Guidance notes on renewable energy
A useful overview covering Biomass; Community involvement in renewable energy projects; Ground source heat pumps; Hydro-electricity; Solar photovoltaics; Solar water heating; Wind power and Social finance.

Biomass

Wood and other biomass fuels used as heating fuel avoids the release of carbon dioxide into the atmosphere from fossil fuels. Any carbon dioxide released during combustion is locked up again during growth of new trees. Wood can be used as a fuel in its own right as logs, chips, chunks or pellets or in association with other fuels.

Wood heating system can be hand fired, semi-automatic or fully automatic. Hand fired systems use logs, cordwood or off-cuts and are best run in conjunction with an accumulator tank to store the hot water. Semi-automatic and automatic systems are normally fed with woodchips using a mechanical conveyor or auger feed system and are appropriate for larger buildings – schools, hospitals swimming pools etc.

The most efficient and clean use of wood as fuel is when the wood is burnt fast. Woodfuel boilers are often sized to a basic heat load and the heat load topped up with other fuels. Wood systems are ideal for buildings with a steady heat-load for long periods of time although modern efficient wood boilers modulate down to 20% without losing much efficiency.

One of the main concerns in considering whether to adopt a woodfuel heating system is the availability of a caretaker, or local maintenance person. Using any form of solid fuel is inevitably more labour intensive than gas or oil. The amount of labour required depends on the type of wood system employed. Carrying logs is obviously a high labour operation but a modern automatic woodchip system requires only minimum daily checking plus regular maintenance time of, say, depending on the system and the quality of fuel, an hour a month.

Manual long log heating system with accumulator tank

Long log systems use 500mm logs which are fully loaded in the morning and fired flat out. This process heats the water in the highly insulated accumulator (buffer) tank to a high temperature and then functions in the same way as an indirect hot water system. When the fire goes out the heating of the building is met by heat stored in the accumulator. In extreme weather in winter a second firing may be needed in the evening.

Automatic or semi-automatic wood chip fired heating

Automated woodchip heating systems are commonly used in Europe and the USA. They are suitable for larger scale requirements, such as commercial buildings, schools or groups of dwellings. They convey fuel mechanically into the boiler and so require only occasional attention from a caretaker. Woodchips do not flow, cannot be poured and will not drop from a hopper without agitation. They can be handled automatically using a moving floor in the storage bunker and a screw feed or auger to transport the chips from the store to the fire. An alternative is to employ a mixture of automatic and manual handling but the size of the system required here suggests that fully or partially automatic systems would be preferable.

The woodchip heating system consists of a boiler or heat exchanger, a burner, a feed system and a storage area or container with moving floor and feed auger. A secondary storage area is usually used in order to ensure a supply of dry fuel. The burner needs to be separated from the main fuel supply area by a fireproof wall.

Community Involvement in Renewable Energy Projects

Community owned renewable energy schemes are well established in countries like Denmark and Sweden and can benefit communities through financial returns, an increase in local employment and a degree of ownership and control in the project. Community groups can consider the value of generating their own electricity both in terms of the potential for it forming part of an overall regeneration project, and for the educational benefits that it can bring.

A community renewable energy project is one in which a community has a significant interest, i.e. in the form of ownership or receipt of benefits be they financial, social or environmental. A community can be a school, a village, town, or other group of individuals with a shared interest.

It is important that the community becomes involved in all stages of the project, and that it is supported by everyone. Community projects require some initial work to raise awareness and secure commitment, therefore the first step is to set up a core group of people to take the scheme forward. Once this has been done, professional advice should be obtained about the technical and economic possibilities of the site in question.

Large renewable energy schemes are capital intensive, and there are a number of ways the community can raise the necessary money

- grants
- share ownership
- banks and other investors.

See below for sources of social finance.

Further information about community owned renewable projects is available from the Department of Trade and Industry. It has a number of reports and publications, for example,

Consulting Communities: a renewable energy toolkit
http://www.dti.gov.uk/files/file15108.pdf or information is available on the website www.dti.gov.uk

Ground source heat pumps

Heat pumps (ground source and air source) are not renewable energy technologies (unless the electricity used to power them comes form a "green" source), but are ways of using electricity efficiently. For each kilowatt of electricity used to run the heat pump, three or four kilowatts of heat are produced. This means they are 300% - 400% efficient, compared to a gas-fired condensing boiler, which is around 90% efficient. However, as most mains electricity is generated from fossil fuels, it has relatively high carbon emissions. The CO_2 emitted by a GSHP or ASP system is roughly similar to the CO_2 from heating the building with gas.

For ground source heat, pipes are either laid in trenches in the ground, or, if space is limited, in a borehole. These carry a liquid and antifreeze mix, which circulates through the pipe and is gradually warmed by the heat of the surrounding warmth. A heat pump is an electrically powered unit consisting of a compressor and a pair of heat exchangers which is able to extract heat stored in the earth, air or water and use this to heat buildings. Some can be reversed to provide cooling systems as well as heating.

