community renewable energy toolkit

Community Energy Scotland

The Scottish Government

Community Renewable Energy Toolkit

Foreword

The purpose of this toolkit is to contribute towards the achievement of Scotland's renewable energy targets by galvanising and guiding community groups to find ways of maximising community involvement and benefits from renewable energy.

Who is this Toolkit for?

This toolkit has been produced to help community groups to develop renewable energy projects. 'Groups' may be an informal collection of like-minded individuals wishing to start something in their community; or may be well-established, constituted organisations linked to a community facility (e.g. village hall or community centre) or with a wider purpose (e.g. Development Trust).

It does not assume any detailed knowledge of the topic and so allows you to decide where to start – whether this means looking at the basics of energy generation and use, or at specific detail of a particular renewable energy technology.

The Structure of the Toolkit – Three steps

The toolkit is designed to allow you to work through what your community's options will be and point you in the direction of further help and information to allow you to take a project forward.

It is structured according to 3 steps:

- **Your current position**: chose which section is most relevant to your requirements;
- **Information** on your chosen topic (Annex 2 includes case studies to support and help explain this);
- **More detailed and supporting information** on your chosen topic is in Annex 1. This along with links to further information in the body of the document will enable you to determine your need for further advice and, most importantly, be in a position to manage the provision of that advice and make decisions on it.

Community needs

It is a good idea to start by developing an understanding of what the needs of your community are. These may be obvious – for example the community hall or centre may be cold, difficult or expensive to heat and as a consequence, people may be reluctant to use it. There may be concerns that through increasing heat and power expenses it will become unsustainable to run and will fall into disrepair and/or that the community will suffer by not having an available meeting place. Alternatively, investment in new community buildings may be under investigation, so now is an ideal opportunity to build in renewable energy provision at the outset to help reduce long-term running costs. In addition, the community might want to actively participate in reducing its greenhouse gas emissions and combating climate change.

It may also be that the community needs an ongoing source of income to help address critical community needs and there may be a source of renewable energy nearby which could be used for this purpose. There may even be plans for a private renewable development near to the community from which the community could benefit.

Whatever the specific requirement is, it is highly likely that a renewable energy project could be taken forward and that this will bring a number of benefits to a community. For example, by equipping a community centre with a renewable energy system, running costs could be reduced, the centre would be warm, well used *and* its carbon emissions would be reduced.

Your Community's Requirements

Look at the following headings and decide which one best describes your current position. You can then begin by going to the section of the guide most relevant to your requirements. You can come back to the table in the light of your new position and move onto another section.

Your current position	Section
Beginner	1. Basics
Cold hall – high bills	2. Energy efficient buildings & 3. Technologies
Adjacent community buildings/houses need heating	4. District Heating
No grid connection	5. Off Grid Solutions
May generate more electricity than needed	6. Generating and Selling Electricity
Commercial wind farm locally	7. Securing Benefit from commercial schemes
Group structure	8. Organisation and consultation
Funding	9. Funding and Finance
Details	Annex 1 : Further Information
Other communities' experiences	Annex 2: Case Studies

A range of possibilities

Over the last few years an increasing number of community groups have discovered that it is possible to use renewable energy to benefit their community. There has also been a rapid growth in the range and quality of renewable energy technologies available to generate heat and power. There are now hundreds of such projects across Scotland which are up and running. They range from micro wind turbines to solar thermal to hydropower installations which help meet community energy needs. There may be one near you that would be worth going to see.

Section 1: Energy, Renewable Energy and Carbon Basics

1. Energy, Renewable Energy and Carbon Basics

1.1 Energy basics

'Energy' can be defined as 'the ability to do work' and is measured in Joules (J). The rate at which energy is generated or used is measured in Watts. One Watt is one Joule per second – (Js^{-1})

The unit of Watts most commonly used when discussing energy consumption is the kilo Watt – i.e. 1000 Watts – or 1kW.

1.1.2 Energy rating

Electrical appliances are rated in kilowatts. So, for example an oil filled radiant heater is rated at 1.5kW. This means that when the heater is switched on it will immediately consume up to a maximum 1.5kW.

Where large amounts of energy are generated or consumed, the units used are more likely to be in one of the following formats; Mega Watt (1,000,000 Watts or 1MW), Giga Watt (1,000,000,000 Watts or 1GW) or even Tera Watt (1,000,000,000,000 Watts or 1TW).

1.1.3 Energy consumption

Units of energy consumption are usually expressed in terms of the amount of energy used over a certain period – the standard term for this is kilowatt hours or kWh i.e. the amount of energy consumed over an hour.

The 1.5kW heater if left on for an hour with a constant electrical supply will therefore consume 1.5kWh of energy. By the same token, a 60W light bulb left on for an hour will consume 0.06kWh = 60 Watts X 1 hour = 60 Watt hours or 0.06 kWh.

Electricity is sold by the kWh, which equals 1 unit. The current domestic tariff is around 13p per kWh. Therefore keeping the electric heater on for 1 hour will consume 1.5 units of electricity – 19.5p.

1.1.4 Energy generation

The same rationale is applied to energy generation. Generators are rated in kW or MW, indicating the maximum that can be generated at any moment. If a 1kW generator is operating at full capacity for 1 hour it will generate 1kWh.

However, the amount of energy generated will depend on how much useful energy is available to power the generator. It will only generate to its maximum rated level if it is supplied with sufficient useful energy. This applies equally to a small diesel generator or a wind generator, the only difference is that a small diesel generator will generally either be full on (with fuel), or off (no fuel) whereas the output from a wind generator will vary with wind speed.

1.2 Renewable energy basics

Understanding some renewable energy basics will help you to work through what may be possible for your community. Below are some typical questions that arise as people seek to understand how renewable energy works and why they should consider using it.

1.2.1 What are the useful sources of renewable energy?

The main sources and how they can be used are summarised in the table below;

Source	Utilisation	Output
Sunlight - heat	Solar water heating	Hot water
Biomass - wood	Combustion – boiler or stove	Heat
Sunlight – heat from sun transferred to soil, air or water	Ground source heat pump Air source heat pump Water source heat pump Passive solar	Heat and hot water
Sunlight - photons	Solar photovoltaic cells (PV)	Electricity
Wind	Wind turbine	Electricity
Water	Hydro turbine	Electricity
Biomass - wood	Combustion – boiler (+ steam turbine if electricity generation is desired)	Heat (and electricity)
Biomass – biodegradable matter	Anaerobic digestion (decomposition without oxygen, producing methane gas) - can also use the gas to generate electricity if desired	Heat (and electricity)
Wave (wind)	Floating or shore based electrical generators converting kinetic energy from waves.	Electricity
Tidal	Underwater electrical generators converting kinetic energy from tides	Electricity

1.2.2 Can we get free heat and power?

As sources of renewable energy, like the wind, are free, fuel cost will be free (the exception being biomass which will have a cost in terms of sourcing pellets, woodchip or logs). Ironically, though the fuel is free or low cost, the capital investment required to harness the renewable energy can sometimes be quite significant compared to traditional (fossil fuel) based systems. All systems need to be regularly maintained, just as with traditional systems.

The Scottish Government provides grant assistance to community groups undertaking renewable energy projects, more information is available here:

http://www.energysavingtrust.org.uk/scotland/Scotland/Scottish-Community-and-Householder-Renewables-Initiative-SCHRI and
http://www.communityenergyscotland.org.uk/grant-funding.asp and in section 9, Funding and financing your project.

For some communities with abundant renewable resources, the use of renewable technologies will allow cost savings compared with traditional energy fuels and equipment.

1.2.3 How, in practice, does it compare with using traditional energy sources?

From the user's perspective, there is no reason for any significant difference in operation of renewable systems compared with traditional sources – user-friendly control panels are standard.

With certain technologies, however, there is a requirement to be aware of the limits of operation and to think a bit more carefully about energy requirements. For example, a ground source heat pump can be ideal for providing background warmth, but cannot react instantaneously to provide immediate additional heat.

However, the on-going cost of renewable energy based systems is likely to be lower than those based on fossil sources. Fossil fuels are widely expected to increase in cost as global demand increases. In addition, as the use of renewable systems increase, economies of scale will mean installation costs will become more competitive.

In terms of heat supply, the key practical difference between biomass and fossil energy sources is their *energy density.* Energy density is a measure of how much energy is stored per unit mass of the material in question. In general, renewable energy sources are less energy dense then fossil sources. This has two practical implications:

- More space to store or extract the energy source is required;
- It takes longer to harness an equivalent amount of useful energy.

So, for example, you will need a larger storage facility for, wood chips than for oil for an equivalent heat output.

1.3 Carbon Calculations - basics

Energy consumption is one of the main sources of man-made carbon dioxide emissions to the atmosphere.

1.3.1 Carbon (C) or Carbon Dioxide (CO_2)?

Carbon dioxide is one of the greenhouse gases that contribute to global warming, but often statistics and information refer to carbon only. This does not really matter as long as there is a consistency in which is used.

Emissions of either C or $C0_2$ are often expressed in kilograms (1000g) or tonnes (1000kg) but it is important to remember that CO_2, as a molecule of carbon plus two molecules of oxygen, weighs more – 3.67 times more. For this reason, any figure for the weight of CO2 will be 3.67 times more than the figure for carbon alone.

1.3.2 Is carbon dioxide the only greenhouse gas?

Greenhouse gases are those gasses that trap heat in the atmosphere and listed below are the six most important ones as per Kyoto protocol.

Greenhouse gases
Carbon dioxide
Methane
Nitrous oxide
Hydro-fluorocarbons
Per-fluorocarbons
Sulphur hexafluoride

Carbon dioxide and methane are the main greenhouse gases that arise from human activities. Water vapour is also an important greenhouse gas as it traps heat in the atmosphere.

Carbon dioxide is typically produced when something is burnt to produce energy. Methane is produced mainly by bacteria which decompose organic matter in anaerobic conditions i.e. where there is no oxygen – typically in a land fill site, or in coal mines, or in cattle rearing. (Controlled anaerobic digestion uses the methane released as an energy source instead of releasing it to the atmosphere, see section on 4.4.2 anaerobic digestion.)

Natural sources of methane include wetlands and peat bogs. Although far less methane is emitted than carbon dioxide, methane is 23 times more effective at trapping heat in the atmosphere and is therefore a more potent greenhouse gas per tonne. Anaerobic Digestion technologies can capture methane generated by the decomposition of organic matter, and use it for heat or electricity generation.

