a larger scale photovoltaic panels can be incorporated into building roofs and walls to provide electricity for offices and homes. The electricity can be used to meet the immediate electricity demands within a building with any surplus solar electricity being fed to the grid where appropriate.

MEASURING THE RESOURCE

The number of hours of sunshine, the latitude, altitude, geographical relief, cloud cover and shading are all important parameters which need to be taken into account when considering how to harness solar energy. National meteorological institutes are able to provide data and maps of the incident solar radiation in a region. A visual inspection of a site will also be needed to assess whether there will be an impact from shading from other buildings, for example, or other limiting factors caused by microclimatic conditions.

Obviously, annual solar radiation levels are generally higher in southern Europe than they are in northern Europe. However, solar technology, particularly passive and active solar technologies, can still be cost effective in northern latitudes even where there is an apparent large amount of time spent under cloud cover. As most solar heating applications only require collectors to be faced anywhere from southeast to southwest, a large proportion of existing building stock will have roof orientations suitable for solar energy systems. In order to collect as much solar radiation as possible, a surface must be tilted towards the sun. How much it should be tilted is dependent upon the latitude and at what time of year most solar collection is required.

DEVELOPING A SCHEME

Passive solar heating

"Passive" solar measures such as orientating a building towards the south, concentrating the glazing on the south side and avoiding shading of windows are relatively easy to design into a new building, but are often much more expensive and difficult to incorporate into existing buildings. However, measures such as fitting a conservatory on to an existing wall, for example, can still be cost effective. Architects are best able to advise on the options available for both new and existing buildings.

Solar water systems

There are several types of solar collector used for water heating, the most popular of which is the flat plate water collector. This consists of a layer of glazing over a black absorber plate through which water is passed to be heated by the sun. A solar water heating system for an individual household will have an area of about 34 m^2. Another device is the evacuated tube, able to heat water to much higher temperatures. These are tubes, similar in appearance to long fluorescent lamps, consisting of an evacuated glass tube with a heat absorbing plate and a heat pipe running up the centre. An array of 20 to 30 tubes is normally used for an individual house.

These types of system can be supplied and installed on a building relatively easily, either by professional contractors or indeed by anyone with good plumbing skills. They are usually mounted on the roof of a building and need to be firmly secured in a leakproof manner.

Photovoltaic systems

The panels of a PV system can be mounted on the ground or on a building. There are three possible methods of mounting solar PV modules to a roof:

> **Surface mounted system** – The modules are mounted on a steel or aluminium frame which is fastened to the finished roof structure. These are probably the cheapest to install.

> **Integrated system –** The modules are mounted directly onto the roofing rafters, providing weatherproofing. Rather than lying adjacent to the roof surface, the modules are integrated into the roofing structure, meaning that the costs are partially offset against the need for conventional exterior roofing materials. Roofintegrated systems are less visually intrusive than surface mounted systems.

- > **Tiling system –** Solar electric roof tiles are available from a number of manufacturers. Although the cost of the tiles is high compared to conventionally framed modules, some of the difference in cost will be offset by the fact that there is no need for a mounting structure. They have a neat and conventional appearance and are simple to install.

The size of the array will depend on the amount of electricity needed and the suitable space available. A system that requires an array with a peak output of 2 kW will typically require panels with a surface area of between 1250m^2, depending on the efficiency and type of the modules. This is usually sufficient for over half of an average household's electricity needs.
Modules can be expected to have a lifetime of up to 30 years and so their corresponding support structure should also be designed for longlife using corrosion resistant material. However, easy access to the modules will be essential for maintenance and cleaning. If modules can be replaced individually this will assist in cases where single modules need to be replaced. A solar electric scheme has no moving parts and maintenance will be minimal.

ECONOMICS

It is cheaper to install solar systems into buildings when they are being built rather than retrofitting existing buildings (in some cases it may not be possible to obtain planning permission to retrofit an old building). Solar panels can be used as a facade for a building, in which case they can offset some of the cost of the material which would otherwise be used on the front of the building. Such uses of photovoltaics are still relatively expensive and will only be economically viable in most cases if grants can be obtained to support the project (perhaps to test the equipment).

The capital cost of a PV system will include not only the cost of the PV panels themselves, but also the cost of connecting the modules, the panel support structure, the cost of cabling, charge regulators, switching and inverters, plus the cost of storage batteries or connection to the grid.

Solar heating and PV systems need to be able to withstand the impact of the elements. Water can cause corrosion to metal parts, and high winds can damage the structures and crack the modules. The expansion and contraction may cause cracking. Most of these risks can be overcome with a well designed system. The major risk associated with a solar heating system is from leakage. Typical risks associated with a PV scheme include inaccurate solar data and lightning. There are not any particular added risks associated with a passive solar installation.

SOLAR POWER AND THE ENVIRONMENT

Passive and active solar heating techniques have very few environmental impacts other than from a visual perspective. In operation, photovoltaic panels are silent and have no emissions. The environmental impact is predominantly influenced by the building to which they are attached, or landscape in which they are placed, and planning considerations will be similar to those for any other new building or alteration of an existing building.

Example: Homerton Grove Adventure Playground (England, UK)

The Homerton Grove Adventure Playground Association, a registered charity, decided to construct a new building incorporating a low energy design and PV system. The scheme, which incorporated 54 solar electric tiles, had a peak output of 1.9 kW. A 1.8 kW inverter is used to provide an AC supply, enabling the scheme to be connected to the electricity grid. The local utility were very supportive and did not charge the charity for grid connection.
The solar electric roof tiles were installed in two days, in the conventional way, with clay roof tiles to surround them. The total solar system cost including roof tiles, the inverter and installation was ECU 25,600. Over the course of a year, it generates around 1,425 kWh of electricity and exports surplus power to the local electricity utility for ECU 0.035/kWh.

[Source: Greenpeace UK, London]

FACTSHEET 4
WIND POWER

People have been harnessing energy from the wind for grinding wheat and pumping water for thousands of years. This century the technology has also been adapted to produce electricity, there now being thousands of operating turbines in Europe.

Wind power can be harnessed almost anywhere and on almost any scale. Large wind farms can provide sufficient power for tens of thousands of grid connected households, while small turbines can provide electricity to an individual house or a farm. Even smaller turbines (of say between 50W-250W) can meet a wide variety of needs, supplying power for:

> animal feed dispensers,
> remote weather stations,
> electric fences for farms,
> communication equipment,
> lighting for isolated buildings,
> lighting and a TV for a caravan.

There are many isolated households which use wind turbines to provide for their electricity needs where it is not feasible to connect to the electricity grid. This typically involves using a turbine with a capacity between 1 kW and 4 kW connected to a system of batteries, sometimes in combination with a backup generator (typically diesel) which can operate during periods when there is no wind. In times of high wind surplus, output can be used to heat water, but it is not usually economic to have this as the primary usage. Remote communities or business premises can make use of larger turbines as part of such a system. Turbines which have a capacity of 50kW, or more, are usually connected to the electricity grid system.
Modern turbines usually have three blades, but there are multiblade turbines which are more suitable for pumping water than generating electricity.

WIND SITE SURVEY

One of the main factors which will determine the economic viability of a wind power project is the annual mean wind speed at a site. The power produced by a wind turbine depends on several parameters including the wind speed (the main factor), the area swept by the blades and the efficiency of the rotor and generator. The power output can be doubled by increasing the rotor blade length by 40%, or by an increase in wind speed, for example, from 6 metres per second (m/s) to 7.5m/s.

Wind speeds vary enormously from region to region and from valley floor to hilltop, so wind speed measurements will usually be needed for virtually all proposed developments, other than those for only a few kilowatts. For schemes larger than about 10 kW onsite wind measurements will usually be required, with results being correlated to longer term, local meteorological data of average wind speed in the region. For smaller schemes, meteorological data may be all that is required, even though there will be some discrepancy between the data and the actual wind speed at a given site.

A full wind speed assessment will normally involve:

> erecting a mast, preferably of similar height to the proposed turbine, with a recording anemometer,
> monitoring the wind speeds and direction over an extended period,
> correlating the data with long term records from local meteorological stations.

A data collection period of six months is generally thought to be minimum to obtain reasonably reliable results, but a 12month collection period will reduce the uncertainty in the estimates as all seasonal weather patterns will have been recorded.

DEVELOPING A SCHEME

The development process that needs to be followed for a wind power scheme is highly dependent on the size of the schemes.

If what is required is a small wind turbine to charge batteries for lighting, for example, the feasibility assessment will be very minimal. A turbine supplier or manufacturer will in most cases be able to provide all the information required. Installation at the site is also likely to be very straight forward and no outside consultancy should be required. A 72 W Windcharger, for example, weighs less than 15 kg and can be mounted on a mast made from standard steel pipe.

Even a small wind power scheme for an individual building, for example, can be designed and installed by a turbine supplier. A small 2.5 kW machine, with a 3.5 metre diameter rotor on a 6.5 metre mast is often suitable for domestic supply where there is no grid connection.

Larger schemes, however, will require the involvement of specialist wind power consultants. As well as the steps shown on factsheet 7, it will also be important to:

> investigate the site's geological conditions,
> determine the optimum turbine positions, and
> check on access routes for construction vehicles and for maintenance of the turbines and power lines.

ECONOMICS

The cost of electricity from wind turbines is extremely sitespecific. Typically, large wind turbines selling electricity to the grid can be financially viable where the average wind speed is greater than about 7m/s. Smaller turbines and wind pumps may be viable with average wind speeds as low as 5m/s, if the alternative is a more expensive power source such as a diesel generator.

A manufacturer will usually provide information on the anticipated annual energy production for a range of average wind speeds. A doubling of the wind speed leads to an eightfold increase in power and in very light winds no power will be produced. It is therefore vital to try to site a turbine in a place where the wind speed is greatest, but is sensitive to local environmental conditions. Siting a turbine on a nearby hill, however, may yield more energy but the cabling costs may be greater than if the turbines had been located close to the buildings where the energy is to be used. This may be particularly relevant for small schemes. If a turbine is placed too close to buildings or trees, however, the wind speed can be reduced. For larger schemes the availability of a local grid connection point can also be a major factor to be considered in siting the scheme.

Generally the costs involved in setting up a gridconnected wind farm are: manufacture of wind turbines (65%); infrastructure (25%); financing and legal costs (5%); and grid connection (5%). Successful schemes in the UK, for example, are able to develop the whole scheme for a capital and installation cost of between ECU 1,000 to ECU 1,700 per installed kW. Annual operating and maintenance costs are approximately 1.5% of the total capital costs.

The European Wind Energy Association states that 1 MW of installed capacity creates jobs for 1519 people on average in Europe.

OUTPUT FROM SOME TYPICAL WIND TURBINES

Av. wind speed (m/s)	8	7,7	7,5	6,2
Hub height (m)	41	31,5	25	6,5
Rotor diameter (m)	41	27	15	3,5
Rated output (kW)	500	225	50	2,5
Energy (MWh/year)	1650	740	180	5,7

N.B. Average wind speed increases with the height of the tower.