Heat pumps produce a low level of heat, so are best used in highly energy efficient buildings with underfloor heating, or oversized radiators.

Hydro-electricity

Hydro-power technology turns the potential energy of falling or flowing water into electrical energy. Turbines are supplied with water drawn from either a reservoir or directly from an intake weir on a river. Most reservoir schemes make use of the change in water levels at a dam and capture the energy of the water as it falls from the reservoir into the river below.

Electricity is produced when a flow of water, is channeled through a turbine connected to an electricity generator. The amount of power produced depends on the rate of flow, head of water and the volume of water available.

The principles of operating a small-scale and large-scale scheme are essentially the same. They both require:

- A suitable rainfall catchment area
- A good “head” of water (vertical distance between the reservoir or river to the turbine). The height of the “head” and amount of water available will determine how much power can be produced
- A water intake placed above a weir or behind a dam (although small, fast flowing streams can occasionally accommodate micro turbines placed directly in the water), with a pipeline or channel to transport the water from the reservoir or river to the turbine
- An outflow, where the water is returned to the main water system

Hydro-electric schemes are environmentally attractive because they do not produce pollution during operation. Small-scale schemes, which do not involve collecting water behind dams or in reservoirs, have very little impact on the environment.

The principle environmental issues are:

- Visual intrusion of the turbine building, but this can be hidden by bushes and plants
- Ecological impact of diverting water flow
- Effect on fish - but they can be protected by close fitting mesh screens
- Impact of the scheme’s construction phase especially when temporary dams may be necessary

Decommissioning at the end of their useful life is simply a matter of removing the equipment.

Before extracting water from any river or stream, a license has to be obtained from the National Rivers Authority or other relevant authority. Planning permission may also be needed.

Solar photovoltaics

Solar photovoltaic cells use direct sunlight to produce low voltage DC electricity. The DC electricity from each solar cell is collected together by joining cells into modules. The power from these is changed to mains quality AC power through an inverter as required.

Maintenance is minimal, as only a once a year inspection of the cable connections and a surface cleaning is required, depending on the installation location. Photovoltaic panels could be expected to remain operational for 20 to 25 years (possibly longer), but this is dependent on type. Impact damage and weather conditions can cause problems and panels may be vulnerable to vandalism in some locations.

The panels can be mounted at high (roof) or low (ground) level, but must not be shaded. They could be fitted on an adjustable frame to be angled at 30º (summer) and 60º (winter) to the horizontal. Alternatively, the panels could be mounted on a fixed frame at a 45º.

Solar PV cells operate best on an angled south facing roof or canopy and can be used either to form a new roof surface or fixed to the roof surface, depending on the type chosen. There are a number of different forms of PV. These vary from conventional panels of cells, through solar slates, to solar PV cells combined with glazing in elegant patterns for atria. Translucent PV can make a positive contribution to the ambience of the space as well as contributing to the energy demand of the building.

An automatic disconnection device, approved by the Electricity Distribution Company, must be provided between the photovoltaic panels and the mains connection. In the event of loss of supply from the mains this prevents feedback from the PV panels into the electricity distribution system (and avoids electrocuting the repair engineer!).

If the power generated by the photovoltaic panels is to be utilised as a standby facility to the mains electricity supply, then it is necessary to store the renewable energy generation in a battery storage bank. The capacity of the storage battery depends on the loading to be supplied and the time required for the standby period. An inverter / controller units converts the stored power into mains compatible electricity.

Solar water heating

Solar water (or solar thermal) panels trap the sun's heat in panels or tubes for use in homes, other buildings and swimming pools. A typical system consists of a heat collector, usually mounted on a roof. It needs to face as near to south as possible (SE to SW is ideal). A water and anti-freeze mix passes through the collector, is heated by the sun, then passes through a coil in the hot water cylinder to transfer its heat to the surrounding water, ready for use. The systems need a special hot water tank to store the heated water. These tanks have two heating coils – one supplying heat from the solar collectors, one from the main central heating system (often mains gas). Most gas boilers can be used in conjunction with solar panels, although not all combination (combi) boilers are suitable.

Here in Britain, solar water heating can provide approximately 50-70% of the hot water for a home. On sunny days, water temperatures of 70ºC to 85ºC are common (although hot water storage temperatures are usually set at 60 ºC for safety. Even on cloudy days in winter, warm water will be produced, and this reduces the energy used by the conventional water-heating system when heating by conventional means. Solar systems usually give at least 20 years useful service, during which time the money saved more than repays the initial cost.

Solar panels are not obtrusive, they look similar in appearance to a large Velux skylight on the roof – and can either sit on an existing roof or be built into it. A typical installation for a family of four would need about 4 square metres of panels. Planning permission is not needed, unless the building is listed or in a conservation area. However you should contact your local authority planning department for advice and also check if building regulations might apply. If there are problems installing the panels on the roof, it may be possible to install a ground-mounted system.