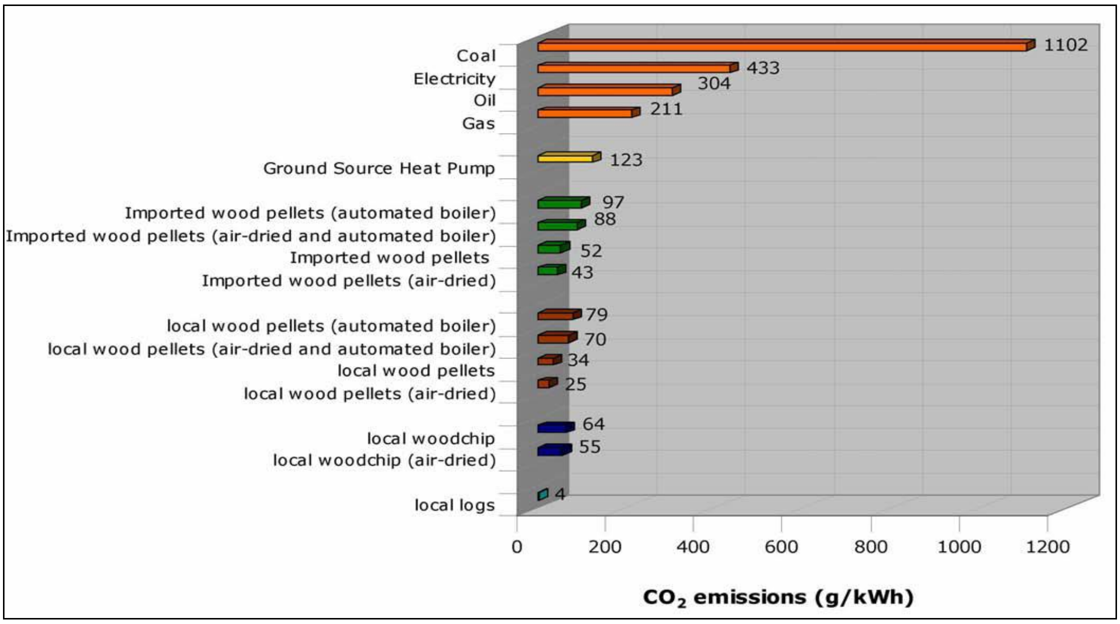
1.4 Renewable energy and carbon emissions

Substituting energy from fossil fuels with renewable energy is an important way to reduce carbon dioxide emissions. This is because when fossil fuels (coal, gas oil etc) are burnt and carbon dioxide is produced, there is no way of replenishing that resource or securing the carbon dioxide emitted.

Renewable energy sources such as wind, wave, tidal, hydro and solar are all carbon free fuels, with capture of the energy at locations where the resource is abundant. Scotland has one of the best wind, tidal and wave energy resources in the world and also has a high amount of hydro resource available. Carbon dioxide emissions are created in the construction of plant and equipment, but studies suggest that the CO_2 emitted during manufacture of plant is offset after the first few years of operation, given that the renewable technology displaces energy previously sourced from fossil fuels.

Biomass – wood and biogas – when combusted as fuels do create carbon dioxide emissions but as biomass resources can be replanted and as the growth cycle absorbs CO_2 during the life of the plant, essentially this is seen as CO_2 neutral. However there are CO_2 emissions associated with the transport of biomass fuel from resource area to end use location. Where this does happen, it is at a much reduced level in comparison to fossil fuels as biomass resources are usually sourced from local supply chains.

The relative carbon dioxide emissions for biomass and fossil fuels (excluding construction of plant) are presented below.



The Carbon balance of wood fuel, fossil fuels and ground source heat pumps
(From: Northern Wood Heat – The Carbon Balance of Wood Fuel (Highland Birchwoods / Northern Woodheat; Northern periphery Programme, 2007).

1.5 Community relevance

For communities to engage their members on carbon reduction and energy projects it can be useful to explain and promote the benefits of acting as a group. There are a great deal of opportunities, support and momentum to be gained from acting collectively as a community group to address concerns of energy security.

This toolkit explains how this can be achieved practically in terms of the technologies involved (section 3), size and types of projects (section 4, section 5, section 6 and section 7), community organisation (section 8) and funding availability (section 9).

Section 2: Energy Efficient Buildings

2. Energy efficient buildings

This section deals with energy efficiency issues and will help communities understand how best to tackle inefficient buildings or practices. It covers some technical detail which could be useful if a community is looking at improving building performance and energy usage.

2.1 Assessing Heat Loss and Insulation Requirements

Immediate savings on energy can be obtained by applying simple energy efficiency measures. These include:

- Draft proofing
- Adding new or more insulation into walls, ceilings and under the floor
- Installing double glazing
- Using low-energy light bulbs
- Blocking off unused chimneys
- Installing white goods with high ratings for energy efficiency
- Raising the awareness of those that use the facility as to best practice regarding energy efficiency.

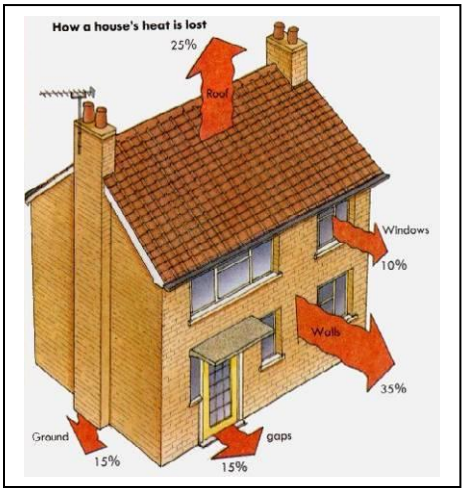
Buildings built before 2002 will not be as energy efficient as more modern buildings. Therefore, where possible, it would be advised to have the building improved to at least current day building standards so that maximum benefit can be gained from renewable technologies. Planning the installation of any renewable energy heating system will require consideration of *heat load, heat loss and insulation*.

A good source of advice and information on energy efficiency measures, and current building standards is Scottish Building Standards http://www.sbsa.gov.uk. They also have a useful guide available at http://www.sbsa.gov.uk/homeimprovements.html.

Further information on energy efficiency measures and funding is available at
http://www.energysavingtrust.org.uk/What-can-I-do-today and
http://www.energysavingtrust.org.uk/scotland/Scotland/Consumers

2.1.1 What is Heat Loss?

Heat Loss is the amount of heat that transmits from the inside to the outside of a building through walls, windows, roof and other building surfaces. Heat loss is expressed as Watts per metre squared (W/m^2). The rate at which heat is lost from a building is determined by many factors. Understanding how to minimise these factors can help to save money and carbon emissions.

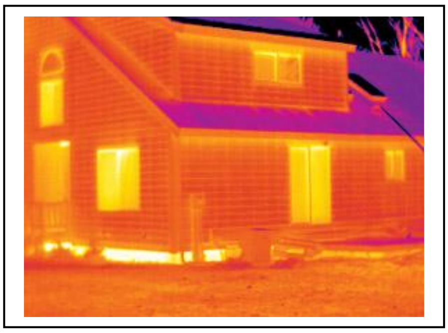


2.1.2 How do we assess heat loss?

Heat loss can be estimated using the following equation:

Total building heat loss = Fabric Heat Loss + Ventilation Heat Loss.

The use of an infrared *thermal imaging camera* can also give a visual indication of where heat is being lost from a building. Thermal imaging involves measuring long-wave infrared radiation (heat) and displaying it as a visible picture. Thermal imaging can detect defects in insulation, air leakage, dampness, hidden objects such as flues and air ducts, damaged areas of insulation and blocked heating distribution pipes, locating central heating pipes.



Infra red photo of a building – brightests colours indicate highest heat loss

2.1.3 How can we minimise heat loss?

Get a survey carried out for the building to see where the levels of insulation can be improved to current building standards. The following measures can all help improve energy efficiency of buildings and reduce heat loss.

Draught Proofing

Draught proofing is an inexpensive measure which can be used to increase the insulating values of windows and external doors in buildings. Draught proofing can be fitted to letter boxes, access hatches and loft hatches.

Improving building fabric

Walls, windows, doors and other materials that make up a building envelope all have different levels of insulating properties. Older buildings can have higher ceilings and minimal or no insulation which requires a lot of energy to heat. New buildings are designed to meet specific building regulations on insulation levels to prevent heat loss. If the date of construction of the building is known, the minimum levels of thermal performance it should comply with can be found out. Further information is available on the Scottish Building Standards website http://www.sbsa.gov.uk/homeimprovements.html.

Insulation

Insulation is any material used to reduce heat loss. When insulation is placed in walls, ceilings or floors it reduces the loss or gain of heat from outside sources. The ability of material to retain heat or reduce loss is expressed as its **U-value**.

U -value is a measure of the amount of energy that will pass through an area of material when there is a 1°C difference in temperature between inside and out. U-values are expressed in W/m^2K. Lower U-value materials are better at preventing heat loss.

Floor Insulation

Insulation can be fitted between suspended floor joists or under raised access floors to help prevent heat escaping though the floor. This should be standard where under floor heating has been fitted.

Loft/Ceiling Insulation

Current building regulations state the insulation in these areas should be of a depth of at least 270mm. It is essential that water tanks and pipe work present in the loft space are insulated also, but taking care not to insulate underneath the water tank as this could cause the water to freeze.

Typical loft insulation and pipe lagging

Photo from CES library

Solid Wall Insulation
For walls there are options to insulate both externally and internally. Internal wall insulation comes in the form of insulated plasterboard. The most common form of external insulation is external render or cladding.

Cavity Wall insulation
Cavity wall insulation can result in up to an 85% improvement in wall performance. Check that the building has a cavity wall structure – if there are no building plans and it is not possible to tell from the appearance, a local insulation company can assess the building free of charge by drilling a small hole in the wall to determine whether it is a solid or cavity wall. Cavity wall insulation is usually installed by drilling holes in the outer membrane of the wall and blowing in the insulation.

Glazing
Heat loss from the most thermally efficient window is still ten times more than the most thermally efficient wall. For this reason secondary, double or triple glazing will provide a beneficial increase to the thermal performance of windows. Conversion to Double or Triple Glazing windows can be expensive. The addition of a secondary layer of Perspex can prove less expensive but can still provide benefits.

Air tightness
A leaky building will allow heat to escape through poorly fitted windows, doors, and wall joins. Sealing the building envelope will prevent heat from escaping. Air tightness or pressure testing of a building can test for leakage. Air tightness testing is a legal requirement for community buildings with a usable floor area greater than $500m^2$.

Note that with the addition of any energy efficiency measures it is extremely important to allow for adequate controlled ventilation, otherwise damp and condensation can build up.

2.2 What is the Heat Load of a Building?

The *Heat Load* of a building is the amount of energy required to raise and maintain the temperature of the structure to the desired level. Heat Load is usually expressed in kW. This value is used to determine the size of heating system required for the building. This is usually calculated on a room by room basis then scaling up to give a total heat requirement for the building. Sizing the heating plant correctly is important as an incorrectly sized plant will result in inefficient operation.

A heating plant is sized to overcome the heat losses of a building. The calculation also takes into consideration the internal and external design temperatures.

The Internal Design temperature will depend on what temperature is required for the specific uses of the building. The External Design temperature will depend on your location in the country. For example the typical Scottish External Design temperature is -4°C. However if you are in a more extreme location such as Aviemore this can be -10°C. The actual external temperature can go below the design temperature but it is not practical or economic to design for heating system for 100% of the time.

The size and shape of a building will influence the amount of heat that is lost through the building envelope. The larger the building the larger the external surface area the more heat is lost through the building. Conversely the smaller the building the less opportunity there is for heat to escape. A south facing building will also benefit from solar gain ensuring that maximum daylight is absorbed by the building.

The number of air changes required in your building will differ depending on the specific usage of your building. Fresh air from the outside will be cooler so will require energy to heat up.

When designing a new building speak to your architect about designing an energy efficient building, minimising heat loss and maximising solar gain.