Risks associated with a wind power development which need to be considered and possibly insured against include: lightning, blade damage, third party injury, storm, vandalism, electromagnetic interference, inaccurate wind data, refusal of planning consent and failed grid connection. It should be pointed out that the risks involved are typically no greater than for other similar types of development.

WIND POWER AND THE ENVIRONMENT

Wind turbines use only a small area, typically only 1%2%, of the land upon which they are sited. Consequently, where the land has been used for crops or livestock, this can continue right up to the turbine base, allowing 98%-99% of the land to remain in agricultural use.

The issue of visual impact is often considered to be the most important. It is, however, a highly subjective issue and can depend on a variety of factors, particularly the landscape in which the turbines are sited. Careful siting and layout of wind turbines can help address these issues and enhance public acceptability of a scheme. A preliminary assessment of visual impact using, for example, photomontage techniques can help to give an indication of the way in which a scheme will look.

There is also some concern over the amount of noise made by the turbines. In fact, studies have shown that at a distance of 350 metres, a wind farm is only slightly louder than a quiet room. Furthermore, the trend is towards quieter turbines as the technology develops and improves. Very small wind turbines are often quiet enough to be sited much closer to a dwelling without causing a disturbance.

Another possible issue of concern in some regions is the impact which a wind farm can have upon birds. In general, however, bird strikes are typically no higher than those experienced with other forms of infrastructure, such as roads, or overhead powerlines.

Wind farms can interfere with television and radio reception as well as other communications signals. For large schemes an assessment will be needed to determine whether the installation of signal boosters will be needed to overcome the problem.

Example: Dottrel Cottage Pig Farm (England, UK)

An 80 kW wind turbine was installed at this moderately windy site, 100 metres above sea level. About 60%70% of the power is used on the farm, displacing electricity purchased at an average of ECU 0.089/kWh. Surplus power is sold to the local electricity utility for ECU 0.03/kWh.

Annual cost savings over what used to be paid for the electricity amount to ECU 12,800 and the expected payback period for the capital expenditure of ECU 100,800 is 10 years. The availability of cheap electricity has also boosted the economics of a new milling business on the farm. Routine servicing is done twice per year by the farmer and occupies about half a day on each occasion.

[Source: Scottish Agricultural College, Edinburgh].

FACTSHEET 5
HYDROPOWER

People have been using water wheels to harness the energy from rivers and streams for thousands of years. Modern hydropower turbines, based on these same principles, presently produce about onefifth of the world's annual electricity output.

Large hydropower schemes (which are not covered in this factsheet) typically require a reservoir to provide water storage. Smallscale hydropower schemes, on the other hand, are usually runofftheriver, using a weir to divert some of the water through a turbine without requiring a reservoir.

The amount of power that can be obtained from a turbine is primarily determined by the volume of water and the height through which the water falls through a scheme's high pressure pipe work (known as the 'head'). The larger the flow of water and the larger the drop in height, the greater the power output.

Once operational, a well designed and well engineered smallscale hydropower scheme will last a very long time. If regularly maintained, the turbine and generator equipment will typically operate effectively for 40 years before major refurbishment work or replacement is required. Suitably installed civil structures such as weirs, intake canals, tailraces and buildings may be expected to last for well over 100 years.

Although approximately 40% of Europe's total hydropower potential has already been developed, there are many possible smallscale hydropower sites, as well as significant potential for uprating and refurbishing existing schemes.

HYDROPOWER SITE SURVEY

Generally at least 612 months of accurate water flow data at or near to the site is required. This then needs to be correlated to approximately 10 years of rainfall data from historical meteorological records and to records from nearby river gauging stations to give an indication of the mean flow rate and the way in which the flow of water typically varies throughout the year. Obtaining and analysing this data can cost in the region of ECU 7,000 *(to enable comparison, all figures on this factsheet are typical UK costs)*.

While it is recommended that professional advice be obtained to make accurate measurements, it is possible to make an initial assessment of the potential power which can be obtained from a stream. This requires the measurement of water flow and the head height. There are different ways to do this. *(see the hydropower publication list in factsheet 12)*.

DEVELOPING A SCHEME

Hydropower schemes can be developed in many types of locations, from mountain areas where there are fastflowing mountain streams, to lowland areas with wide rivers. Most new smallscale hydropower schemes are situated in hilly areas and use a relatively small volume of water. In general, the lower the head, the larger the volume of water required for the same output. As well as a suitable flow of water, a site will also need to be able to accommodate a weir and a turbine house, which can be difficult and expensive on lowlying rivers. However, there are some lowlying sites, primarily where it is possible to make use of existing civil works from an old mill, which can be economically viable and environmentally acceptable.

A typical hydropower project will take approximately two years from conception to completion, with construction times being less than six months. Much will depend upon the time taken to obtain planning permission. In general, refurbishment projects are likely to suffer fewer delays in obtaining consents and will require less time to construct as the civil works will already be present.

Every hydropower site is different, requiring its own tailored design. Before committing significant finance to the design and construction of a hydropower scheme it is vital that independent professional advice be obtained. An initial site visit will enable an experienced professional to determine whether a site is worth considering further. This will generally require no more than two days work and may cost between ECU 450 and ECU 1,100.

The cost of a feasibility study carried out by an independent consultant depends on its scope and on the specific characteristics of the site, but would typically be around ECU 7,000 to ECU 20,000 for a 50 kW500 kW scheme.

The construction work, installation and commissioning of the equipment will usually all need to be undertaken by professionals.

ECONOMICS

Hydropower schemes are typified by:

> a large initial capital outlay per kW of generating capacity,
> a long lifetime for the scheme,
> high reliability and availability,
> low running costs, generally 1%2% of capital costs, and
> no annual fuel costs.

Hydro schemes usually require that most of the cost be met at the start of the project and once operational it will run for several decades without substantial further expenditure.

Capital costs are highly dependent upon the details of a particular scheme. The civil works for a low lying scheme can be very expensive unless existing civil works from an old mill can be used.

The table below shows average cost estimates for both greenfield sites where there has been no previous water power usage and for the refurbishment of former water power sites (the costs should be treated with caution as the actual cost will depend upon many factors):

CAPITAL COST PER INSTALLED KW (TYPICAL FOR UK)

Greenfield high head site	EUR 1,350 – EUR 3,500
Refurbished low head site	EUR 1,500 – EUR 4,000

Generally the cost per kW of installed capacity decreases as both the head and the capacity of the scheme increase. Low lying rivers are also likely to have fish in them and may therefore need a fish pass to be constructed, which will be an extra cost in the region of ECU 28,000. Providing fish protection at turbine intakes will cost anything between ECU 5,500 and ECU 14,000 and a further ECU 7,000 for fish protection at the turbine fallout on migratory salmon rivers.

The risks associated with a hydropower scheme which would affect income generation include: lack of water, collapse of the weir, piping or canal workings, and failed grid connection.

There will be many jobs created during the construction stage of a hydropower scheme. However, once operational, a scheme will generally only require parttime input.

INDICATIVE COSTS FOR AN ECONOMICALLY VIABLE 200 KW HYDROPOWER SCHEME WITH A HIGH HEAD OF 200 METRES

Capital costs:

Turbines	ECU 64,000
Commissioning and installation	ECU 75,000
Civil and electrical engineering	ECU 115,000
Miscellaneous costs	ECU 16,000
Total capital cost	**ECU 270,000**

Annual operating costs:

Operation and maintenance	ECU 8,500
Other costs	ECU 2,500
Total annual operating costs	ECU 11,000

Such a scheme would typically generate well over 1 million kWh/annum. If this is offsetting electricity costs of ECU 0.09/kWh, say, the electricity generated will be worth at least ECU 90,000. Where the electricity is sold to the grid for ECU 0.04/kWh, say, the income will be at least ECU 40,000 and the scheme will take approximately 10 years to pay for itself. A 200 kW hydropower scheme, for example, will typically supply enough electricity for approximately 200 homes.

HYDROPOWER AND THE ENVIRONMENT

The environmental impacts associated with largescale hydropower developments are often very substantial. However, the environmental impacts of smallscale schemes are usually considerably less, but nevertheless need to be fully addressed.

Although hydro schemes are nonpolluting, site specific environmental concerns including landscape impact, noise and the effect of water abstraction on fish and other wildlife, all need to be taken into account. Altering the rate of water flow on a water course can affect habitats down stream and fluctuating water levels in reservoirs can also have an impact.

Information may be required on the impact of a scheme upon fish habitats, population and migration.

If so, survey work may be required throughout the full cycle of a season in order to prepare an Environmental Statement for a proposal.

A scheme's structures (turbine house, weir, pipe work, electricity distribution lines and access track) may also have a visual impact which needs to be considered.

Early consultation with interested parties will help to ensure that any problems are identified at an early stage.

Example: The smallscale hydropower scheme at Glen Lyn Gorge (England, UK)

A grid connected smallscale hydropower scheme (78 metre head), developed at Glen Lyn Gorge in the Exmoor National Park in Devon, generates 300 kW at full power and supplies an average output to the grid of 1.44GWh/year. The scheme, which encompasses a public exhibition centre, is privately owned and operated by a local company. Before being given the go ahead, a water abstraction licence was required for the site and planning permission had to be obtained for both the turbine house and the pipeline, part of which had to be buried. The total capital cost was ECU 315,000, with funding coming from the private sector. Payback was forecast to be within four years. One fulltime person is required on site to regulate the machinery.

FACTSHEET 6
ENERGY FROM BIOMASS

Biomass remains the world's fourth largest energy source and the major fuel for threequarters of the world's population. It also makes a major contribution to the energy supply in several European countries.

There are a variety of ways in which the energy stored up in biomass can be harnessed. The most obvious is by utilising the heat from burning the material either directly, or by producing steam to generate electricity. Biomass can be used to generate electricity in this way in a combined heat and power (CHP) scheme with the 'waste' heat being used either in a district heating system or an industrial process. Other methods of obtaining energy from biomass involve the production of gas through digestion, or gasification, and the production of liquid fuels.

Usable biomass sources include: wood wastes (e.g. forest residues, sawmill and construction/industrial residues); agricultural wastes (e.g. straw, slurry); short rotation forestry (e.g. willow, poplar); sugar crops (e.g. sugarbeet, sugar cane); starch crops (e.g. wheat, maize); herbaceous lignocellulosic crops (e.g. miscanthus); oil crops (e.g. rapeseed, sunflower); separated municipal solid waste and refuse; and industrial wastes (e.g. residues from the food and drinks industries).

Using forest waste is a well understood process and one which is commercially viable in several countries. A proportion of the tree is always unsuitable for timber or pulp use and in some cases this can be as much as 50%. The brash, which can comprise 30%40% by weight of a tree for conifer crops and over 50% for deciduous crops can be collected and chipped. Removing brash from forest sites aids replanting and minimises the risk of disease for the new crop, but on the other hand it can also remove nutrients. Another source of waste wood is offcuts and sawdust from wood processing and waste from papermills.