Wind power

Wind turbines range from very small units to charge batteries for caravans and boats, to large turbines designed to supply the National Grid. A turbine, basically, is a set of blades designed to rotate as the wind blows past them. The amount of electricity a turbine can produce is determined by the speed of the wind and the size of the area swept by the blades. As the blades turn, they produce rotational torque, which drives a generator, either directly or through a gearbox

Wind turbines occupy very little ground space and so can co-exist with livestock or cereal crops. The only permanent use of the land is the concrete turbine foundations, service road and the transformer building and these occur only with larger commercial turbines. Smaller ones for local use will normally simply be mounted on a freestanding or guyed tower or scaffold pole attached to a building. For good wind speeds, the turbines need to be sited on high exposed land. However, as technology has developed and system costs have reduced, it has become more feasible to locate wind turbines in less windy sites. The turbines, like other conventional infrastructure and power generation plant, such as power transmission lines and power stations, can be visually intrusive. There is therefore a delicate balance to be struck between the change in the landscape and wind power's environmental benefits.

Social Finance

What is a social enterprise?

There are several definitions of a social enterprise, but the DTI definition identifies a social enterprise as:

"a business with primarily social objectives whose surpluses are principally reinvested for that purpose in the business or community, rather than being driven by the need to maximise profit for shareholders and owners."

A social enterprise does not have to have a specific legal form – social enterprises can be companies limited by shares or limited by guarantee, unincorporated associations, trusts, co-operatives, community benefit societies or community interest ccompanies. They can also be registered as charities, although charitable status does place restrictions on companies.

Not all forms of finance are available to all legal structures, though in general, the organisation will have to be structured as a not-for-profit company with social objectives.

Funding for social enterprises

Social finance can take a number of forms – but will generally fall into one of three categories:

- Loans (debt finance) – from specialist banks and Community Development Finance Institutions (CDFIs)
- Issue of shares (equity finance)
- Grants.

Many community groups and social enterprises have found it difficult to access traditional sources of finance from, for example, mainstream banks. There are many reasons for this:

- Community groups may not have a credit history and /or assets to offer as security for loans
- Mainstream banks may not fully understand the sector and the specific challenges that it faces
- There may not be sufficient business support for community groups wanting to make a loan application to a bank
- Some banks require personal guarantees or investment from directors of the company which may not be possible for a community group.

This has led to the development of specific bodies that lend to, or can raise finance for, community groups and social enterprises – often those who have been refused credit by mainstream banks. These bodies often offer more flexible terms for paying back loans and include investors who are willing to accept lower and /or uncertain financial returns in return for social outputs. There are many advantages for community groups in going to a specialist lender:

- They take account of social and environmental criteria (as well as financial criteria) when deciding whether or not to lend to an organisation
- Decisions are made more on a bespoke basis rather than using credit scoring procedures
- They have innovative methods of taking security for loans
- There is often more flexibility in structuring finance repayments.

Lenders include:

- Industrial Common Ownership Finance Ltd. (ICOF), 020 72516181, www.icof.co.uk
- Triodos Bank, 0117 973 9339, www.triodos.co.uk
- The Cooperative Bank, 0845 7 213 213, www.cooperativebank.co.uk
- The Charity Bank, 01732 774040, www.charitybank.org
- Local Investment Fund, 020 7680 1028, www.lif.org.uk

Community Development Finance Institutions (CDFIs) are a new financial tool for social, economic and physical renewal in underinvested communities. They lend and invest in deprived areas and under-served markets that cannot access mainstream finance. There are many different CDFIs and there is no standard structure for them. Some lend to individuals, some to social enterprises and to for-profit businesses. The eligibility criteria for loans will also vary. www.cdfa.org.uk

The Renewable Energy Investment Club (REIC) is a not for profit organisation that links renewable energy developers and ethical investors. It assists with the process of offering shares in a community development, and reduces financial and legal complexities. 01654 705000, www.reic.co.uk

Grant availability various from region to region, and from year to year. Social enterprises should be aware that there may be tight timescales to apply, spend and claim assistance. The main national source of funding for renewable energy projects is the Low Carbon Buildings Programme, www.lowcarbonbuildings.org.uk, and some electricity supply companies also offer grants, such as the E.ON SOURCE Fund, www.eon-uk.com/source or the Scottish Power Green Energy Trust.

Local community advice bodies should be able to advise on regional funds.

In Northumberland sources include:

- The Northumberland Coast AONB Sustainable Development Fund, 01670 533791, CGray@Northumberland.gov.uk
- The Northumberland National Park Sustainable Development Fund, 01669 622061 (northern area), 01434 611512 (southern area)
- Northumberland Renewable Energy Capital Grants Scheme, 01670 533408 (2007 only)

Case Studies

Moel Maelogen - a co-operative of 3 farmers from the Conwy valley, an area still polluted by radioactive fallout from the Chernobyl nuclear disaster in 1986, have taken radical steps to secure their long-term future, benefiting their local community for decades to come in the process. With the support of Triodos Bank's renewable energy team, the farmers boldly developed 3 wind turbines on the hills around their homes. The turbines provide energy for 1600 homes and secured the long term future of the farmers. *Source: Triodos Bank Project List 2003*