2.3 Defining options

For a group about to explore whether renewable technologies can bring benefit to a local community and have identified the key needs of the community, the next important step is to define options. This will require analysis of the local resources and an assessment of what the most efficient and beneficial technology would be. In some cases it may be necessary to gain expert advice and commission a report or a feasibility study by a specialist. Studies which may need to be undertaken include:

- Energy Audits
- Option Studies
- Feasibility Studies

Potential Gains from these studies include:

- Increased knowledge of how the building operates from an energy perspective.
- An indication of possible improvements to the building.
- An indication of whether renewables are feasible in the local area.
- An understanding of which renewables are feasible for the project.
- A strengthened application to funding bodies.

Carrying out a study can add additional time to a project. However, it can also give a community group better knowledge and understanding of what options are available.

If a study is necessary, it's a good idea to ensure that it also covers practical design requirements for the best option.

For more information on how to approach a feasibility study, see Annex 1. See the Scottish Renewables Forum website for a list of consultants active in Scotland.

2.4 Options – an initial guide

For groups initially assessing options, the following table will help guide the reader through this toolkit.

If not already considered, the first statement on this table needs to be addressed if dealing with an existing building. Once completed, choose one or more of the subsequent statements which most reflects the position of the group, then go to the relevant option identified for more information.

State of building	Option	Section
We have not assessed heat demand, heat loss, or insulation requirements. There is little/no insulation in our building.	Get some help in assessing heat demand and heat loss to help scale your heat requirements. Assess scope for insulation before doing anything else	heat loss and insulation
It has a sunny/open aspect	If you need hot water, solar water panels may be an option	solar water heat ing
It is in a windy location and has land nearby	A wind turbine to power heaters (direct heating from wind) may be an option	direct heating from wind
We have a river nearby	A hydro-electric plant may be an option	Hydropower basics
We have a daily demand for heat and hot water and a local supply of wood	A boiler burning logs, woodchip or pellets may be an option	Biomass heating District heating
We need a reasonably constant background warmth	A heat pump may be an option	Heat pumps

We are planning a new building	Careful design could significantly reduce energy requirements	SBSA website

2.5 Planning applications and Building Regulations

In almost all projects involving installations on or adjacent to buildings, planning consent and a building warrant are likely to be required. It is essential to check first with local authority planning and building control departments. The Scottish Government has brought to Parliament the conclusion of the General Permitted Development Rights (GPDR) consultation. This brings solar panels, ground source heat pumps and biomass boilers (specifically flues) into permitted development (PD), so for most circumstances planning permission will not be required for such installations. There are restrictions in areas of conservation status. Further information on this can be found at:
The Town and Country Planning (General Permitted Development) (Domestic Microgeneration) (Scotland) Amendment Order 2009.

Section 3: Technologies

3. Technologies

This section discusses the variety of technologies that have been employed by community groups across Scotland. The principles of how the technology works is provided along with the key issues regarding installation and operation. Case studies for each technology are referenced and in Annex 2. Further information regarding installers, ROCs (Renewable Obligation Certificates) and FITs (Feed In Tariffs) are introduced.

Other sources of assistance and information may be found at the Community Action for Energy Programme (CAfE) which is a UK wide programme that provides case studies on community energy projects.
www.energysavingtrust.org.uk/cafe

A recent energy report that investigates the best types of technology for rural, semi urban, and urban communities in terms of cost and CO_2 savings is available and may help guide communities to look at technologies that are more appropriate for their locations. http://www.energysavingtrust.org.uk/corporate/Global-Data/Publications/Power-in-numbers-full-report

3.1 Solar water heating

Solar thermal panels work on the principle of using the direct heat from the sun to heat water for use in buildings. Solar water heating systems have three phases;

- collection of solar heat (radiation) via a collector ('solar panel')
- transfer of the collected heat to the water
- storage of the hot water in a hot water tank

The solar panels are usually roof mounted and are connected via pipe-work to a hot water tank and control unit. Roof mounting will normally require drilling into existing tiles which can then be sealed with suitable sealants. A survey should be carried out to determine the load bearing qualities of the roof.

The heat absorbed by the solar panel collectors is transferred to water which is circulated around these collectors by a pump. The heated water is then stored in the tank which normally has provision for an electrically operated heater or other form of heating input. Some systems may require the replacement of your existing hot water tank. When the levels of sunlight are low or demand for domestic hot water is high, the heater is used to boost water temperature in the tank. For public installations it is necessary to ensure that the hot water in the tank reaches 62^{o} C to prevent Legionnaire's Disease.

There are two main types of solar panel – evacuated tube and flat plate collector

3.1.1 Evacuated tubes

Evacuated tubes works so that there are twin tubes with a vacuum between the tubes – and the inner one is normally coated in a material that absorbs heat well. The vacuum is heated by radiation from the sun which is then transferred to the inner tube and from there to an inner pipe network which works to heat water through a manifold exchange.

This results in an efficient system as the vacuum prevents heat loss, and also there is often a high reflectivity membrane behind the tubes which increases capture of heat even further.

Evacuated tube solar water heating tubes

Photo from CES library

Evacuated tubes are:

- Generally more expensive than Flat Plate.
- Good for areas where there is low amounts of sunshine.
- Can be affected by high winds

3.1.2 Flat plate collectors

Flat plate collectors are generally cheaper than evacuated tube collectors, as their manufacturing process is cheaper. The standard flat plate collector consists of a system that has a collector sitting behind a highly absorptive panel. This collects the heat via a heat absorbing fluid and the water is heated by closed loop system in the hot water tank.

Flat plate collector solar water heating panels

Photo from CES library

Flat plate collectors are:

- Relatively cheap compared to Evacuated Tubes.
- Good for areas that have a lot of sunshine.
- Deemed to be more stable for windier locations

However although evacuated tubes are more efficient per m^2, flat plat collectors generally have greater surface area per panel so there is often not a great deal of extra energy to be collected to from an evacuated tube system.

See case study 1, Hilton Community Cafe, Inverness and case study 2, Dunbog Hall, Fife, for examples of projects using flat plate collectors for solar water heating.

3.1.3 Appropriate areas for solar panels

Solar panels are suitable for installation on buildings which have a large part of their roof facing in the general direction of south, and a moderate amount of sunlight. The pitch of the solar panel can be individualised on installation to either gain the maximum sunlight throughout the day as a whole, or to be able to generate more electricity/thermal energy in the morning or afternoon depending on your own energy consumption. The usual pitch of a solar panel in Scotland is between 30-40^{o} from the horizontal. When deciding upon which type of solar panel is most appropriate to a project, it is always advisable to look at the amount of sunshine that could be received and the energy requirements of the project. It is important to match the product with the demand so as to operate with the most efficient system for the community group.

For more information see:
http://www.energysavingtrust.org.uk/Generate-your-own-energy/Types-of-renewables/Solar-water-heating

3.1.4 Checklist for solar thermal panels

This section provides a selection of top tips for installing solar thermal panels. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. The size and type of panel needs to be considered and matched with demand as does the size of hot water storage.
2. Mounting direction and panel angle is crucial to maximise heat input.
3. Surfaces and roofs where the panels are to be mounted must be capable of carrying the additional weight.
4. The system needs to be protected against frost and boiling.
5. Allow provision of a heat meter to show you how much energy you have gained from the sun.
6. The installation may require a new hot water tank to operate and provide sufficient storage.
7. There may be scope to provide some solar heating as well as domestic hot water if this is designed into the system.
8. Depending on what is expected of the system it may need some backup heating for the water such as an electric immersion heater. Solar works well as a supplementary source of energy to another primary source, so for example it can be integrated well with other renewable technologies through the use of a buffer or accumulator tank.
9. Remember the amount of water heated will change throughout the year as sunlight levels change.

3.2 Photo voltaic panels

Photo voltaic panels (PV) work on the principle of utilising the sun's rays to create electricity. Because of a semi-conductor material manufactured into the PV panel, when light is applied to the panel, electrical current is produced. Solar PV panels are generally installed by attaching to the existing tile structure on a roof, but some manufacturers are now manufacturing solar panels that can be installed as tiles integrated into the roof.

PV panels are usually roof mounted and must face the general direction of south in order to be effective. A survey should be carried out to assess the load bearing qualities of the roof.

The capital cost of equipment purchase and installation can be high.

> See case study 3, Sgoil na Coille, Salen, Argyll, in Annex 2 for an example of a project using photovoltaic panels for electricity generation.

For more information:
http://www.energysavingtrust.org.uk/Generate-your-own-energy/Types-of-renewables/Solar-electricity.

Ground mounted PV panels

Photo from CES library

3.2.1 Checklist for solar PV panels.

This section provides a selection of top tips for installing solar PV panels. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. Mounting direction and panel angle is absolutely crucial to maximise electrical output.
2. Ensure the surface is clean.
3. The capital cost of equipment purchase and installation can be high.
4. Actual electricity generated from PV can be low.
5. Solar PV can be especially well suited to off-grid applications where it compliments a small wind turbine for example.

3.3 Wind energy – small wind turbines

Wind is one of Scotland's most abundant renewable resources, which can be utilised through wind turbines. Wind turbines are one of the most proven renewable technologies.

A wind turbine captures energy by its blades turning. The capture of wind energy is proportional to the area of swept rotor area. The larger the area the greater the amount of wind captured. When the blades turn this turns the shaft in the generator which creates electric current. The generator changes kinetic energy into electrical energy which can be used to supply power to a building (electricity system), heat a building (wind to heat system) or supply the national grid.

For more information on how wind turbines work see here on the British Wind Energy Associations website - http://www.bwea.com/energy/how.html.

Small wind turbines are generally turbines in the rated range of 0.05kW (50W) - 50kW. Both vertical and horizontal axis turbines are available in this range. Horizontal axis turbines are the most usual form and have turbine blades spinning perpendicular to the ground with the turbine shaft horizontal to the ground. Vertical axis turbines spin horizontal to the ground with the turbine shaft perpendicular to the ground. Recent developments in both types of turbines have led to building mounted turbines installed in areas where there is limited space. For more information on larger wind turbines please see Section 6, Generating and selling electricity.

Small horizontal axis turbine

Vertical axis turbine

Photos from CES library

A community group looking to assess a site for wind energy potential should assess the site available for wind resource. The key to this is:

- Does the area have a good open aspect away from tall trees or buildings- specifically in the prevailing wind direction (normally from the South West in the UK)? If there is not a clear and open aspect for a wind turbine to capture wind, then in most situations poor turbine performance will result.
- Are there tall buildings, hills or trees close by in the path of wind? This can cause turbulence in wind and decrease the production of a turbine.
- Is there land available away from the building to install a turbine on? The further from a building the less turbulent the wind.

- Do you know if there is a rock strata close to surface of soil as this will influence the foundation of a turbine?
- If a building mounted turbine is the only suitable option it will be necessary to get the building checked for structural stability to ensure it is able to carry the weight and rotational forces of a turbine.

3.3.1 Supplying power using wind energy

Wind generated electricity can serve a building for its own electricity or electric heating needs, and any excess can be exported to the grid. This generation if metered using a correct Ofgem accredited meter can be eligible for ROC (Renewable Obligation Certificate) income – all of the generation produced is eligible for ROC income even if all of it is consumed on site. (Please see Annex 1 for further information on ROCs.)