Trees can also be grown specifically for energy production by a method known as short rotation coppicing. Typically, trees are planted as cuttings into cultivated land, allowed to grow for 34 years, and then harvested by cutting back to ground level. The crop then regrows, enabling successive harvests at three year intervals over a period of 25 to 30 years. Suitable species, which include willow and poplar, have to be grown on terrain suitable for mechanical harvesting to enable them to be cut back by a machine similar to a combine harvester. The harvested crop is chipped and dried before being used as a fuel. Short rotation coppicing, which can be grown on set aside land, generally requires blocks of ten hectares or more for economies of scale.

Agricultural wastes provide another source of energy. Animal wastes, including chicken litter and slurry from intensively reared stock, and straw and other crop waste can provide a useful source of energy.

Plantbased oils can also be used as transport fuels, known as biodiesels, giving a performance similar to conventional diesel. Suitable crops include sunflower, soya, rape, linseed, maize, olives and dates. Recycled waste vegetable oils can also be used in this way.

Useful energy can also be obtained from sugar cane and sugar beet. More than four million Brazilian vehicles run on ethanol produced from sugar cane.

Finally, energy can be obtained from domestic waste and tyres, although these are not strictly renewable sources of energy, as tyres and the plastics in domestic waste are made from fossil fuels.

ASSESSING THE AVAILABLE RESOURCE

The first step in assessing the locally available resource is to look at the land uses in the region, in particular the types of crops grown and whether there are any resulting waste residues which are not presently being used. These can include such things as wood remaining after felling in forests, straw or olive stones.

Where it appears that there may be significant amounts of available residues it is worth considering employing a consultant to calculate the total annual resource and its energy content, which varies significantly from resource to resource.

The yield and economic viability of specifically grown biomass crops will vary widely, depending upon soil type, climate, crop type, existing land use patterns, farm size, crop husbandry and socioeconomic factors related to the uptake of the technology in the region. An assessment of the practical resource that can be realistically harvested and brought in to the market therefore needs to be carried out on a scheme specific basis. This will involve discussions with local farmers or land owners to assess their interest in diversifying into biofuels.

DEVELOPING A SCHEME

Once a sufficient resource has been established, it will be necessary to determine what is the best method of harvesting it, storing it and converting it into energy. The type of equipment needed for the different fuels and their uses will vary considerably, depending on whether it is used for space heating, for hot water, for electricity generation or for transport. This ranges from: chipping equipment to produce wood chips and a boiler to burn the fuel to produce hot water; gasifying equipment used in conjunction with a combined heat and power system to produce electricity and space heating via a district heating system; pyrolysis equipment to produce charcoal; fermentation equipment to produce liquid fuels; or crushing and chemical processing equipment to produce a good

diesel substitute. It would be impossible to go into detail for all of these technologies on this factsheet. Further details can be obtained from one of the publications shown on **factsheet 12**, or by contacting the European Association for Biomass ***(factsheet 13)***.

ECONOMICS

Unlike most other sources of renewable energy, biomass schemes have high operational and fuel costs. The supply of fuel is therefore central to the viability of a scheme its proximity to where it is to be used and the reliability of supply being of major importance. The economics of a particular scheme also depend heavily upon the type of fuel, the technology used and the region in which it is being developed.

The economic viability of biomass schemes has seen a significant improvement in many countries over the last few years, and in countries such as Austria and Denmark, it has been used extensively for many years.

Typical risks associated with a biomass development which need to be considered include: problems with transport of the fuel or waste, changes in the calorific value of the fuel, problems with fuel storage, environmental damage from operation and ash disposal, default of the grower and disease/drought limiting fuel supply.

A biomass scheme will generate several permanent jobs in the growing and/or collection of the fuel and at least one parttime job in operating the boiler or other equipment. It is often advantageous for several growers to get together to take responsibility for the management and marketing of the crops and to sell in bulk.

BIOMASS AND THE ENVIRONMENT

A careful assessment of the ecosystem needs to be carried out before the development of an energy crop, particularly if it is of intensive monoculture. Large areas of monoculture are susceptible to disease and may require the use of pesticides, which may have a subsequent impact upon biodiversity. This can be overcome by using a mixed variety of plants and no artificial fertilisers or pesticides.

There is also a need to protect soil fertility and so the harvesting of forestry waste should be avoided on sites where this may lead to nutrient depletion. Transportation of the fuel may be an issue for biomass schemes if the power station is sited some way from the fuel source. Special consideration should also be given to hydrological impacts of using water for the crop. Landscape and visibility may also be an issue where a crop will be a new feature in the landscape.

Burning biomass causes carbon dioxide emissions. The advantage compared to fossil fuels is that the carbon dioxide released is equivalent to that taken up by the biomass as it grew There is, therefore, no net release of carbon dioxide from the growing and burning of biomass. There can, however, be associated carbon dioxide emissions from the production of fertilisers, and from the harvesting and transportation of the biomass. Biomass sources are also less environmentally damaging than coal or oil in that they produce virtually no sulphur emissions.

Example: A community owned woodchipfired heating project (Svebolle, Denmark)

A committee was established by the local community in the small town of Svebolle, 90 km west of Copenhagen, to assess the potential for a district heating system for the town. They employed a local engineering company to undertake a feasibility study on a contingency basis, with a fee of ECU 8,000 only being paid if the project came to fruition.

The favoured fuel was originally waste oil, but as most of the local waste oil was being recycled, wood chips were considered to be the next best option.

A detailed prospectus was prepared and distributed to every property in Svebolle to inform all potential customers of the proposals in order to obtain as many commitments as possible for the scheme. A commitment from 50% of households was needed to make the scheme viable. Incentives were offered a discount of ECU 335 from the first year's bill was offered to those joining immediately and ECU 200 for later joiners. Connection to the system was initially free, but once the system's distribution pipes were laid and covered, new consumers would need to pay a substantial charge to connect. Contracts were eventually entered into for a 20year period with 352 users, including 72% of households, four shops, a school, a sports hall, the Town Hall, two kindergartens and 12 industrial units.

The total cost of the project was ECU 5.35 million financed by various loans. Income from 7,500 MWh sold per year is ECU 695,000; expenditure on wood chips and oil ECU 160,000; cost of loans ECU 455,000; other costs ECU 40,000; leaving a ECU 40,000 surplus.

Clear support from the Danish Government seems to have been central to making the scheme work. This included consumers being offered home improvement grants for connection to the district heating system. But what seemed to motivate consumers the most was not so much their concern for green issues but the idea that they would save money (source: ETSU, Harwell, UK).

FACTSHEET 7
THE MAIN STEPS OF A SCHEME

Harnessing a renewable source of energy involves a series of important steps and tasks, beginning with the team that has to be set up to run the scheme and ending with the installations that have to be decommissioned.

TIMING OF THE DEVELOPMENT PROCESS

The development process is often iterative, requiring some aspects to be reworked. The timing and order of particular phases will vary due to particular project circumstances, some will overlap and indeed some may be bypassed altogether, particularly for small schemes. The time required to measure the available renewable resource and to secure contracts is often substantial for larger schemes.

FORMATION OF A CORE TEAM

The first step is to create a core team which will take responsibility for taking the scheme forward. A meeting of interested parties to decide upon a development principle and to formulate an initial business plan will be helpful. Few groups, however, will be able to provide the necessary expertise and experience to develop a project fully without engaging expert input at some stage.

AWARENESS RAISING

Even at this early stage it is advisable to raise awareness about the proposed ideas locally and to consult with communities near to potential sites. Identifying and engaging potential partners at an early stage often helps to increase the momentum for a scheme.

Discussions with local communities can help to identify and even make available sites which had not been anticipated. Even where this does not occur, involving local people at this stage and encouraging local investment in a scheme can be important for engendering public support.

SITE SEARCH

Before committing significant funds to a full feasibility study for a particular site, it is often wise to undertake prefeasibility work to identify various potential sites. This could be undertaken in part or solely by the core group, depending on available expertise, using approximate data. A group may be eager to promote a specific technology and will look for an appropriate site, or may alternatively consider which technology is most appropriate to a particular site. Sites for smallscale hydropower, for example, are very limited, while solar power projects can generally be included in many places, particularly on new buildings.

At this stage, it will also be important to:

> obtain a rough approximation of how good the renewable energy resource is at potential sites,
> undertake initial consultations to determine who owns the land at a particular site,
> speak to the relevant planning officer and determine the planning authority's reactions/requirements at an early stage,
> identify any locally sensitive features (e.g. historic monuments) or designated areas which could restrict development,
> consider the reaction of local environmental and conservation groups,
> investigate possible networking and partnership opportunities,
> estimate the level of noise at the nearest habitation,
> consider how accessible the site is, and
> for a scheme which may need to be connected to the electricity grid, consider how close a site is to a suitable connection point on the grid. Early discussions held with the grid company to determine feasibility and to outline connection costs will also be helpful.

LAND NEGOTIATION

Once a potential site has been chosen, negotiations over land use can be entered into to allow for proper measures of the resource.

MEASUREMENT OF THE RESOURCE

The installed capacity and energy yield at a particular location will vary considerably, depending on local site conditions. Renewable energy sources which depend upon weather may require monitoring over a period of up to a year, as well as requiring research into past weather data. Conducting the appropriate hydrological, or wind speed surveys, normally requires the services of experienced professionals who will also be able to help verify any preliminary work which may already have been done at the site selection stage.

Resource management activities are often highly visible and it is usually beneficial to ensure that local communities are made aware of the nature of the investigations before measuring equipment is installed.

FEASIBILITY OF A SCHEME

Once the potential resource at a site has been measured, a full feasibility study can be undertaken. This will take into account the technical feasibility, potential market for the energy and funding opportunities to give an indication of the viability of a scheme and determine whether it is worth investing further resources.

It is advisable to have professional input into the feasibility study as it may be used by planning authorities, financiers and others when making their decisions about the project.

A feasibility study will involve an investigation of planning, legal and environmental considerations. Early attention will need to be paid to the requirements for planning consent many soundly conceived projects fall through due to problems related to planning, permits and consents. To help avoid this, a checklist could be prepared which describes all of the necessary permits and consents needed for the development, and a plan developed describing how these permits and consent will be obtained. In most cases it will be advantageous to have further contact with the planning authorities at this stage and it may be beneficial to get advice from an external planning consultant. An environmental statement for the project may also be required.

Another key component of the feasibility study will be to estimate the energy output and analyse its sensitivity to variations, including seasonal weather conditions. An energy demand study will also be required, assessing both onsite power demand and the likelihood of securing an off-site energy sales agreement. Once the likely demand and the resource has been established, the size of the proposed system can be considered to give an idea of the scheme design. An economic assessment, taking into account system costs and income generation, will now be possible. At this point, further consideration of the business structure and its legal status (e.g. cooperative partnership, joint venture with a utility company) will also be needed. Preliminary discussions with potential financial partners and bankers will enable an outline financial appraisal to be completed.

DETAILED ASSESSMENT

Once a site has been chosen, following a favourable feasibility study, a detailed assessment of viability will be needed along with a detailed business plan. These include details of such things as a description of the overall development process (stages, timing, funding), the impacts of the construction phase (lorry access, noise), estimates of costs (construction, operation and maintenance) and the implications of operation (maintenance, dealing with emergencies).