A grid connected turbine can take electricity generated and power the building as needed before any surplus electricity (e.g. when there is low energy demand) goes straight onto the grid. This grid connected system is useful if the building has high electricity consumption and is open 'seasonally' or for part of the day. In these circumstances extra energy can be sold to the national grid and used as an added income, coupled with the income from ROCs. However, groups should bear in mind that the electricity they sell back to the grid is at a lower price than the electricity they purchase. Consumed and generated electricity is metered; these meters are often referred to as import and export meters. It is always more efficient if the energy can be used at source with any excess then going to the grid.

3.3.2 Heating using wind energy – Direct heating from wind

This is an approach that utilises the wind to heat a building, instead of the normal effect of cooling, on windy days. By installing a direct wind heating system, energy captured by the wind turbine is used to power heaters inside the building resulting in increased heat and comfort levels for building users, with reduced fossil fuel consumption.

In general, direct wind heating systems fall into two categories:

- '**Grid connected'** – where the system is connected to heaters and the electricity mains, so that when the heaters are fully charged, the power from the turbine is switched to feed into the electricity grid.
- '**Standalone**' – where the output from the turbine goes directly to storage heaters

> See case study 4, Cults Primary School, Aberdeen, for an example of a project using a small wind turbine for electricity generation.

> See case study 5, Eriskay Hall, in Annex 2 for an example of a project using a small grid connected wind turbine for electricity and heat (direct heating from wind) generation.

See case study 5, Berneray Hall, North Uist, for an example of a project using a small standalone wind turbine for electricity and heat generation.

3.3.3 Checklist for wind turbines

This section provides a selection of top tips for installing wind turbines. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. You will need planning permission and agreement with the land owner to erect a turbine.
2. You need to decide how your generated electricity is to be used i.e. grid connect, stand alone or direct heating from wind.
3. Ensure that whatever system you choose; you are eligible to claim ROCs.
4. If it is to be connected to the grid you will need an agreement with the local electricity District Network Operator (DNO) and an agreement with an electricity supplier to purchase your export electricity – see section 6.10 Grid connection.
5. Ensure you check the warranty on any machine and that there will be a post installation maintenance service.
6. Check with the manufacturer that spare parts will be available for your turbine in the future.
7. Remember to calculate a payback time for the turbine using typical wind data for the area to make sure it is a viable option.
8. Wind turbines operate the most effectively in large open areas with minimal tall buildings, hills or trees which cause turbulence.
9. Make sure you receive all information about the system from your installer, including how to shutdown the turbine in excessive winds.
10. See Section 6.7 Planning permission for further information on this and organisations such as RSPB who should be consulted.

3.4 Biomass Heating

Biomass is a fuel that is biological in origin and although this section will deal with the most common forms of biomass fuels – wood logs, chips and pellets - it should be recognised that energy crops, food wastes streams, some agricultural residues, industrial wastes and residues are also biomass based and can be used for heating. Anaerobic digestion of organic waste is covered further in the district heating section.

Wood is by far the most common source of biomass fuel for heating community buildings, primarily in the form of logs, chips or pellets. Chips and pellets often are sourced from off cuts and remnants from wood processing or wood waste.

Biomass heating using wood as a fuel works by combustion of the fuel in a boiler. Most boilers supplying heat up to 150kW work by an auger delivering fuel to a burner head in a combustion chamber. Larger systems often work by delivering the fuel to the combustion chamber via moving grates. Along with the pellet, chip and log burning boilers, some can also cope with a variety of feed stocks such as the residues etc mentioned previously, which could provide future flexibility for groups. Modern biomass boilers are low maintenance with self cleaning functions and sensors that monitor the air content of the combustion to maximise efficiency.

3.4.1 Wood pellets

Wood pellet hopper and boiler

Photos from CES library

Wood pellet characteristics
Low moisture content. Higher energy density. Lower storage capacity required. Lower capital storage costs due to standardised shape. Requires minimum amount of maintenance to ensure energy output. More expensive

Wood pellets are burned in a boiler and the heat from this burning process is transferred via a heat exchanger to domestic hot water and heating systems. The wood pellets are made from compressed sawdust. They are stored on site in a large hopper and are automatically fed into the boiler as demand requires.

Wood pellets are consistent in size and moisture content and therefore in potential energy so are a less variable source of fuel than woodchip or log, though can be more expensive as a result. Also, it is imperative to establish a reliable local wood-pellet supplier. A useful guide to pellet suppliers in Scotland can be found on www.usewoodfuel.co.uk however this is not a comprehensive guide. See following section on wood chips.

Wood Pellets

Photo from CES library

See case study 7, Fountain Road Hall, Golspie, in Annex 2 for an example of a project using a wood pellet boiler for generation.

3.4.2 Wood chips

Typical wood chip boiler and hopper

Photos from CES library

Wood chip characteristics
High moisture content. Lower energy density. Higher storage capacity required. Requires more routine maintenance to ensure energy output Cheaper than wood pellets

Woodchip boilers operate in the same way as wood pellet boilers. Woodchips tend to be less consistent than wood pellets in potential energy and size so more volume needs to be stored. Consideration must be given to the amount of storage space and delivery access that is available.

Wood chips are however often much less expensive. It is important to find a local supplier of good quality woodchips to ensure uniform size and moisture content before deciding to install a woodchip boiler (see www.usewoodfuel.co.uk). It should not be overlooked that there may already be a wood chip supplier in the locality. They may be currently supplying the horticultural and/or agricultural trade and will be happy to extend their local customer base. Some communities may also benefit from considering setting up community woodland areas such as in Cairndow in Argyle www.hereweare-uk.com/woodchip.

See case study 8, Lochaber College, Fort William, and case study 9, Coach House Trust, Balmore, in Annex 2 for examples of projects using a wood chip boiler for heat generation.

Wood chipping

Photo from CES library

3.4.3 Logs

The principle for log boilers is similar to wood chip and wood pellet. Logs are burnt internally and the resulting heat is transferred to an accumulated hot water tank. This hot water is used to heat living space and domestic hot water.

Log fuel is more labour intensive for a community but a lot less costly than wood chip or pellets, and can help stimulate community forest enterprises. Logs supplied by a community will require cutting of harvested or delivered logs to required length, air drying to decrease moisture content, and the boilers normally require manual loading of logs. Projects using logs as fuel are low cost and with good community commitment can be an ideal solution for a local heating demand and supply. Logs need to be manually loaded into the boiler once or twice a day but are generally cheaper than chips or pellets.

Cutting and storage of logs

Photographs courtesy of Neil Buchan, Castletown heritage Society

The principle for log boilers is similar to wood chip and wood pellet. Logs are burnt internally and the resulting heat is transferred to an accumulated hot water tank. This hot water is used to heat living space and domestic hot water.

See case study 10, Castlehill Heritage Centre, Castletown, in Annex 2 for an example of a project using a log boiler for heat generation.

3.4.4 Checklist for Biomass

This section provides a selection of top tips for installing biomass boilers. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. You will need to have a reliable local wood-fuel supplier and preferably an alternative supply in case of problems.
2. Ensure your fuel supply is dry at all times. Season logs for at least 1 year.
3. A large storage hopper with easy access for deliveries without specialist equipment will be required.
4. Wood-fuel boilers can utilise existing wet radiator systems from existing oil or gas fired boilers.
5. The boiler will need to be maintained by a specialist biomass boiler engineer.
6. Provision must be made for removal of ash, a waste product from the wood-burning process.
7. Modern biomass boilers are generally low maintenance with self cleaning functions and oxygen measurement to maximise efficiency.
8. Wood pellet boilers tend to require lower maintenance than woodchip because the size and moisture content of the fuel is more uniform.
9. Log boilers require manual loading of logs, often daily or more frequently in periods of extreme demand.

3.5 Heat Pumps

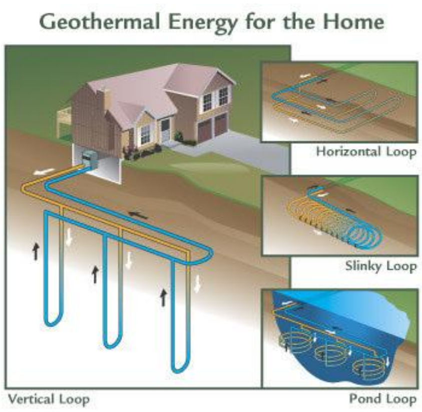
Heat pumps works on the principle of drawing heat out of a source and transferring it to a heating system like radiators or under-floor heating. A heat pump works in a similar fashion to a refrigerator in reverse.

Heat pumps consist of 3 elements

A. A heat source and the means of extracting heat,
B. The circuit of working fluid within the heat pump itself and a power source,
C. A distribution system to deliver the energy in the required form

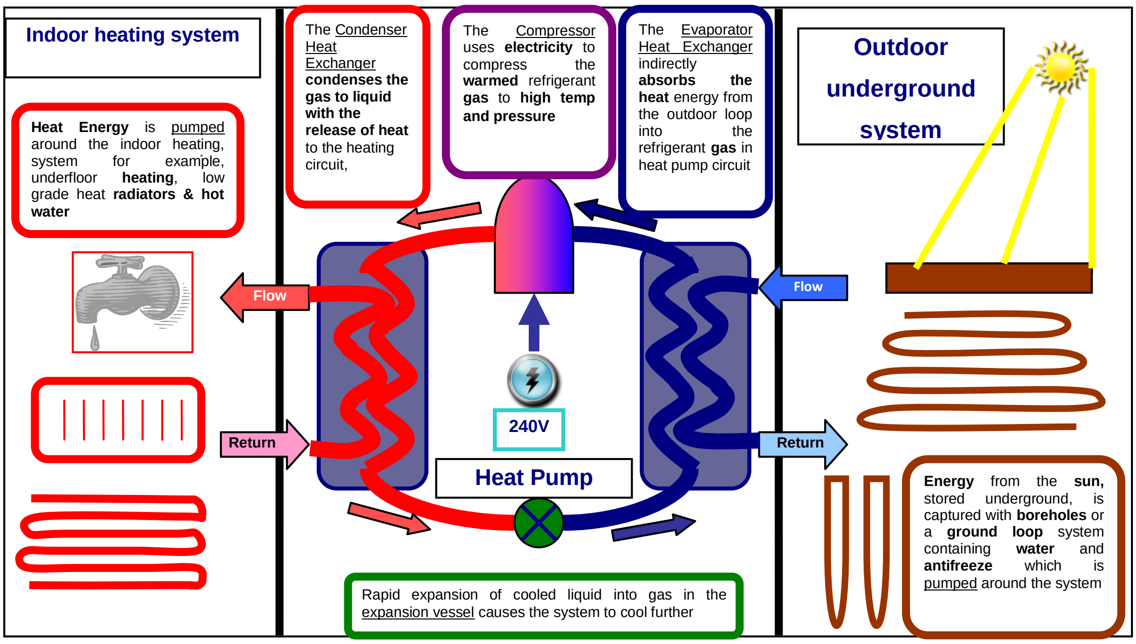
A. The heat is extracted using a sealed pipe network installed in the heat source which can be either
   - ground loops in soil, loops in water,
   - boreholes in bedrock and groundwater,
   - or through the intake of ambient air over a finned heat exchanger

   The sealed pipe network is filled with a mixture of water and an anti-freeze solution such as Glycol



B. The mixture of anti-freeze and water pumped through the outside circuit (e.g. a ground loop) is pumped through an evaporating heat exchanger where the small increase in temperature is transferred to a refrigerant gas in the heat pump circuit. This warmed refrigerant gas is then compressed by means of an electrically driven compressor which causes the gas to become very hot. This hot gas is pumped around a condensing heat exchanger where the gas condenses to liquid with the release of heat which is transferred to a distribution system such as under floor heating or a low temperature radiator system. The liquid is then pumped back through an expansion valve where it cools further and is pumped back through the evaporator heat exchanger to start the cycle again.