For all but very small schemes a full design study will need to be conducted by consultants. This will involve, for example, specification and design of the system, selection of appropriate equipment, design of any grid connection, foundations and access roads. There are a number of technical regulations and standards with which private generators have to comply if they are to be connected to the grid. An assessment of operating and maintenance requirements will also be needed.

A revision of financial calculations is essential at this stage to determine the financial requirements that need to be secured and the insurance requirements. Further consultation with interested parties and energy purchases will be needed, along with a decision about the nature of ownership and control of the development.

An outline planning application can be discussed with planning, regulatory and consenting authorities. For large schemes an Environmental Impact Assessment may be required at this point to assess potential environmental effects. It is advisable to share this information with local communities as early as possible.

SECURING COMMITMENT

It is vital to secure commitment from stakeholders before committing further. This will include all lenders, landowners, shareholders, the operators, insurance companies, energy purchasers/users and suppliers.

PLANNING APPLICATION

When the site has been shown to be suitable and viable for development, and when consultation at the local level has resulted in a definite plan for all aspects of the project, a formal planning application can be made.

CHOOSING THE LEGAL STRUCTURE

Before appointing contractors and suppliers, a formalised legal structure for the project needs to be established, involving:

> site lease agreements,
> loan agreements,
> electricity connection agreements,
> fuel and waste supply contracts,
> electricity/heat sales contracts,
> operating and maintenance agreements,
> engineering procurement and construction agreements,
> shareholders agreements, and
> insurance agreements.

It is now time to finalise all legal and financial matters, to raise equity and secure debt finance.

CONSTRUCTION

Once all agreements have been reached, planning approved, investments secured and design finalised, construction of the project can begin.

OPERATION AND MAINTENANCE

Operation will require ongoing project management. Repayment of loans and/or dividends to community investors will also require administrative support. And, after decades of operation, it may also be financially beneficial to undertake a major refurbishment of the plant.

DECOMMISSIONING

Decommissioning should always be considered in the detailed design phase.

SOME PITFALLS TO AVOID WHEN DEVELOPING A SCHEME

Pitfalls to avoid	How to avoid them
Lack of professional advice, especially at the planning stage.	Hire a recognised independent consultant, at least for the feasibility study, before embarking on the construction phase.
A shortterm view means poor choices in the beginning (poor assessment of expected energy savings and often poor selection of material), resulting in low efficiency and additional expenditure to solve the problem.	Make sure the site study and characteristics of the scheme are at a sufficiently advanced stage to proceed to the construction phase.
Poorly drafted contracts for construction and the supply of equipment.	Use standard contracts; clearly define project cost and operating responsibilities, with the consent and written agreement of each of the parties concerned.

FACTSHEET 8
ASSESSING LOCAL ENERGY CONSUMPTION

The relevance of many renewable energy schemes depends to a large extent on local needs.

ASSESSING THE MARKET

Ensuring that there is a market for the energy produced by a scheme will be central to its success. In cases where a renewable energy project is developed in order to meet a local need for energy, for example for an isolated system, matching supply with demand will be particularly important. Even where a scheme is connected to the electricity grid there are often higher financial benefits to be gained from offsetting existing local consumption, than from the income which may be obtained from supplying the energy to the grid.

In a situation where a scheme is being designed to supply a single farm, or household, an energy assessment will be relatively straight forward, involving a calculation of average energy consumption and peak demand. Typically, a standalone system designed to provide power to a single house will require an effective capacity of between 1 kW-2 kW and some method of energy storage, usually batteries.

Other schemes may be designed to supply a larger local demand. There may be opportunities for selling power directly to large individual consumers such as a school, holiday cottages, or business premises. In this case an assessment of the demand will be a much larger exercise and is often best undertaken with expert input.

Alternatively a scheme could be connected to the electricity grid. In this case it may still be possible to supply onsite or some other local demand. In many cases, however, there is no need to match supply with demand for grid connected schemes, other than to ensure that the local grid connection point is capable of handling the peak supply of electricity from the proposed scheme. For it to be economically viable to connect to the grid, a renewable energy scheme typically needs to have a capacity of at least 50 kW.

The prospects for renewable resources to provide energy for space heating, hot water and even transport fuels could also be considered. Again, in most situations this will best be undertaken with some expert input.

At the same time as assessing local demand for energy, it is often beneficial to consider whether there are costeffective energy efficiency improvements that can be made to reduce energy demand.

ENERGY CONSUMPTION IN THE HOUSEHOLD

Household demand for space heating, warm water and electricity can place a heavy financial burden upon consumers. In most buildings, energy costs can be brought down significantly by improving the thermal insulation, using energy saving technologies and applying common sense.

In both central and northern Europe the most significant energy savings can usually be made through improvements in the provision of space heating and warm water, whereas in Mediterranean countries cooling and water heating are often the most important.

When assessing how efficiently energy is being used in a building and which improvement measures can be taken, two fundamental concepts need to be borne in mind, namely the ‘energy efficiency rating’ and the ‘Uvalue’.

ENERGY EFFICIENCY RATING

The energy efficiency rating (kWh/m^2/year) measures the amount of energy used per square metre in a building per year. It gives an indication of a building's use of energy, in a similar way to a measure of a car's fuel consumption. In Central Europe a typical house consumes approximately 70 kWh/m^2/year of energy, while an energy efficient house consumers no more than approximately 40 kWh/m^2/year. For ‘zero energy heating houses’ ratios as low as 20 kWh/m^2/year are quoted.

THE UVALUE

The Uvalue (W/m^{2}k) is a measure of how easily heat passes through part of a fabric of a building, such as a wall, roof, floor, or closed window. It indicates how much heat flows through a material per square metre at a temperature difference between each side of 1°C. The lower the Uvalue, the better the insulating effect.

	Very good Uvalue	Good Uvalue
Doors & windows	0.8	1.3
Basement ceiling	0.3	0.5
Attic ceiling	0.15	0.3
Outer walls	0.2	0.35

Source: VKJ, Richtig Heizen, Wien 1998, p.9

ROOM CONDITIONS AND HEALTH

For a healthy adult the ideal room temperature lies between 18°C and 20°C. As well as the need for good thermal insulation and cooling measures, particular attention also needs to be given to provide adequate airing and to air humidity (40% 45% is considered ideal).

SURVEYING ENERGY CONSUMPTION IN BUILDINGS

There are several key factors which determine a building's energy consumption:
> climatic conditions,
> location of the building,
> cladding material and construction,
> installed technology, and
> consumer behaviour.

In order to determine how efficiently energy is being used in a building and whether improvements need to be considered, the condition of a building needs to be rated. There are a wide variety of methods and tools which can be used to obtain a quick and approximate assessment, yet for a detailed assessment it is necessary to employ an energy consultant. Calculating the energy efficiency rating is often undertaken as a first step, it being a relatively straight forward way of evaluating energy use which can be compared to that of other similar buildings. To do this, the electrical energy and fuels used are calculated over a period of a year to account for the different uses during different seasons. The total energy consumption is then divided by the gross floor area to give the energy efficiency rating.

CALCULATING THE ENERGY EFFICIENCY RATING

Energy source	Quantity	Conversion factor	Total in kWh
Electricity (kWh)			
Oil (litre)		x 9,5	
Coal (kg)		x 7,0	
Wood (m^3)		x 800	
Gas (m^3)		x 9,5	
	Total energy consumption =		kWh
	Gross floor area =		m^2
	Energy efficiency rating =		**kWh/m^2**

If the energy efficiency rating exceeds 140 kWh/m^2 for the year, it is usually advisable to have an energy advisor investigate the potential savings which could be as much as 50% of the energy consumption.
In order to determine where improvements can best be made it will be necessary to consider the insulating ability (Uvalues) of a building's individual elements.

Building element	Insulating potential	Costs
Top floor ceiling	High	Low
Flat roof	Very high	Medium
Outer wall	Very high	Élevé
Pitched roof	Very high	Medium
Basement ceiling	Medium	Medium
Floor	Low	Medium

Source: Bundesministerium für Umwelt, Limahandbuch, Wien, o.J. p.53

OPTIMISING HEATING SYSTEMS

Heat consumption can be reduced significantly by optimising the size of the heating system. Many old heating systems, in particular, are overdimensioned.

A COMPARISON OF TYPICAL HEATING REQUIREMENTS

Building gross area (m^2)	200	500	1000	2000	5000
Poorly insulated building (W/m^2)	90	75	67	60	55
Well insulated building (W/m^2)	40	33	30	27	25

Source: Bundesministerium für Umwelt, Limahandbuch, Wien, o.J. p.58

It is also important to consider the overall efficiency of a heating system, taking into account periods when it is not in use and energy losses due to processing and transporting the fuel.

OVERALL EFFICIENCY OF TYPICAL HEATING SYSTEMS

Typical system efficiency (%)		Comments
Gas boiler	65	Condensing boilers are most efficient
Oil boiler	60	
Wood boiler	50	Using dry, uniform size fuel
Electric heating	85	*
Heat pump	250	A low temperature system using a ground probe

** Efficiency of the electric heating system does not take into account losses during generation. For a conventional coalfired power station this will typically be 65%, leading to a total efficiency of below 30%.*

CHECKING ELECTRICITY CONSUMPTION

Household electricity use can be reduced in a wide variety of ways. Devices are available which can measure the energy use of individual appliances. These can be used to determine the running cost of appliances in a building. Electricity consumption while in standby mode can be significant.

Replacing old electrical appliances with modern ones may reduce electricity consumption by up to 50%. Connecting washing machines and dishwashers to a warm water supply to reduce the need for heating the water directly from electricity can lead to savings when another source of water heating is available.

After undertaking an initial survey of energy consumption and making improvements, it may still be beneficial to monitor energy consumption on a continuous basis. Continuous energy accounting will show how the demand for energy evolves and where readjustments need to be made.

Example: Zero heating energy house (Germany)

The aim of this demonstration project was to construct a highly energy efficient residential building (with an energy efficiency rating below 20 kWh/m²/year) that could be heated exclusively by solar energy. The house stands in the middle of a row of houses, has two floors, a large southfacing facade and a floor area of 170m².

Heating
- *54m² of solar panels;*
- *23m³ hot water tank;*
- *low temperature heat exchanger;*
- *fresh air is preheated with waste heat*

Structure
- *Out wall 24 cm brickwork,*
- *insulated with 16 cm mineral wool*

Windows
- *Uvalue = 0.4 W/m²K*

Rating
- *25 kWh/m²/year*

Additional Cost (compared to a "normal" house): ECU 75,000 (1997)

FACTSHEET 9
INVOLVING THE LOCAL COMMUNITY

As with any type of development, it is important that a renewable energy scheme is sited in a way that minimises the impact upon people living locally as well as upon the environment.

CREATING COMMUNITY BENEFIT

Solely concentrating upon cost reduction and the cheapest sites for renewables can lead to conflict, particularly in environmentally sensitive areas. In some regions there is concern, for example, over the visual impact of wind farms on scenic landscapes, over the ecological impact of hydropower schemes, and over the impacts of monoculture energy crops on biodiversity. Insensitive siting and development of environmentally damaging renewable energy schemes is likely to be detrimental not only to the local environment, but also to the prospects for continued public support for renewable energy in general.

Any new type of development in an area is likely to rouse interest and sometimes concern about the potential impact. Consultation with local people during the planning and development stage of a renewable energy scheme and encouraging local investment in it, can be key to engendering public support for the initiative. Informing and involving local communities at an early stage may help to secure:
> a feeling of community ownership,
> less public opposition,
> speedier development through the planning process,
> ideas for improved location, layout and design, and
> local funding.

Local communities expect prompt and honest communication, particularly where there may be concern about a new type of development about which they know very little. In many instances, developers decide to keep proposals confidential until late into the process. There have been many instances where the first knowledge a community has of a potential wind power scheme in an area, for example, is when they have seen a wind anemometer mast on a nearby hill. This has often led to an initial negative reaction towards the proposal, one that has been hard to change.

Acting quickly to involve a community in a venture can help to provide a sense of satisfaction and support for the scheme. A range of awarenessraising and confidence-building activities can be used to facilitate community involvement, including:
> informing the community of the possible benefits and impacts of a proposed renewable energy scheme,
> consulting with the community about a scheme,
> providing opportunities for the community to influence how a scheme is developed,
> offering local job opportunities, for example, in the operation of a scheme,
> facilitating some form of control over a scheme,
> offering people the opportunity to invest in a scheme and receive a financial return, and
> enabling complete community ownership.

There is often a desire by local people for some form of benefit to be derived from a scheme. For example, to receive a discount in their electricity bills or to be able to partown the scheme. Community ownership, which is well established in Denmark and elsewhere, is a particularly effective way of providing benefits to the community and gaining their support. There are several methods of ownership which could be considered, including:
> general share ownership without restriction,
> general share ownership linked to energy consumption, and
> targeted share ownership (e.g. local people of specific interest groups).

Establishing community ownership, however, usually requires a considerable time commitment from individuals within the community. Also, investment in the project carries a degree of risk, as with any other business venture. It may also be difficult for a community to raise adequate money.

COMMUNITY INVOLVEMENT AT CERTAIN STAGES OF THE PROCESS

Site search – Few people are usually involved at this stage, but if support can be generated then a real sense of ownership and belonging towards the project can be generated.

Planning consent – This is usually the time when the views of statutory consultees are sought.

Environmental Impact Assessment (EIAs) – This is a mandatory part of the process for some larger schemes and on a voluntary basis for smaller schemes. EIAs can help define communities of impact and lay down clear parameters for subsequent decisions and remedial actions. Few communities are ready to contribute positively to such procedures, mainly because they are unaware of their content and value.

Detailed design – Getting involved at this late stage is not likely to be very fruitful as most of the decisions about the scheme will already have been made and the changes sought may not be technically possible.

FACTSHEET 10
COSTS AND FUNDING OPPORTUNITIES

The cost of many types of renewable energy schemes have fallen significantly over the last decade. There are now many situations where renewable sources of energy are now competitive or even the cheapest source of power. In many other situations, however, renewable energy is still more expensive than other sources of energy, partly because the true cost of other alternatives are not taken into account. The search for funding is therefore crucial, and programmes providing financial aid do exist.

COSTING A DEVELOPMENT

There are several key questions which will need to be answered in order to determine the economic viability of a renewable energy scheme. These include:
> How much will the development cost to construct?
> How will the electricity be sold and at what price?
> How is the project to be financed?
> What will the financial returns on the investment be?

The cost of many types of renewable energy schemes has fallen significantly over the last decade. There are now many situations where renewable sources of energy are competitive or even the cheapest source of power. In many other situations, however, renewable energy is still more expensive than other sources of energy, partly because the true cost of other alternatives are not taken into account.

The principle costs involved in developing a renewable energy scheme include:
> costs of any preliminary studies (including initial design and resource measurements),
> costs incurred in obtaining planning permissions,
> purchase price of the equipment,
> infrastructure costs (cables, access roads, foundations),
> costs of connection to the local electricity distribution system where appropriate,
> installation, delivery and commissioning charges,
> project management costs,
> charges for additional warranties,
> fees for the arrangement of finance and provision of capital, and
> legal fees.

Annual outgoings usually include:
> operation and maintenance costs,
> metering costs and standing charges,
> insurance costs,
> local taxes,
> payment to landowners,
> servicing of borrowed capital, and
> repayment of cost of installations.

Some costs of a development will be incurred regardless of whether a project goes ahead or not. These costs are unlikely to be covered by borrowing, although subsequent development costs might be. Even if the results are positive and a project goes ahead, the costs are not normally recoverable in any form of grant or subsidy they can only be recovered from the longterm profits of operation. Typical sunk costs include:
> project identification,
> prefeasibilty study, feasibility study, negotiations and contracting, and
> site monitoring investigations.

The cost of a feasibility study carried out by an independent consultant depends on its scope and on the specific characteristics of the site. In the early stages of a project, however, advisers (particularly financial advisers) will often work largely on a contingency basis (i.e. if the project does not go ahead there will be no, or a very much reduced, fee).

ASSESSING THE RISKS

Defining the risk at the outset of a project will enable parties to minimise risks before the project actually starts. It is very important to identify the different risks which appear at different stages of a project and apportion them to an appropriate party. The most common risks include:
> unreliable energy source,
> problems with the technology,
> delays in construction,
> poor operation of the equipment,
> the market for the energy,
> financial arrangements,
> political and legal changes, and
> environmental impacts.

Apportioning the risk to the party most able to reduce that risk is usually the most effective strategy at reducing insurance costs. For example, the supplier and installation contractor is usually required to insure against delays in construction. Risks that are usually borne by the sponsors include operative risks and project management. Innovative technology might not be reliable, making it important to secure guarantees from the equipment supplier. It should be stressed, however, that the level of risk involved in a mature renewable energy technology is not necessarily any different to that of other types of development.

FUNDING

Most renewable energy projects are highly capital intensive and will require the developer to raise large amounts of finance well in advance of the start of operations. It is unlikely that 100% funding will be available from equity and so some level of debt finance will need to be obtained in most cases. It may be difficult, however, for small projects in particular to attract the attention of lenders and investors.

The process of arranging finance is very time consuming and is typically greatly underestimated by the developers. Although every project is different, there are generally five routes through which finance can be obtained:

> use of personal reserves except for the smallest of renewable energy projects, however, it is unlikely that sufficient personal or company reserves would be available to meet the total cost of the project,
> grant obtained to support a new or emerging technology,
> use of bank loans secured against parts of the developer's assets,
> codevelopment of a project with a financially strong joint venture partner, and
> limited recourse project financing, whereby bank loans are secured largely against future cash flows rather than just physical assets.

Securing contracts for the sale of the power produced is the cornerstone of a renewable energy project. Most renewable energy schemes provide an intermittent or irregular energy supply, resulting in a fluctuating cash flow. This is not a significant problem in most cases, but needs to be fully appreciated by the parties involved. For a biomass project, lenders will usually wish to see evidence that longterm supply contracts have been agreed ensuring that sufficient fuel supplies are available for a period which comfortably exceeds that of the financing, ideally by a margin of 23 years. With most schemes being in rural areas, grid connection costs are often critical and may be a major item of expenditure.

EUROPEAN FUNDS

The main European Union programmes which support renewable energy development are:

ALTENER:
This programme, managed by DirectorateGeneral XVII (Energy) of the European Commission, aims to promote the increased use of renewable energy in Europe. It is a 'software' rather than hardware programme, providing support for: pilot actions to create or extend infrastructure for renewable energy development; promotion and dissemination measures; targeted actions to facilitate market penetration and encourage investment; and monitoring and support actions.

Funding is not generally available for an individual renewable energy scheme. Transnational cooperation is essential.
Contact: europa.eu.int/en/comm/dg17/altener.htm

5th Framework Programme for Research, Technological Development and Demonstration 1998-2002:
This provides funding for RTD projects and will not therefore be an appropriate source of funds in most rural development contexts. All projects require transnational cooperation and should involve technology which is precompetitive. Up to 35% of the cost of demonstration projects is available (and 50% for research and development projects). This new programme replaces the **THERMIE** and **JOULE** programmes which were operated under the Fourth Framework Programme.

Other Community mechanisms:
Other Community programmes are concerned with biomass, including **FAIR** which aims to promote research in agriculture and forestry (including biomass projects), and **LIFE**, which focuses on the environmental impact of a range of activities (including agriculture and forestry). Other EU programmes which may be relevant are **SAVE** (energy efficiency) and **SYNERGY** (better international energy cooperation).

Some rural development Objective 1 and Objective 5b funding has also been used for renewable energy projects.

NATIONAL MEASURES

There are a large number of national and local sources of financial support for renewable energy at the national level. Further information can be obtained from the relevant national information centres shown on **factsheet 13**. Regulations aimed at stimulating the renewable energy industry vary widely from region to region.

FACTSHEET 11
A CHECKLIST FOR IMPLEMENTING AN ENERGY SCHEME

Formation of a core team

Awareness raising

Site search

Land negotiation

Measurement of the resource

Feasibility

Detailed assessment

Securing commitment

Planning application

Legal structure

Construction

Operation and maintenance

Decommissioning

FACTSHEET 12
USEFUL PUBLICATIONS

WORLD DIRECTORY OF RENEWABLE ENERGY SUPPLIERS AND SERVICES

Published by: James & James (Science Publishers) Ltd, pp488. Published annually.
Summary: Lists over 4,500 companies and organisations involved in the renewable energy industry.
Contact: James & James Science Publishers Ltd.,
3537 William Road, London NW1 3ER, UK
Tel: + 44 171 387 8998 Fax: +44 171 387 8558

THE EUROPEAN RENEWABLE ENERGY STUDY II (TERES II): ENERGY FOR THE FUTURE MEETING THE CHALLENGE

Published by: ESD, 1997.
Summary: A first multilingual European Commission report on CDRom in four languages (English, German, French and Spanish), supported by the ALTENER programme. It reviews historical and current renewable energy development, provides a basic introduction to the various types of renewables and contains a host of illustrations showing renewable energy projects in use across Europe. It goes on to describe the potential social, economic and environmental benefits which renewable energy developments can create over the next twenty years.
Contact: ESD Ltd., Overmoor Farm, Neston, Corsham, Wiltshire SN13 9TZ, UK.
Tel: + 44 1225 816821, Fax: + 44 1225 812103
Email: info@esd.co.uk

RENEWABLE ENERGIES IN THE CONTEXT OF REGIONAL ENERGY PLANNING

Published by: FEDARENE, pp62.
Summary: Provides an eclectic summary of experiences and examples of renewable energy schemes developed by members of the European Federation of Regional Energy and Environmental Agencies Regional Energy Planning working group.
Contact: European Federation of Regional Energy and Environment Agencies (FEDARENE),
11 rue du Beau-Site, B1000 Brussels, Belgium
Tel: + 32 2 646 82 10, Fax: +32 2 646 89 75
Email: fedarene@infoboard.be