C. Heat pumps work best when providing a low grade heat distribution temperature of 30-40°C and so are best suited to under floor heating or low temperature radiators. This suits buildings that require a constant source of heat.



Distribution Working fluid circuit Source

Outline of a working ground source heat pump system, CES library

3.5.1 Efficient use of heat pump systems

As heat pumps work on a low grade heat supply they are more suited to highly energy efficient buildings. Draughty or poorly insulated buildings generally require a higher grade heat source to maintain comfort. Buildings with poor energy efficiency will have to be brought up to current regulatory standards to maximise the potential gains of a heat pump.

When thinking about installing a heat pump, consideration needs to be given to what the heat demands of the building are. Heat pumps work best at providing low grade heat constantly but cannot provide an instantaneous heat boost if required immediately. There is a time lag – usually of several hours – between a heat pump system turning on and providing maximum heat output. Similarly between switching off and cooling down.

The type of distribution system also needs to be considered. Conventional radiators require circulation temperatures of between 55-80°C so are unsuitable for efficient use of a heat pump. Under floor heating and larger ambient temperature radiators are suited to heat pumps.

Although heat pumps draw their energy from a free heat source (soil, air or water), the pumps require electricity to operate. It is therefore common practice to install heat pumps as a hybrid system of micro-generators e.g. install a wind turbine to help power the pumps.

The efficiency of heat pumps is assessed by its Coefficient of Performance or COP. This is a ratio between the heat energy supplied in relation to the electrical energy consumed by the pumps. For example a COP of 4 means that for 1 kW of electricity used to power the heat pumps, 4 kW of heat energy is supplied.

However COP depends on a number of variables and is not standard.

- COP is increased if the temperature difference between source and distribution network is low i.e. COP is higher if delivering temperatures of 40-50°C as opposed to 60°C
- COP is decreased if the complete system is inefficient due to poor design, or installation
- COP is decreased if the building is not energy efficient resulting in higher than normal operation of the pumps to maintain a required temperature.

3.5.2 Ground Source Heat Pumps (GSHP)

Ground source heat pumps use the temperature of the ground as their source of heat. There are 2 ways of extracting this heat:

- Vertical Ground Loops or
- Horizontal Ground loops

Vertical Ground Loop

A vertical ground loop is when a deep vertical bore hole is excavated and a large length of pipe is put down into this hole which can be up to 100m deep. Most boreholes can be drilled in a small defined area; however, if problems occur due to unexpected geology for example, then more area for alternative holes may be required. For this reason a test hole and/or a geologist survey is recommended prior to project commencement. Bore holes are also a more costly option and are usually only considered when available space is an issue.

Horizontal Ground Loop

A horizontal ground loop uses a large length of spiral coil/pipe, also called a ‘slinky’, in a long shallow trench. This trench is usually situated between 750mm and 1.2m below the ground which requires a large area available to be excavated for the short term. Therefore, unless this land can be unused for a couple of months, horizontal loops would not be an appropriate option. Horizontal loops are generally less expensive and are a more common option.

Examples of sinking a borehole (vertical loop) and a ‘slinky’ cable (horizontal loop) for Ground source heat pumps.

Photos courtesy of Carnon Contracting and Andrew Engineering

See case study 11, Shawbost Old School, Lewis, in Annex 2 for an example of a project using a ground source heat pump and a wind turbine.

3.5.3 Water Source Heat pumps (WSHP)

The basic working principles of a ‘slinky’ is the same for a water source heat pump where heat from the sea or a large enough area of water is used instead of the ground. The water source should ideally be fairly close to the property, and should not require pumping up any significant height or the power for pumping it may detract from the energy savings.

Pumping river water through a heat pump is another option, and can give very good results, but heat pump units require water at temperatures above 5 to 8°C (varying depending on type).

Oxygen and contaminants in the river water may also be a concern in some circumstances, causing pump failure and possibly a system refrigerant leak. But this system can give excellent results if installed correctly.

For those lucky enough to have a spring**,** this is a much more stable and better heat source. It is an opportunity not to be overlooked, offering excellent efficiencies. Again, acidity and impurities in the water can sometimes make its use prohibitive.

Permission should be sought from the relevant authorities as an abstraction licence may be needed.

3.5.4 Air source heat pump (ASHP)

Air source heat pumps work on the same principle as ground source heat pumps. Instead of heat being extracted from the ground it is simply extracted from the air. This heat is again compressed within the electrically driven heat pump and transferred to a low temperature distribution system such as under floor heating. This is best suited to new buildings or those undergoing extensive refurbishments as installation in existing buildings would be expensive.

Air source heat pumps are typically slightly less efficient than ground source heat pumps but installation costs can be considerably less.

> See case study 12, Barra Learning Centre, Barra, in Annex 2 for an example of a project using an air source heat pump.

3.5.5 Checklist for heat pumps

This section provides a selection of top tips for installing heat pumps. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. Check your electricity supply can cope with the added load of a heat pump. Larger heat pumps need a three phase supply.
2. Heat pumps are best suited to well-insulated buildings with under floor heating systems, rather than poorly insulated buildings with wet radiator systems.
3. Due to relatively low operating temperatures heat pumps are best suited where constant, background, heat is required and cannot offer a fast response in temperature demand change.
4. Ask for a system performance guarantee; don’t just accept the heat pump manufacturer’s claims.
5. Ensure that the installer is responsible for all aspects of the system.
6. With ground source heat pumps, ensure that your vertical or horizontal ground loops are completed to the correct specification, these are specialist jobs.
7. Get a user guide for the complete system installed not just the heat pump.
8. Ensure you get the system tuned to your needs.
9. Make sure that after sales service is available locally.
10. If the system allows sufficient storage, make sure it is programmed for the low cost tariff.
11. Be prepared for the cost of the electricity to run the heat pump.
12. Allow provision of metering so that you can monitor the performance of the system.

3.6 Exhaust air heat recovery (EAHR)

Exhaust air heat recovery units work on the same principle to air source heat pumps, and are often very similar designs. The main difference is that while air source systems draw in air from outside buildings, exhaust air systems draw warm air from within the building, using ducting from warm areas such as kitchens and bathrooms. This type of system can be particularly beneficial if those living in or using the building are asthmatic or suffer from other respiratory conditions as the units usually incorporate filters to clean the air and remove any particulates. In cases where more heavily-used kitchens are used as a heat source, care should be taken to ensure that these filters can cope with any grease in the air, and ducting should be positioned away from the more obvious grease sources.

3.7 Wave and Tidal Power

Wave and tidal power are technologies very much in the design phase. They are mainly large scale and at this stage are not likely to be of benefit to community scale projects.

3.8 Accredited Installers

For micro-generation technologies (up to 50kW) there is an accreditation scheme which is designed to evaluate products and installers against robust criteria for micro-generation technologies. This is to ensure that protection is given to purchasers and users of the technologies and that a high quality service is provided by installers of micro-generation equipment. Details of the scheme which is run by BRE, the certified products and installers are available here http://www.greenbooklive.com/page.jsp?id=4.

3.9 Income from ROCs and FITs

All projects that generate electricity and are grid connected can be eligible for ROC (Renewable Obligation Certificate) income if it is metered using an Ofgem accredited meter.

> ROCs are the certificates issued by the regulator OFGEM to accredited generators for the production of eligible renewable electricity. These provide a valuable income stream for generators in addition to the sale of export electricity.

Micro generation technologies are set to receive two ROCs per MWh from April 2009. Please see Annex 1 for further information on ROCs. A grid connected generator can supply the building's energy requirements before any surplus electricity goes to the grid, yet even if all of the generated electricity is consumed on site it is eligible for ROC income, as long as it is metered using an accredited meter. Further information on accredited meters is available here – www.ofgem.gov.uk. Currently the only meters accredited require the electricity to be inverted, and groups should bear this in mind when making a decision on the technology.

The UK government recently introduced legislation that will allow the establishment of a feed-in tariff scheme to bolster microgeneration uptake. This would mean a guaranteed financial benefit would be available to anyone that installs a renewable electricity generator, and should remove the administration burden associated with ROCs. The ROC scheme will remain, and is better geared to assisting larger scale renewable generation. The UK government is also proposing to introduce a financial support mechanism for renewable heat, and should assist technologies that provide renewably sourced heat. Communities are encouraged to keep up to date with developments on these issues, as they could influence the financial costs and potential for income generation from renewable technologies- consultations on these topics should be issued in 2009 by the Department of Energy and Climate Change www.decc.gov.uk.

Therefore, it is always more efficient if the energy can be used at source with any excess then going to the grid. Currently however, groups should bear in mind that the electricity they sell back to the grid is at a lower price than the electricity they purchase.

Section 4: District Heating

4 District Heating

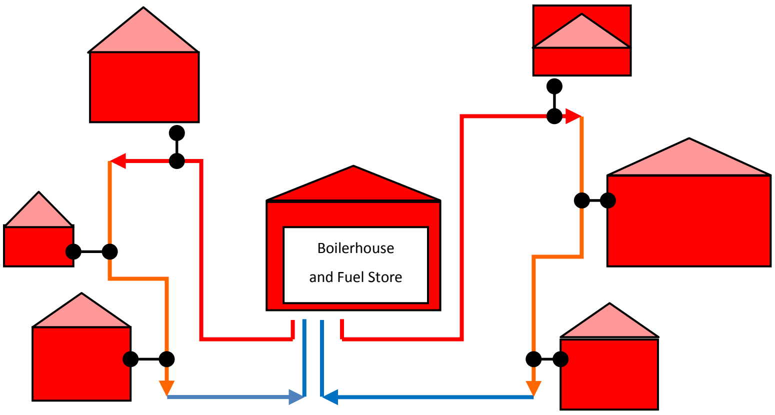
This section deals with heating groups of buildings from a single renewable heat source.

4.1 Overview

District Heating systems have a single heat source supplying heat to a number of properties within a certain area. This form of heating is common in mainland Europe and is now being employed by a number of communities in Scotland. It works best where there is a cluster of houses or buildings in close proximity that can be supplied with heat through a communal system.

A district heating system works by heating water that is then pumped around an underground district heating ring-main pipe. The pipe carries this heated water past each building (see diagram below). Each building is fitted with a heat exchanger which allows that individual building to take the heat it requires from the ring-main. For systems serving housing developments, the heat is then used for both the living space (radiators and under floor heating pipes) and domestic hot water (hot water storage tanks).

Each property drawing heat from the ring-main is metered for heat consumption and will pay for this heat accordingly. An energy supply company (ESCo) is sometimes formed to deal with billing and collection of payments for heat supply and to maintain and manage the boiler system and heat network. ESCos can be community owned and run or can be a service provided by an outside company, sometimes the boiler supplier.