MINIGUIDE FOR INNOVATIVE ENERGY PROJECT DEVELOPERS

Published by: ENEA and ECOTEC, 1997, pp20.
Summary: These three short handbooks aim to assist project developers to prepare a successful project plan, to understand the process of financial appraisal and to allocate project risk appropriately.
Contact: ENEA, C.R. Casaccia, Via Anguillarese 301,
00060 S. Maria di Galeria, Roma, Italy,
Tel: +39 6 3048 4118 Fax: +39 6 3048 4447

ELVIRE EVALUATION GUIDE FOR RENEWABLE ENERGY PROJECTS IN EUROPE

Published by: FEDARENE, pp28.
Summary: This is an evaluation tool which aims to provide an evaluation of development projects involving renewable energy. The model aims to provide public decision makers with an assessment of the spinoff effects which a project will generate in terms of the economic development of a region, employment, return on public finances, sustainable development and the environment.
Contact: European Federation of Regional Energy and Environment Agencies (FEDARENE),
11 rue du Beau-Site, B1000 Brussels.
Tel: +32 2 646 82 10, Fax: +32 2 646 89 75,
Email: fedarene@infoboard.be

EUROPEAN FINANCIAL GUIDE RENEWABLE ENERGY FOCUS ON BIOMASS: OVER 200 WAYS TO FINANCE RENEWABLE ENERGY PROJECTS

Published by: MHP, 1998.
Summary: Provides information on all European and national financial support available for renewable energy including: investment subsidies, low interest loans from both public and private funds, fiscal incentives, feedin regulations, exemption from taxes, payback arrangements and setaside arrangements for the cultivation of energy crops.
Contact: MHP, PO Box 127, 3950 AC Maarn,
The Netherlands,
Tel: +31 343 44 15 85, Fax: +31 343 44 19 36

LAYMAN'S GUIDEBOOK ON HOW TO DEVELOP A SMALL HYDRO SITE

Published by: European Commission, DG XVII, 1994.
Summary: This twovolume manual describes the principle steps to be taken in the development of a small hydro site in Europe. The guide presents a thorough coverage of the subject. The new edition of the report is available on the Altener Web site.
Contact: European Commission, DG XVII,
rue de la Loi 200, B1049 Brussels, Belgium.
Tel: +32 2 295 63 19, Fax: +32 2 296 62 83
Email: Altener@bxl.dg17.cec.be
Web: http://europa.eu.int/en/comm/dg17/altener.htm

THE EUROPEAN ATLAS OF SMALLSCALE HYDROPOWER RESOURCES

Published by: Institute of Hydrology.
Summary: A PCbased software package for rapidly estimating the hydropower potential at a location. The user needs little hydrological knowledge. Aimed at hydropower consultants, electricity utilities, environmental agencies and investors, the package enables the user to assess the feasibility of proposed smallscale hydropower schemes based upon analysis of national river flow and catchment data. The software, currently available for Spain and the UK, is being developed for other EU countries.
Contact: Institute of Hydrology, Wallingford,
Oxfordshire OX10 8BB, UK,
Tel: +44 149 183 88 00, Fax: +44 149 169 24 24
Email: softdev@iod.ac.uk

INTEGRATION OF SOLAR COMPONENTS IN BUILDINGS

Published by: Generalitat de Catalunya and TÜV Rheinland, 1998, pp25.
Summary: Provides an introduction to the use of solar technologies in buildings, including photovoltaic, passive and active techniques. Twelve case studies provide a review of the range of approaches which can be taken. An overview of the cost of the various different types of equipment which can be used is included, along with a reference section for further information.
Contact: Generalitat de Catalunya, Av. Diagonal,
453 bis, àtic, E08036 Barcelona, Catalunya, Spain.
Tel: +34 93 439 28 00 Fax: +34 93 419 72 53

LES SYSTÈMES SOLAIRES, POUR LA PRÉPARATION DE L'EAU CHAUDE SANITAIRE

Published by: Institut wallon, 1997, pp23.
Summary: Presents an introduction to and examples of solar water heating developments.
Contact: Institut wallon, Boulevard Frère Orban 4,
5000 Namur, Belgium.
Tel: +32 81 25 04 80, Fax: +32 81 25 04 90
Email: iwallon@mail.interpac.be

WIND POWER A GUIDE FOR FARMS AND RURAL BUSINESSES

Published by: Scottish Agricultural College, 1998, pp38.
Summary: An excellent summary of the business opportunities presented by wind power. It provides a basic introduction to some of the uses to which the technology is being put in rural areas and an introduction to the type of equipment which is on the market.
Contact: Scottish Agricultural College, West Mains Road, Edinburgh EH9 3JG, UK.
Tel: +44 131 535 4000, Fax: +44 131 535 4246

WIND ENERGY IN EUROPE THE FACTS

Published by: European Wind Energy Association, 1998.
Summary: A policy document which attempts to summarise the state of development in the wind power industry and presents a vision for the future for wind power in Europe.
Contact: European Wind Energy Association, 26 Spring Street, London W2 1JA.
Tel: +44 171 402 7122, Fax: +44 171 402 7125
Email: syoung@ewea.org

REFUEL RENEWABLE ENERGY ASSESSMENT A COMPUTER TOOL FOR ADVISERS

Published by: Scottish Agricultural College, 1998
Summary: REfuel is a new computer programme that estimates the energy a farm could generate from wind, hydro, solar and biomass sources; compares the value of these renewable energy sources with the cost of electricity, heating oil, etc.; carries out a payback analysis for each energy source; compares energy demand with typical farms of a similar size and type.
Contact: John Boyd, SAC Environmental Division, Bush Estate, Penicuik EH26 OPH UK.
Tel: + 44 131 535 3034, Fax: + 44 131 535 3031
Email: j.boyd@ed.sac.ac.uk
Web: http://www.sac.ac.uk

FACTSHEET 13
KEY SOURCES OF FURTHER INFORMATION

Each of the following organisations is able to provide information on renewable energy. The OPET Network (listed below) has coordinators in virtually all European countries. By contacting the central coordinator in Brussels you can ask to be put in contact with the OPET member in your country.

AEBIOM EUROPEAN ASSOCIATION FOR BIOMASS
c/o APCA,
9 avenue Georges V
F-75008 Paris
Tel: +33147235540
Fax: +33147238497

APERE ASSOCIATION FOR THE PROMOTION OF RENEWABLE ENERGIES
171 rue Royale
B-1210 Brussels
Tel: +3222187899
Fax: +3222192151

EFRE EUROPEAN FEDERATION FOR RENEWABLE ENERGIES
28 rue Basfroi
F-75011 Paris
Tel: +33146590444
Fax: +33146590392

EPIA EUROPEAN PHOTOVOLTAIC INDUSTRY ASSOCIATION
Avenue Charles-Quint 124
B-1083 Brussels
Tel: +3224659162
Fax: +3224682430

EUROPEAN SMALL HYDROPOWER ASSOCIATION
Try Ansquet, 5
B-5030 Gembloux
Tel: +3281600612
Fax: +3281600759

ESIF EUROPEAN SOLAR INDUSTRIES FEDERATION
19 J. Papaodreou Str.
GR-14452 Metamorlfosis
Tel & Fax: +3014944154

EUROPEAN ISLANDS ENERGY AND ENVIRONMENT NETWORK
Council Offices, Sandwick Road,
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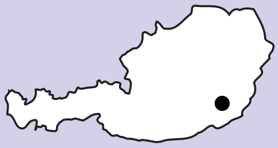
STYRIA (Austria)



Building one's own solar heating system

The action

Support for building one's own domestic hot water system using solar collectors, with the help of local groups in small workshops. The members of the original groups help create new groups and provide them with logistical support. The action benefits not only owners of private homes (farms and family homes) but also rural SMEs (distributors and craftsmen responsible for the final installation work) and the technical and university team which is directly involved in the action (creation of "green" jobs). Business owners, finally, largely benefit from the technological development created by this self-building movement and also from the sound reputation of these solar heating systems.

Key elements

> Transfer to local groups of self-building solar heating technology.
> Creation of an association for the research, development and promotion of solar energy for everyday use (heating, building, transport, waste water).
> Development and rapid growth of the use of solar energy for heating purposes based on: simple and comprehensible technology; immediate availability of building materials; a certain local aptitude for autonomy; appropriate logistical support.

Context

The initiative has benefited from the coincidence of several factors:

> the relative poverty of the area and the dispersion of private accommodation. The inhabitants could not afford a costly alternative energy system but were able to decide what they wanted for their homes;
> the high degree of rural multiactivity, which means that a high level of skill is available for self-building;
> the survival of a system of mutual aid and a village social life;
> the granting of financial aid by the regional authorities in 1990 (usually in the form of credits at a reduced rate) for the installation of solar systems. In the start-up phase, the entrepreneurs were afraid that the operation would encourage undeclared work but soon realised the benefits that they themselves could derive from this initiative, and their fears were quelled.

Starting point

At the end of the 1970s, two amateur builders in Gleisdorf, a small town near Graz (the capital of the Land of Styria) decided to put into practice what they had learned in various workshops on the use of solar energy. They gradually developed a less expensive and simpler system than what was available on the industrial market. They presented the results of their work at a workshop for those interested. A few months later, some of their friends wanted to install solar energy systems in their new flats, so they improvised a small collective workshop with basic equipment which they leased. The first self-building group was set up, with 32 members.

Word quickly got out about the positive results of the workshop, and the example spread to the neighbouring communes. The participants, who for the most part were farmers and convinced amateurs, very quickly adopted the technological approach proposed: just about every new group injected new ideas and improved the system, thus making it increasingly efficient. From 1986 to 1990, the surface area fitted with solar energy systems almost doubled from year to year. In 1988, the original group set itself up as an association to facilitate the creation of new groups and to acquire the basic equipment. A newsletter was started to improve communication between the old and new groups. In this way the movement became very well known.

Implementation

Founded in 1988 and set up in Gleisdorf, the Arbeitsgemeinschaft Erneuerbare Energie association (AEE / Association for Renewable Energy) became an institution and developed activities in the field of alternative technologies (solar energy, organic treatment of waste water, biomass heating, insulation). In the early 1990s, the movement of building one's own solar heating systems spread to the rest of Austria. In 1991, under the auspices of the AEE, regional branches were set up elsewhere in Austria and South Tyrol (Italy). A subsidiary was created to provide technical assistance (the town of Gleisdorf held a 20% stake in it). Now highly professionalised, the association today has 6 000 members and employs 11 people. The qualification of the consultants and researchers is guaranteed by permanent training.

Since 1991, the annual surface area of collectors installed

by self-building groups has been relatively stable: about 40000m²/year, or a total of 240 000 m² at the end of 1994. This represents about 40% of the market in Austria, with the remaining 60% coming from professional suppliers. The assembly system has gradually spread beyond the Austrian borders to Germany, Switzerland, Italy, the Czech Republic, Slovakia and Hungary. An expert is working in Zimbabwe to promote similar processes and a project is soon to get off the ground in Latvia.