A district heating scheme with two loops serving six properties

For new-build developments an evaluation of the housing or building heat demand and the clustering of buildings at an early stage would be advantageous so that a district heating scheme can be installed during site construction. For existing properties there would need to be retrofitting of the heat exchanger and ring-main network and so project economics will need to be evaluated closely. To date the insulated pipe network for district heating has proved to be quite costly.

For further information see
http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,97356&_dad=portal&_schema=PORTAL

4.2 Determining the Energy Source

For a community group seeking to review the feasibility of a district heating scheme in their locality, energy sources and systems will need to be evaluated thoroughly. Current options using renewable resources could be based on a boiler or a combined heat and power (CHP) system fuelled by biomass and would entail using local biomass resources. This could be woodchip or pellet based and communities should aim to work with local suppliers to assess feasibility of supply to a district heating scale project.

The quality of woodchip or pellet supplied is crucial to the efficient operation of a biomass boiler and communities should seek to discuss with local users of woodchip or pellets to gain awareness of the quality of material supplied. It should be noted that some purchasers and suppliers of woodchip are now moving to long term contracts which detail quality of chip to be supplied. One way of ensuring that a supply of good quality fuel is maintained is by monitoring of heat produced by the fuel and basing payments to the supplier on the amount of energy it produces rather than paying for woodchips by either weight or volume.

4.3 Project Management and contractual issues

A project involving district heating is of its nature a large and complex project. The project will involve

- Securing planning permission
- Tendering for supply of system and contractual negotiations
- Securing grid generation connection if CHP to be used and electricity export required
- Installation of a network of pipes and heat exchangers and a payment system
- Installation of a boiler or CHP system and fuel reception / storage and fuel augers
- Possible retrofitting of new heating infrastructure in existing properties
- Securing fuel supply
- Raising finance for the project costs
- Possible establishment of an ESCo
- Items to be co-ordinated by an ESCo or community
    - Long term management and maintenance of system and all network connections
    - Heat monitoring and billing
    - Fuel supply monitoring

See case study 13, Glenshellach district heating system, Oban, in Annex 2 for an example of a district heating system for 89 domestic properties using a woodchip boiler.

4.3.1 Checklist of Key points for district heating

This section provides a selection of top tips for considering a district heating scheme. It should be noted this is not an exhaustive list and all projects present individual circumstances to consider.

1. Ensure you have a community group willing and able to take on the scale of project demanded by district heating.
2. Ensure you have a cluster of houses or other buildings that require a heat supply.
3. If these are existing buildings, clarify you be able to install a ring main network.
4. Investigate a biomass supply or other supply of fuel suitable for use in a large boiler.
5. Be sure you can you raise the finances necessary to complete such a project.
6. Decide if you have the skills and resources to establish and run an ESCo or if you would prefer to see this outsourced.

For a manufacturer's guide to district heating pipe work installation, see
http://www.rehau.co.uk/files/Technical_information_RAUTHERMEX_817600_.pdf

4.4 Future directions

4.4.1 Combined Heat and Power Plant (CHP)

A CHP plant is any plant that generates electricity and usable heat simultaneously in the same process. This process is a very efficient use of fuel as it maximises the amount of energy recovered from combustion – typically CHP plants can achieve efficiencies of over 70%, whereas conventional electrical generation plants can only achieve efficiencies between 35% and 45% due to heat loss. The power generated can either be used on site or exported to the grid.

The source of fuel can be renewable or fossil fuel; renewable fuels can include biogas, biomass, and bio energy crops. All of these are eligible for ROCs and indeed may even be eligible for ROCs if used in conjunction with fossil fuels in a CHP system. Energy from waste using CHP is also eligible for ROCs – please see further detail on ROCs in Annex 1.

4.4.2 Anaerobic Digestion (AD)

This is a process whereby biogas (which is predominantly methane) is generated by anaerobic decomposition of organic waste. Organic waste is decomposed in the absence of oxygen by bacteria to produce methane which is then captured and stored. The methane gas can be used to generate heat and/or power which could be used for district heating, or through a CHP plant to provide heat and power to a site or a community. Research is also being carried out on upgrading biogas to make it suitable for injection into existing or new gas networks for use in domestic gas boilers.

The waste product from the anaerobic digestion process is nutrient rich and can be used as a fertiliser in agriculture. The resultant fertiliser is easier to spread than raw slurry and can reduce the need for artificial fertilisers.

The diagram below gives an insight into the general principles behind the whole process.

AD is a biological process and can work with a variety of feed stocks:

- food waste segregated at source i.e. in households and collected as organic waste
- animal wastes - slurry and dairy products
- industrial organic waste
- brewery and distillery waste
- food processing waste
- seaweed

As the feed stocks can vary, an AD plant will need to be designed to treat all the possible wastes, and ensure that it meets all the relevant regulations. As AD can cross the waste, wastewater, agricultural, food and energy sectors there can be quite a lot of regulation to keep up to date with for AD plant operators.

AD is set to qualify for two ROCs per MWh under the Renewable Obligation Scotland schemes from April 2009.

Some community groups are currently investigating the use of organic waste in anaerobic digesters for community heat or power.

See case study 14, the Creed waste management facility, Isle of Lewis, in Annex 2 for an example of an anaerobic digester plant project.

More information at:
http://www.orkneycommunities.co.uk/WESTRAY/Documents/Renewables.pdf
http://www.orkneycommunities.co.uk/WESTRAY/index.asp?pageid=1032
http://www.foe.co.uk/resource/briefings/anaerobic_digestion.pdf
http://www.highlandenvironment.org.uk/sitebuildercontent/sitebuilderfiles/wdtbiofuelsenergyfromwaste.pdf
http://www.nnfcc.co.uk/metadot/index.pl?id=2192;isa=Category;op=show

4.4.3 District Wind to heat

This is a system currently being investigated by some community organisations whereby large scale wind generation of electricity can be used to heat water for district heating. This would act to enhance the value of the generation from wind turbines in that it would provide a storage mechanism for the energy generated. The water would then be used as a heat source for properties connected to a ring-main and heat exchange network.

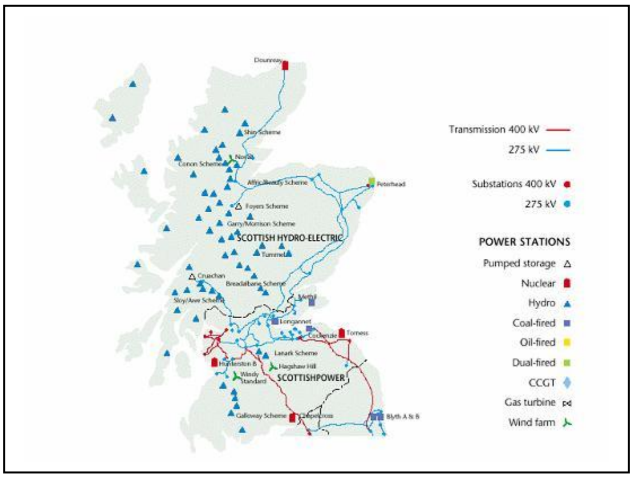
Section 5: Off - Grid Solutions

5. Off - Grid Solutions

Some of Scotland's more remote areas have no connection to the national electrical grid network. This section deals with possible renewable energy solutions to this problem.

5.1 Current off-grid Solutions

Some communities are not currently connected to the main electrical grid network and so do not have easy access to electrical supply. In other communities it may not be possible to get a mains supply connection to a particular building, or power may be required for only a small outdoor based load e.g. lighting. For all such situations, designing an off grid electrical supply system may be the best option. Some off grid communities or buildings today rely on individual diesel generators to deliver electrical supply.



Electricity Grid Network in Scotland

Diagram courtesy of Strathclyde University

Some communities have moved to install a predominantly renewable off grid system. The Isle of Eigg has recently installed such a system including connections and a network to operate between each house on the island. This is a complex project but has resulted in a mixture of hydro, wind and PV generation, with some diesel back up for emergencies.

See case study 17: Electrification of Eigg, Isle of Eigg – *PV, Hydro & Wind turbines*

5.2 Defining your requirements and options

Designing an off-grid renewable supply for a community or a building will require accurate assessment of all electrical loads within the building or area to be connected. Two key parameters will need to be established -

- Peak load - which is the maximum power requirement (kW) at any one second e.g. if all electrical appliances are switched on at same time
- Daily power consumption which is the number of kWh required per day - this will vary according to season

For a single building this will encompass assessing all the electrical devices required within the building, their kW rating, the number of hours used and the maximum amount of demand at any one time.

For a community this will encompass establishing the peak and general power demand of the community if the power is to be supplied on a networked system. For communities previously without mains connected electrical supply it is important to consider the fact that if a 24-7 electrical supply is installed, overall electricity consumption may increase due to an increase in electrical devices used by consumers.

Once the overall demand pattern has been established, a community will need to assess the resources available in the locality - is it suitable for wind generation, is there potential for hydro power, solar thermal, solar PV, simple biomass systems? All of these are suitable for generation of heat and power energy in an off-grid situation. These criteria will then force the design of the system. It is likely that a self sufficient power system will require some form of battery system to store energy generated at times of low demand and release it at times when demand is greater than available generation. Battery technology is improving constantly and the design of an efficient and cost effective battery system will be key to the viability of many schemes. Battery systems need to be designed to cope with all generation and demand fluctuations so that power is available when needed. Communities should also be aware that there will be losses of power resultant from charging and discharging battery banks.

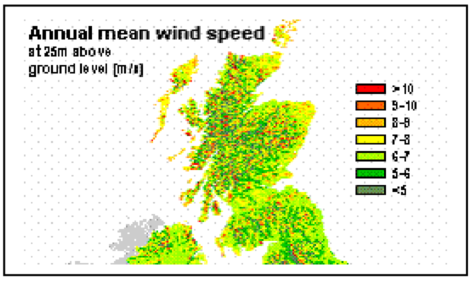
5.3 Building or small scale off-grid solutions

For small scale installations a range of renewable technologies can be used.

PV installations integrated with battery units are often used where only a small amount of power is required, e.g. for lighting, maintaining power to monitoring equipment or maintaining water treatment facilities.

See case study 3, Sgoil na Coille, Salen, Argyll, in Annex 2 for an example of a project using photovoltaic panels for electricity generation.

In areas with a good wind resource a wind/battery or wind/storage heater system can capture and store energy for when it is required. Such systems can be installed in remote locations and can prove very valuable where grid connection is either difficult or very costly. There are several examples across Scotland; remote ferry waiting rooms on the Western Isles, and the Charles Inglis Clark Memorial hut on Ben Nevis.



Wind speeds in Scotland
Courtesy of Strathclyde University

See case study 15, Nunton Steadings, Benbecula, in Annex 2 for an example of an off grid wind system.

Hydropower can be a valuable resource for many communities close to a good water resource. Hydro resources typically have a high capacity or availability in Scotland and can be designed to allow a degree of management of the resource so that a continuous power supply can be achieved.

See case study 16, Pier hydro system, Eigg, in Annex 2 where a 6kW hydro scheme was installed, utilising some old redundant hydro infrastructure, to supply a local building.

For larger scale community projects, integrated hydro power resource monitoring might be required and will allow communities to assess the available resources and best manage the balance between resource availability and power demand.

5.4 Community scale off-grid solutions

Some communities have worked on projects that look at community wide power supply from renewables, which could require the integration and management of multiple energy sources. These can be quite complex projects and will require a high level of time commitment from a community, both in the initial feasibility and design stages, and also in the operational phase. For such systems a detailed feasibility assessment would be required to determine the best solutions for a community. Design and installation will require a community to be able to raise the necessary finance, through a grant, loan or other funds (see Section 9, Funding and financing your project). Once a system has been installed and commissioned there will need to be expertise in the locality to maintain and repair the systems – which can provide at least a part time job in the community. This can mean that local residents may have an opportunity to up-skill for such a role.

Knoydart and Eigg are two communities that do not have mains grid connection, and have previously relied on diesel generators for their electrical supply.

Eigg has recently installed an energy supply system that encompasses a wide range of technologies across the island, and now has a wholly renewably powered electrical supply network to all domestic properties on the island. The system has:

- a new 10kW solar photovoltaic array
- a new 100kW run-of-river hydro
- wind power from four new 6kW wind turbines
- incorporated power supplied from two existing 6kW Hydro-s

The new scheme also includes a control system and a battery system that can yield 24hrs of stored renewable electricity. For back-up there are also two 80kW diesel generators. Estimates are that the scheme shall be 98% renewably powered.

See case study 17: Electrification of Eigg, Isle of Eigg – *PV, Hydro & Wind turbines*

See case study 18, Knoydart hydro scheme in Annex 2 for more information on a 280kW hydro system that provides power to most of the households and businesses on Knoydart.

For both of these communities innovative management of loads on the system is either in place or being investigated. Eigg has limited each household to a peak power supply of 5kW, with businesses to a peak power supply of 10 kW.

Section 6: Generating and Selling Electricity- Community Ownership

6. Generating and selling electricity- Community Ownership

This section focuses on projects developed and owned by community organisations.

6.1 Strengthening communities through renewable energy projects

There are approximately 40 community groups across Scotland currently taking forward renewable energy projects which are seen as routes to strengthening communities in a number of ways:

- There are real examples of communities progressing and successfully completing complex renewable generating projects - the first such project was completed by the Isle of Gigha community in 2004 with the installation of 3 wind turbines
- A community that generates a large amount of renewable energy can make a large contribution to helping reduce that community's dependence on fossil fuels, this in turn can lead to a greater awareness of energy issues, increased energy efficiency across the community and a reduction in energy costs and carbon emissions
- The income generated from such projects can be significant for communities and can lead to self sufficiency for community organisations and re-investment in the local area reducing grant dependency.
- Individuals may wish to pool their resources and set-up a community co-operative. Operated on a commercial scale these projects can add significantly to the local economy see section 9.3 – The Co-operative Model.

6.2 Community consultation

Community consultation is essential when considering a community developed and owned large renewable generation project. Please see section 8, Organisation, consultation and development planning, for further detail on community consultation. Local support will be essential to gain the commitment of volunteer effort and resources to progress such a project. This stage is also crucial in convincing funders that the community really wants the project. If the project is to benefit the community, the community needs to have a say in how it progresses. The community will also therefore 'own' the project in more than just the legal sense.

There are three main initial areas which should be discussed openly throughout the community.

1) *Is there a real need across your community for an energy generation project and / or a long –term source of revenue?*

It is essential to have a clear idea of the benefits of a project for the community and why it is needed – if not it may be difficult to keep volunteer effort on board as it meets difficult challenges. Insufficient local support can lead to opposition to the project.

Social needs that require financing might include, improvements in energy efficiency in local housing to reduce fuel poverty, funds for a community centre, investment in training facilities, to employ staff to take forward community projects or facilities for young people.

Energy needs might be related to the community's current fossil fuel demand and high carbon footprint of energy consumption e.g. from inefficient diesel generators or as a result of being run off mains gas. They may also be directly related to current local high energy demands - e.g. fish farms.

Consulting the community is essential in developing a strategy for the future of the community that is based on local needs and priorities and can be used to guide decisions around the investment of income generated from a project.

2) *Does your group have the commitment and capacity to take forward a large and complex project?*

Before embarking on a project designed to generate revenue from renewable energy, it is essential to be certain that there is a high level of commitment from the group considering it. These projects can be time consuming and complex. They are not projects that can easily be taken forward by one or two people alone. A number of willing volunteers in for the long haul will be required. In the first instance a community development trust, community council or community association can be the body which can serve to facilitate discussions about a renewable energy project.

For more information on development trusts, how to set one up or to find out if there is already one in the area, visit www.dtascot.org.uk. Also, further information on community councils can be gained from the Association of Scottish Community Councils at www.ascc.org.uk.

Large projects can take several years to reach completion and can face technical, regulatory and financial challenges. A community working on such projects will therefore generally require setting up a group dedicated to the renewable energy project (see section 8) which has input from well organised, resourceful and determined individuals. It is important to ensure that participation in such a group can be open to all community members. If there are members of the community that are willing to volunteer and have project development, technical, engineering, financial/accountancy, or legal skills, these could be very valuable to a community project. However, communities should be clear that all the work necessary to deliver a project need not be through volunteer effort. Where there are skill shortages e.g. technology, finance, legal etc, industry professional advice should be bought in. Early recognition of this is essential to ensure provision is made in project budgets and funding applications.

It should be recognised that for all communities the project development process can lead to a massive up-skilling of a community group and give it the confidence to tackle further, even more ambitious projects for the benefit of its community.

For communities that do not have the capacity or desire to take forward a wholly community owned development there may be opportunities to liaise and partner with commercial and professional organisations developing renewable projects in their locality. This is covered in Section 7.

3) *What viable renewable energy resources do you have available within your locality?*

Wind or hydro power offer the most viable opportunities for generating and selling electricity as the technologies involved are well established. If there is an extensive available source of wood nearby, a biomass-based district heating system may be possible, or perhaps even a combined heat and power plant. This latter option is likely to be quite complex owing to the pipe network infrastructure required although it may be an option if the community has a high density of housing or there are a number of nearby heat and power demands - e.g. school, sports centre, swimming pool, in close proximity (see section 4).

It may be that there is good idea of what the best resources are in the community. On the other hand a resource assessment to identify the best options for the community may need to be undertaken.

For a good example of a renewable energy resources assessment, see the Sleat Community Trust – Renewable Energy Assessment at Sleat Community Trust - Renewable Energy Assessment on the Community Energy Scotland website at http://www.communityenergyscotland.org.uk/userfiles/file/Feasibility%20studies/Sleat%20Community%20Trust%20Renewable%20Energy%20Report.pdf.

The remainder of this section will deal with wind and hydro power projects.

6.3 Developing a community energy project

6.3.1 Wind energy basics

Please see section 3.3 on wind energy for very basic information on how wind turbines work. More information is available on the Scottish Renewables website, the British Wind Energy Association's (BWEA) website and a detailed guide is available on the Danish Wind Energy website.

www.scottishrenewables.com/Default.aspx?DocumentID=6ebf031d-d976-4f86-9302-ac8375473acd

www.bwea.com
www.windpower.org/en/knowhow.htm

The company Energy 4 All has a web resource for any community which would like to assess the potential for developing a community wind farm at www.energysteps.coop. However, the site requires users to register with Energy 4 All and asks for detailed information on projects and documents, although this is optional.

The energy content of the wind is very dependent on the wind speed – the energy content is related to the cube of the wind speed.

$$\text{Wind speed x A} \longrightarrow \text{Energy content x } A^3$$

So if the wind speed doubles, the energy content of the wind increases by eight (i.e. 2x2x2=8). The energy is captured by the rotor blades of the turbine, and the greater the swept area, the greater the amount of energy captured.

Swept area is proportional to ***(rotor diameter)***^{2}

By doubling the rotor diameter, the area is four times larger (2^2=4) and the power output from the turbine is also increased four times.

For these simple reasons, larger wind turbines are more cost effective as they capture more energy, generate more power and, therefore, income. Care should be taken when analysing sites for turbine location, as nearby large buildings, trees, forests and topographical features (mountains, hills, cliffs etc) can create wind shelter and turbulence in the sites wind flow and impact on turbine production and technical viability. Specific wind characteristics on site (annual average speed and turbulence) require that turbines are designed to the appropriate International Electro-technical Commission (IEC) standard. These measure and assess power quality characteristics of wind turbines can be found at the links below. General wind turbine standards
New IEC Standard to help improve on grid wind turbine quality

The economic viability of a project will therefore depend on the average wind speed at the site, the size of turbine to be installed and the costs of getting the turbine(s) installed and operational. Large turbines can sometimes be problematic if access to sites is difficult or ferry transport of turbine parts is restrictive in terms of size and weight and port availability.

6.3.2 Wind turbine technology

Most large scale turbines in use today are based on the horizontal axis turbine and there are many such turbines installed across Scotland. Current turbine sizes that could be used in a community project generally range from 850kW to 3MW with rotor diameters that span from 44m - 100m.

Most turbines available on the market today are geared turbines, with gearboxes and generators located at the top of the turbine. A few manufacturers produce turbines that operate by direct drive, and it would seem that this type of machine is gaining in popularity and is now being investigated by other manufacturers currently producing geared turbines. The advantages of a direct drive machine is that the generator is gearless, with less moving parts so maintenance costs should be lower. However a gear-less generator will therefore need to be quite large, which increases the weight of such components and potentially the capital cost. More detail on turbine manufacturers is available on the British Wind Energy Association's website and company directory http://www.bwea.com/members/CompanyDirectory.asp.

6.3.3 Hydropower basics

There is almost 1400MW of installed Hydro capacity in Scotland. The first large hydro-electric scheme in Scotland was built in the 1890s. The establishment of the North of Scotland Hydro-Electric Board in 1943 led to a succession of new schemes in the following 30 years. Scottish and Southern Electricity are currently just completing a 100MW project at Glen Doe beside Loch Ness. A recent report by the Forum for Renewable Development in Scotland (FREDS, a government chaired body with industry representatives), has been published about the opportunity for new hydro in Scotland which is available at http://www.scotland.gov.uk/Resource/Doc/917/0064958.pdf. This report identified that there is about 650MW of unexploited hydro resource in Scotland with a potential generation of 2.77TWh annually. Interest in smaller hydro power plants is growing and some communities, estates, and businesses now have operating systems or are looking to re-instate old hydropower schemes. For community groups hydro offers a great opportunity to develop a resource that is local and has a long operating life (typically 50 years+). Other benefits of hydro are that it is a highly efficient technology, it is a predictable resource with historical rainfall data available, generally has a high capacity figure of about 50% (i.e. water is flowing for a good proportion of the year) and has a conversion efficiency rate of 70%-90% as typical.

> Hydro electricity involves the conversion of potential energy stored in water held at a height to kinetic energy to drive a mechanical shaft which then drives an electric generator.

The size of any installation's potential power output in kW is directly proportional to;

- Volume flow rate - the volume of water flowing through the turbine per second - measured in litres/second, or cubic metres/second
- Head - The vertical distance between the water level at the intake point and where the water passes through the turbine. Hydro projects can be classified as
    - Low head – up to 10m
    - Medium head - 10-50m and
    - High head - greater than 50m

The annual actual energy output (kWh) depends on how much water is available over the course of the year - this will vary with rainfall.

Potential hydro project river

Photo from CES library

6.3.4 Hydropower technology

There are four main types of hydropower installation: run of river, storage, pump-storage, and catchment transfer.