A self-building group contacts the association to book an information-debate evening, then visits an existing installation. The group then chooses a workplace. The number of collectors necessary and the volume of the water heater are determined according to their needs. A collective order means that reduced prices can be negotiated from suppliers. The association lends the basic equipment necessary for the assembly work which is carried out over two weekends. All stages of assembly are organised in a series: a subgroup welds, another cuts the tubes, another installs the glass sheets, etc. If capable, homeowners directly install the system themselves, otherwise professional craftsmen do the job. The logic of the different steps is such that know-how can be conveyed quickly by way of imitation.

The town of Gleisdorf is currently putting across an "environmental town" image, and the achievements of the AEE association have earned it the Eurostar distinction. Communal policy has been greatly influenced by the association's guidelines.

Budget and sources of funding

Starting from scratch, the association today manages, along with its subsidiaries and its firm of consultants, a considerable budget. Training has been partly supported by the Cooperation Fund of the Austrian Federal Chancellery.

Innovative elements for the area

Mobilising the community and social cohesion

> Spontaneous training of groups at the local level (between 15 and 35 families).

> In the long term, professional management of the association on the basis of a decentralised approach.

The area's identity

The town of Gleisdorf has integrated environmental and energy issues in its policy and is itself trying to implement part of what makes the association successful (notably in the building trade). The initiative has relied on the specific skills of rural people and on the way in which they live and work; it provides them with a direction for the future and the assurance of "doing something for the environment".

Activities and jobs

The creation of 11 highly qualified jobs (consultants and researchers) in various sectors (prefabricated houses with low energy consumption, biomass heating).

The area's image

Styria today has the highest density of solar heating systems in the world (in square meters of collectors). This record, in addition to international awards, gives it a strong image of a region concerned about environmental protection.

Environment, management of space and natural resources

- Solar heating helps to considerably reduce emissions of CO2, SO2, NOx and other substances.

Technological development

- Originally intended to provide hot water, solar heating rapidly spread to the heating of homes and, combined with biomass, to the entire village.
- The association has developed initiatives in almost all the areas related to alternative energies. The most promising niche is the building of houses with low energy consumption.

Migrations and social and professional integration

The initiative has helped attract permanent residents to the area.

EASTERN STYRIA

The eastern part of Styria (one of the nine Austrian Länder) is a region of hills that is primarily inhabited by small farms with more than one activity (mixed crops, fruit and winegrowing) and where SMEs-SMIs dominate. Income levels are modest in relation to the national average, unemployment is high and young people are leaving the region in search of jobs. The action presented is set in Gleisdorf (5 000 inhabitants) in the district of Weiz, a town that is showing proof of a new entrepreneurial dynamism in the industrial sector. Eastern Styria is part of the Objective 5b area.

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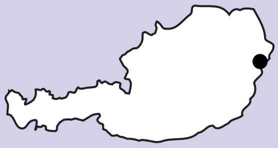
DEUTSCH-TSCHANTSCHENDORF (Burgenland, Austria)



A combined biomass-solar heating system at villages level

The action

A village cooperative set up in spring 1993 built a 1100 kW central heating station in October 1994. The station is powered by wood chips and bark almost solely obtained from clearing neighbouring forests. The system is combined with 325 m^2 of solar panels, built in accordance with the latest systems implemented by the Arbeitsgemeinschaft Erneuerbare Energie association (AEE) in Gleisdorf (Styria) (see corresponding factsheet), which supply hot water to the 29 users, particularly in the summer when the boiler is not on and provide additional energy throughout the rest of the year. The project is part of a programme called “Renewable Energy Region” which involves the district of Güssing.

Key elements

> Village cooperative biomass central heating station for 29 users (accommodation, public organisations and private enterprises), with additional solar collectors for centrally supplying hot water, particularly in the summer.

> Innovation in the field of renewable energy and less polluting heating systems (1 chimney instead of 29, wood as fuel instead of heating oil).

> Boiler heated by local resources.

> Reduction of harmful emissions, particularly greenhouse gases and those that damage the ozone layer.

> Professional management integrated in the other local energy saving initiatives.

Context

The farmers of the Burgenland villages have a very strong tradition of mutual assistance among families. Associations and cooperatives are frequently set up to support local projects.

In Güssing, the main town with about 3 000 inhabitants, the commune expressed an interest in creating a "centre for renewable energy" in the castle situated in the old town, which would play the role of regional energy agency.

The farmers were interested in earning additional income by clearing the forests, but heating wood could not compete with heating oil and electricity. The district and the region decided to create a system of protection and financial aid:

1) there is not and there will not be any distribution of local gas;
2) since the wood and wood chips imported from Hungary are considerably less expensive than those produced locally, the regional government which in part finances these communal facilities imposes a very low price for the wood chips from local forests. The difference in price (ECU 15-17 /m^3 instead of ECU 8-9 /m^3 for the imported wood chips or for industrial sawdust available locally) is covered by subsidies. It also provides users with a loan at a very low rate of interest (0.5% over ten years) to finance their individual connection expenses. The Federal Fund for Ecology is responsible for the control and scientific research.

Starting point

In Austria, the history of collective biomass heating stations began in the 1980s. In 1990, the first station in Burgenland was opened in Unterkohlstätten at the initiative of a farmers' cooperative; a second station followed in 1992 in Glasing near Güssing under the management of the above mentioned engineering office; the third station is the one in Kroatisch-Tschantschendorf. In early 1993, two inhabitants of Deutsch-Tschantschendorf decided to carry out a door-to-door survey to find out who would be interested in the installation of a system of this kind. The mayor gave his support to the initiative and soon an information evening was organised with representatives from the Glasing station and the project engineer. The key group of people interested then visited other stations scattered around Austria. The cooperative was created at the second meeting.

Implementation

At the heart of the heating station, a 1100 kW boiler with two storage tanks (2 x 17m^3) operates for approximately seven and a half months of the year. The wood is kept near the station and shredded twice a year by a mobile shredder. The wood chips and bark are then stored in a building with a capacity of 750m^3. Every 1 to 4 weeks, depending on the needs, part of the pile is dumped into a 70 m^3 container where it is automatically transported to a drying room, then to the boiler - thanks to the preheating system, the wood chips can be stored with up to 50% humidity without causing any problems. The boiler is equipped with a ventilation system and burns at a high temperature so that the combustion is complete. The smoke is filtered, and the residue and cinders serve as fertilizer for the surrounding fields.

By heating a mixture of antifreeze (40%) and water (60%) in closed circuit, the 325 m^2 solar collectors provide additional heating during the day. In summer, they are enough to satisfy needs for a maximum of six days with a completely overcast sky.

In the case of persistent poor weather, the oil-burning boiler from the nearby school is used to avoid having to start up the central heating station. It will soon be replaced by a 67 kW boiler running on bio-diesel (produced by another farmers' cooperative in Güssing and primarily used for the tractors) and connected to the combined biomass-solar system.

The 29 users are part of a cooperative (forest owners, community centre, nursery, school and gymnasium, church and parish, restaurant, carpenter's workshop) that is run by a team of 3-4 people.

The price of connection to the network is the same for everyone (ECU 6 154 unsubsidised instead of ECU 20 769). This is justified by the fact that the more consumers there are, the more efficient the system as a whole will become and the more costs will decrease. Each user has a 300 or 500 l tank in his home, half of which is paid for by the cooperative, and he assumes the cost of the indoor installation work.

The boiler is 85% efficient, the remaining 15% represents distribution losses. The ratio between the installation's capacity and the length of the distribution system shows that isolated accommodation should not use these heating systems because the losses involved are too great for them.

In its first year, the cooperative sold 750 000 kWh at ECU 0.04/kWh, which corresponds to the average cost of producing 1 kW using heating oil, the least expensive fossil energy.

Budget and source of funding

Cost of the investment. Heating station: ECU 692 300. Solar heating system: ECU 153 850. Total: ECU 846 150.

Funding: Heating station: Federal Ministry 35%, regional government 15%, own funds 50%. Solar heating system: Federal Eco-Fund 35%, regional government 30%, own funds 35%. “Own” funds come from the fees paid for connection and a low interest loan.

Innovative elements for the area

Mobilising the community and social cohesion

> The initiative was born in the commune, but a neighbouring village had already installed a biomass heating station.

> Local self-sufficiency in energy is progressing. The fact that there are a lot of groups building their own solar heating systems in south-eastern Austria has contributed to the development of the idea of combined heating, which means that it is no longer necessary to run the biomass boiler in the summer just to supply hot water.

The area’s image

Since the initiative is very well known in Austria, the Güssing's image as an "eco-energy region" has been strengthened.

Migration and social and professional integration

The improvement of the improved environmental framework that the initiative has provided the permanent residents is a factor of stabilisation in the village where there is an old tradition of emigration.

Technological development

A new combination of two technologies which each considerably reduce the use of fossil energy.

THE DISTRICT OF GÜSSING

Deutsch-Tschantschendorf (240 m in altitude, 700 inhabitants) is a small village in the commune of Tobaj, in the district of Güssing. This agricultural region located in southern Burgenland (Objective 1 and LEADER area) is the transition between the eastern Pre-Alps and the Pannonian plains. Most of the inhabitants commute to Vienna during the week (a two-hour drive). Until 1989, the "Iron Curtain" corresponded to the Hungarian border on the southern and eastern limits of the district, constituting an impediment to the development of the region as a whole. Income per capita is one of the lowest in the country.

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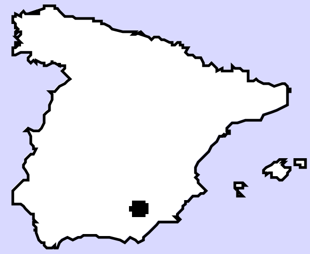
SIERRA DE SEGURA (Andalusia, Spain)

Utilisation of renewable energies in isolated rural environments: the "sun route" leads to the local Energy Agency



The action

The introduction of solar energy in several isolated mountain hamlets marks the beginning of a new local strategy based on the exploitation of renewable energy sources (biomass, windmills, etc.). The process started with a THERMIE pilot project: the "Ruta Fotovoltaica de la Sierra de Segura" that includes 79 households in five hamlets. In addition, there are several other projects. The action led to the creation of a local Energy Agency, the first in Spain to be set up in a LEADER area.

Key elements

> Installation in 1986, under the THERMIE European programme, of photovoltaic electricity providing energy systems in isolated rural hamlets.

> Raising awareness of the advantages of solar energy for the provision of electricity in isolated rural areas in the Mediterranean basin.

> Complementarity between two European initiatives with LEADER taking over from THERMIE.

> Carrying out, under LEADER, of a set of studies with a view to identifying renewable energy resources: using, as a source of energy, the residue of pressed olives (main local agricultural product), experimenting with new energy sources, etc.

> Creation of a local Energy Agency.

Context

The pattern of human settlement in the Sierra de Segura is very scattered. The area has 197 small hamlets and "cortijadas" (farms traditionally housing several families). In the early 1980s, some of the hamlets were still not connected to the general electricity network.

In the middle of the 1980s, the Sevillian Electricity Company (CSE) wanted to demonstrate the viability of solar energy. To this end, the company proposed to carry out an experiment, whereby it provided electricity to 57 houses (later increased to 79) inhabited throughout the year and spread across five isolated municipalities in the Sierra de Segura. The area was chosen for several reasons, i.e. the scattered nature of the population; high levels of sunshine throughout the year; difficulties in installing traditional electric power lines in the area due to the difficult terrain and presence of protected natural zones.

Starting point

Baptised the "Photovoltaic Route", the project was presented in 1986 under the European programme THERMIE by a group composed of the CSE, the Institute of Renewable Energies of the Spanish Ministry of Industry, the Institute of Solar Energy based in Madrid and the regional public enterprise ISOFOTÓN, which manufactures photovoltaic equipment. The project was launched in 1986, and the solar power systems installed in the different hamlets during 1988 and 1989.

The local population, unfamiliar with solar energy, was at first distrustful of the project. A long awareness raising campaign was then carried out, involving house visits to explain the advantages of the system in relation to the household's specific needs.

Certain factors also contributed to reinforcing trust in the project, among them, the possibility to have free electricity persuaded a number of local inhabitants to stay in their houses and modernise them rather than abandon their villages.

The villagers provided with free electricity were, in return, to record data during the first three years of the project, to ensure careful monitoring of the system.

Implementation

At first, provision of electricity by direct current was assured only for lighting. At the end of 1988, all the houses and hamlets concerned were equipped. In 1989, alternating electricity supply systems were installed.

The efficiency of the equipment depends largely on the size of hamlets: in the summer, the presence of tourists increases consumption, which in the end overloads the system in the larger hamlets. On the contrary, in the smaller hamlets, average daily consumption is balanced, and is between 3 kw/h and 5 kw/h.

In 1993, the Association for the Rural Development of Sierra de Segura was created, with the objective of sustainably developing the area. With LEADER, the association has become the Sierra de Segura local action group (LAG).

With the positive experience of the THERMIE project and the "Photovoltaic Route", the LAG undertook an awareness-raising campagn aimed at putting in place an energy strategy based on the local resources. The LAG also contributed to a set of studies, whose results enabled the identification of the possibilities and limits of different sources of energy, i.e.:

> installation of small hydro-electric plants. The idea was however quickly abandoned because an inventory indicated that almost all the local water power was already being exploited;
> exploitation of wind power in the area - in May 1997, a meteorological station was installed with the aim of collecting the necessary information for the design and installation of a windmill park;
> installation of an electric power station supplied by biomass made up of the residue from olive oil production - the study revealed that optimal benefits could be achieved by the construction of a station of 13 megawatts that would not only use the residue obtained from grinding olives but also that from the prunings from olive trees, forest residue and biomass from energy sources (mainly cynara cardunculus, a permanent herbal plant that is very hardy and well adapted to the local soil);
> experimental introduction, on land left to lie fallow, of the cynara plant for the production of biomass, and also of the brassica carinata and synapis alba for the extraction of bio-combustible material from grain.

The favourable information on energy resources identified by the various investigations has prompted the LAG to create a local Energy Agency, the first of its kind in Spain to be installed in a LEADER area.

Budget and sources of financing

The THERMIE project budget amounted to about 800 000 ECU, of which 300 000 was provided by the European Community.

Innovative elements for the area

The environment and management of natural resources

The most important impact in the area is the introduction of new economic and environmental perspectives in the management of energy and renewable resources. The THERMIE project was designed outside of the area and successfully transferred and developed at the local level. Transformation of the THERMIE project into an area project made it possible to experiment with energy and economic alternatives that reinforced the impact of the project.

New technologies

From a strictly technological view point, the project has various innovative aspects such as:

> an integrated electrical network, supplying both the households and public lighting of a hamlet at the same time, unlike the traditional photovoltaic systems whose supply is mainly individual;
> adapted to the size, composition and consumption of each household, the system covers all the electrical needs of a domestic household - lighting, hot water, heating, household electrical equipment, etc.;
> a mixed direct and alternating electricity supply is possible.

LA SIERRA DE SEGURA

La Sierra de Segura is situated in the extreme North-Eastern part of Jaén Province in Andalusia. 70% of the area (1 934 km^2) is at an altitude of 800 metres. La Sierra de Segura (29 155 inhabitants) is part of a natural park that has been declared a Biosphere Reserve by UNESCO. The various local development programmes undertaken in the area have not only contributed towards checking but to also reversing depopulation. Local agriculture is specialised in the production of good quality mountain olive oil. In recent years, organic farming has developed considerably, although the main emerging economic activity is tourism.

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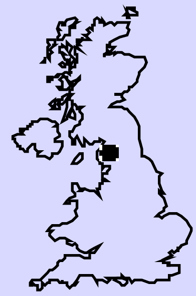
ULVERSTON (England, UK)

"Baywind", a wind turbine cooperative



The action

A wind farm was built in Ulverston, northwest England to boost the power supply of a local electricity grid while at the same time improving the area's economy and encouraging energy savings. With the support of the local community, what was initially a private initiative became a cooperative project to manage the wind turbines.

In this sector cooperative management was unheard of in the UK at the time. The decision to organise the scheme in this way is what made the action successful.

Key elements

> A sustainable energy project having a positive social impact.
> Energy self-sufficiency of a village by using a low-polluting renewable resource.
> Additional income for local owners and farmers.
> Local people benefit from a renewable resource without taking financial risks: a scheme is organised in an innovative way and run as a cooperative in a country where this practice is uncommon.

Context

By the year 2010, the British Government wants 10% of the country's electricity to be produced from renewable sources of energy. The "Non-Fossil Fuel Obligation Fund" programme in the UK requires regional electricity distribution companies to buy at a fair price a certain quantity of power from renewable energies.

The region of Cumbria has a gas power plant in Morecambe Bay and several small hydroelectric power plants but no other power plant uses renewable energies.

Starting point

Given the weakness of the electricity grid, the regional distribution company was unable to supply large amounts of power locally, causing major problems for farmers. Having heard of renewable energies and aware of the potential of wind power in this very windy area, a farmer from Green Moor came up with the idea of building a wind farm in Harlock Hill. He hired a consultant to determine the feasibility of the scheme.

Meanwhile, Wind Company Ltd, a subsidiary of the Swedish wind power company, Vindkompaniet, was looking for sites for its wind turbines. It chose the Harlock Hill site and introduced the concept of "cooperative ownership", a practice that is common in Scandinavia but unheard of in the UK. Once the wind turbines were installed, they were to be managed by a cooperative, "Baywind Energy Co-operative Ltd.".

In October 1993, Wind Company applied for funding from the Obligation Fund for seven 500 kW turbines capable of meeting the electricity needs of 7 000 people. Although disproportionate to the needs of the local farmers, this arrangement was the most viable option financially, because any unused electricity could be sold to the regional distribution company.

The company presented the scheme to the local people who on the whole were interested. There were, however, two reservations: the new residents tended to be against the idea of wind turbines on the neighbouring hills; certain environmental rules had to be observed because of a nearby national park.

In December 1994, Wind Company received the Fund's approval and applied for a building permit. This was granted four months later but only for five turbines. The scheme's funding therefore had to be revised.

Implementation

Wind Company worked whenever possible with the area's contractors, and used local materials as a matter of preference. Given the lack of manufacturers in the UK, the five 500 kW turbines came from a Danish company. Building began in September 1996 and the site became operational in January 1997.

In April 1997, a first share offering was launched and the new Baywind cooperative began buying turbines from Wind Company. Although the five turbines were built at the same

time, the cooperative could only buy one at a time when it had enough funds. In April 1998, 1 100 investors owned two of the turbines.

Wind Company signed a five-year management agreement with the Baywind cooperative to start up, monitor and do maintenance work on the turbines (the site has to be inspected once a week and the turbines are computer monitored via a permanent telephone link).

The three-blade rotors, built to last 20 to 25 years, supply enough electricity to meet the needs of 5 000 people. Although erected on a hill, the wind turbines are rather discrete. The grass-covered dirt roads leading to the turbines make the hill greener but still allow heavy machinery to reach the site if necessary.

The scheme's current success should not conceal a certain number of difficulties with funding (problem of finding a lender), implementation (delays), unexpected technical hitches (e.g. disturbance of TV transmitters), etc.

The different problems were in the end solved and the Baywind cooperative now plans to buy more wind turbines and diversify into other forms of renewable energy.

Budget and sources of funding

The total cost of the operation amounted to approximately EURO 4.5 million, 80% of which was provided by the Triodos bank, a Dutch ethical bank which had a special fund for wind power. The remaining 20% came from the Swedish parent company.

The support provided by the Non-Fossil Fuel Obligation Fund guarantees a market because of the purchases imposed on the regional electricity distribution company. The company also benefits from the deal in that in that it is able to find the additional power that it needed at less cost.

Anyone can buy shares in the Baywind cooperative. However, in order to encourage local ownership, preference is given to local buyers when demand for shares is greater than the number available. Thus in the first offer for sale, 60% of the buyers lived in the region. The minimum purchase was EURO 450. The investors received a guaranteed net annual yield of 7%. Dividends are paid out depending on the annual production and may be converted into a lower electricity bill. Each turbine costs EURO 900 000. When the Baywind cooperative will have purchased all the turbines, the Wind Company will be left with its maintenance role.

Of the revenue generated, 0.5% is invested in energy saving operations (e.g. low tension lamps for public lighting).

The company made the initial investment, not the cooperative. It was only when the turbines were purchased that the members of the cooperative gradually shared the risks. This is a very important aspect, because it is unlikely that individuals unfamiliar with renewable energy issues would have taken the risk of investing in a wind farm.

Innovative elements for the area

Mobilising the local community and social cohesion

> This is the first wind turbine cooperative scheme in the UK.
> Unlike other energy schemes that are too often imposed, the wind farm was designed with and for the local community.

Competitiveness and market access

> The good synergy between the community and the private sector makes the scheme viable and advantageous for both sides: a correct price is paid for the electricity produced in an alternative way, the regional electricity company solves the problems of its grid, the wind turbine company provides a long-term maintenance contract, a renewable local resource is used.

Environment, spatial management and natural resources

> A local resource that cannot be relocated, does not pollute, and is able to satisfy the energy needs of an entire region.
> Special care is taken to make sure that the wind turbines blend into the landscape and produce as little noise as possible.

ULVERSTON

Harlock Hill is located in Cumbria, 5 km from the Lake District National Park which draws a large number of tourists to the region. Farming in this sparsely populated area (72 inhabitants/km^2) is dominated by milk production and sheep farming and complemented by forestry. Most of the Park is an Objective 5b area and the surrounding region was listed as an Objective 2 area after the decline of the shipyards. Today's local industries mainly produce pharmaceuticals, paper and candles.

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