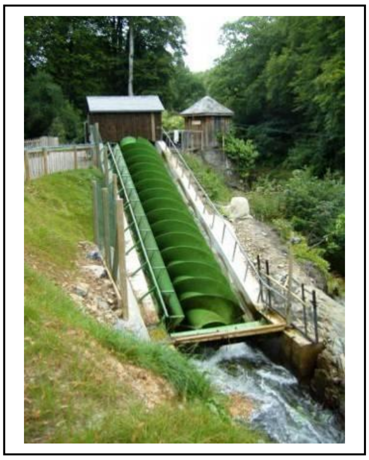
The major components of any hydro installation are:

- **The water intake system;** This can be a system of weirs, dams and screens that extract the water from its normal flow.
- **The delivery system;** The pipes that deliver water from the intake system to the power house and back to the river
- **Power Generation system;** This is the pipe work, turbine or drive shaft, electrical generator, cabling and building; i.e. the infrastructure that converts the potential energy into kinetic energy to generate electricity.
- **Tail Race**; This is the channel that takes water, once it has left the turbine, back to the river.

Turbines are generally classed as low head or high head. Low head sites typically require turbines that are faster. Turbines are also classified by mode of operation – either impulse or reaction turbines.

- An impulse turbine operates in air driven by a jet of water, and a Kaplan turbine is a good example of a low head high volume impulse turbine.

- The rotor of a reaction turbine is fully immersed in water enclosed in a pressurised casing, and a Pelton turbine is a good example of a reaction turbine, more suited to high head sites. A crossflow turbine is a reaction turbine better suited to a low head site.
- An alternative low head turbine is the Archimedes Screw turbine - which is seen by some as a turbine with lower environmental and fish risks and lower costs. This turbine is relatively new to the UK - but it has been installed a few places and there is more information here: http://www.mannpower-hydro.co.uk/case_studies.htm
- For further information on turbine types and manufacturers please see the British Hydropower Association website at http://www.british-hydro.org



Archimedes screw hydro turbine

Photo from CES library

6.4 Resource and feasibility assessment

A good feasibility study should assess the viability of a project in terms of initial resource assessment, energy production, site location, environmental constraints, grid connection issues such as proximity and ability to export, likely infrastructure costs and the likelihood of securing planning consent. It should enable a community to make a considered judgement on whether it is worth taking the project any further. It is far better to decide not to proceed with a project at a fairly early stage than find after considerable time and expense that the project cannot go ahead. There may be grants available to help with the cost of this work - please see the finance section 9 for further detail. If the conclusion of the study is that a project is feasible, detailed development work can begin.

In addition to resource monitoring it may be advisable to start discussions with some potential financial lenders – e.g. banks as they may have specific requirements in relation to anemometry, turbine suppliers, and consultants used for resource assessments. Information on their requirements at an early stage can help avoid extra work further into a project's development.

For wind and hydro sites there will also need to be a thorough assessment of the available resource and/or a resource monitoring regime so that an estimated annual production figure can be determined. This will help to predict annual income and will be required for securing project finance.

6.4.1 Wind specific assessments

A wind feasibility study should ideally consider a number of site locations and assess each with regard to estimated wind speed and turbulence, different turbine types at each site, likely infrastructure costs (e.g. access track), environmental and other constraints (e.g. designated areas, birds, landscape, archaeology, local airport radar), grid connection options, accessibility (e.g. for delivery of a wind turbine). It is highly likely that specialist skills will be needed to prepare this study and there are a number of consultancies that specialise in this work. Please refer to the Scottish Renewables website and member directory for consultancies operating in Scotland www.scottishrenewables.com. A good assessment will identify the best sites available to a community in terms of economic and environmental viability, and affordability on a community scale. Ideally the consultant involved will be able to present the findings to an open community meeting so that all issues can be discussed and the community can make an informed decision on whether they proceed to detailed design and if so which site they wish to concentrate on.

See the South Uist Feasibility Study

6.4.2 Wind resource monitoring

A full wind energy yield analysis will need to be conducted if a project is seeking to source project construction finance from commercial banks. A good energy yield analysis will prove to financial lenders that the project will be a viable, income generating investment. Turbine suppliers require differing periods of wind monitoring but periods will generally be within a range of 6-18 months. This is then correlated with local met office data to look at longer term yields. Typically an energy yield analysis will provide a prediction of energy generated over a ten year period. This information will also be required by a turbine supplier to ensure that their turbine can meet the demands of the wind regime at the site.

Turbines are certified to certain wind speeds and turbulence standards. Class 1A IEC (International Electrotechnical Commission is the certifying body) is the standard for high wind speed sites, which are common across Scotland, and in some cases a special certification may be required if a site has a higher level of turbulence or wind speed than the standard Class 1A specification.

To gather this information will require installation of an industry standard meteorological mast and anemometry equipment. The equipment will need to be set up correctly on the met mast so that it is in accordance with international standards (Recommended practices for wind turbine testing: 11 – Wind speed measurement and use of cup anemometry, International Energy agency, 1999). Once the data has been collected it will have to be analysed and verified by an independent specialist – approved by the financial institution from which the community wishes to gain project finance. Please see the Scottish Renewables, and BWEA websites for a list of companies that can provide this service.

> Communities should be aware that second hand meteorological masts and equipment may be available and also that meteorological masts can be sold on once wind monitoring is complete.

6.4.2 Hydro specific assessments

A Hydropower feasibility study should examine the site location, assess the available resource, estimate potential energy production, investigate turbine and infrastructure options, and identify possible environmental and other planning constraints, grid connection issues, and likely infrastructure costs. Again it is likely that specialist skills will be needed for these assessments. Please refer to the Scottish Renewables and British Hydropower Association's websites for further information
www.scottishrenewables.com
www.british-hydro.org

6.4.4 Hydro resource monitoring

A flow duration curve or hydrograph will need to be established which gives information on the amount of flow on the river over a year. SEPA (Scottish Environment Protection Agency) has many gauging stations across Scotland and to access data on flow duration curves for gauged rivers you should contact the Centre for Ecology and Hydrology at www.ceh.ac.uk with more information available at http://192.171.153.213/data/nrfa/index.html.

Many rivers however will not have gauging and so communities will either need to undertake monitoring of the river or use estimations to create a flow duration curve. The consultancy service at HR Wallingford can provide flow duration curves from modelling and using catchment rainfall information – please see http://www.hydrosolutions.co.uk/lowflows.html. Once the available resource has been assessed it will then be important to ascertain what the overall power potential will be with annual variations in water flow while keeping within environmental restrictions. A portion of flow from a river will need to bypass a turbine scheme so that the ecology of the natural river is maintained. SEPA will give guidance on what this level will need to be. Resource assessment may be best achieved by working with a hydro consultant and physically examining the proposed development to ensure the project would maximise the potential resource and utilise all available geographical features. On the Isle of Eigg initial proposals looked at a 13KW hydro system but on closer examination of the site it was identified that a system closer to a 100kW could be an option.

For projects that will require finance from commercial lenders a full energy yield analysis will be required that gives an estimate of up to ten years energy production.

6.4.5 Land ownership

Site selection and design is very important when trying to balance between developing an efficient and economic system and maintaining an acceptable environmental impact. Key to any community developing a site is establishing the land ownership and gaining access. If the community owns the land the development sits within this should not cause any problems. If not, then permission and access will have to be gained from the landlord or landlords of the site. Communities using non –community owned land should ensure they agree with the landlord that the community has the exclusive rights to develop the site and that they gain a lease on the site if the project gains planning consent. This would need to be for the lifetime of the project, which could be between 25-50 years dependant on technology. It is important to secure access and further use of the site before planning consent is granted and to include area for crane hard standings, access tracks, pipelines and construction activity. If the project is being developed by a subsidiary of a community trust then it is preferable that the community trust has the lease of land rather than the subsidiary as this allows early control over the project. A sub lease would then be granted to the subsidiary company. Rental rates will need to be negotiated and a professional opinion and market rates should be obtained. It is important in a small community that that this negotiation is seen as open and fair. If the site is leased then the rent could be a fixed fee or vary according to power output of the site.

Wind turbine and turbine blade delivery will require access roads to have sufficient turning circles to allow the required long base trailers to access the site. If this is not already available on the local road network alterations will need to be made and will require agreement with all involved parties.

Photo CES Library

Way leaves (the right of way over somebody else's property, for which payment is usually made) may also have to be gained to allow access to construct and maintain site, construct cable routes and maintain access tracks. In Scotland it is also important to establish if the land is under tenure, for example crofting tenure. This means that that the tenant has rights in any lease of land. If the land is subject to crofting law the land will need to resumed or need to have a servitude exacted on the tenure to maintain access for the life of the renewable plant. You should refer to the Crofters Commission who has produced guidance on this www.crofterscommission.org.uk .

6.5 Finalising the legal structure for managing the project

Given the scale of a project like this, it is essential to have a proper, legally recognised group structure in place with a high standard of governance (clear responsibilities for making decisions and transparent decision making). This helps to ensure that those undertaking the project are clearly accountable to the community.

To date, all non-profit distributing community owned wind projects in Scotland have been taken forward by wholly owned subsidiaries of the main community development trust or community organisation. In all these cases, the subsidiary company is a company limited by shares, with all the shares in the company held by the parent community body, which appoints its directors. It is a well established non-profit distributing model which helps to ensure (providing there is good governance) that the community body has full control over the subsidiary company and also that the volunteers involved with the project are not personally financially liable.

Where the parent organisation is a charitable organisation it is necessary to establish a non charitable trading subsidiary body if there is a wish is to become involved in non charitable trading (which energy generation is under Scottish charity law).

For more detail on company structures and governance see Section 8, Organisation, consultation and development planning, and the Scottish Council for Voluntary Organisations (SCVO) website www.scvo.org.uk/information. It may be necessary to gain legal assistance to constitute a group.

6.5.1 Avoiding conflicts of interest

A conflict of interest may arise when someone who is involved in promoting a project also stands to gain from it personally. For example, a member of a community development company may own or lease land where a project might be sited. If a conflict of interest may arise, the person involved should not be involved in any decisions related to their assets or interests. It is essential to have established rules and procedure for such instances so that all decisions are taken in a transparent manner.

6.6 Project Design

The results of the resource and feasibility assessments will drive the design of the project. For planning permission you will need to submit full detail and design of the proposed project. Communities are also advised to develop a business model during project design to ensure that all costs are accounted for and that the project makes financial sense. See
http://www.businesslink.gov.uk/bdotg/action/layer?topicId=1073869162
http://www.scottish-enterprise.com/se-operating-plans-current

For a detailed design of a renewable generation site it is likely a community will need technical assistance to ensure that the site is incorporated into the surrounding area with minimal impact. The feasibility study should provide a lot of the initial information required for design but additional work will be needed to ensure that all impacts are addressed.

6.7 Planning permission

Planning permission will need to be obtained for all large renewable developments. The Scottish Government has published specific policy documents related to renewable energy to guide local authorities on assessing renewable developments (SPP6 Renewable Energy is the most recent policy guide). Please refer to the Scottish Government's planning dept website for further information http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables.

Currently for wind projects up to 50MW the planning consent is dealt with at local authority level, above 50MW it is dealt with at Scottish Government level. Planning applications for hydro projects up to 1 MW in size are dealt with by the local authority, for projects over 1MW in size the Scottish Government deals with the planning application.

Planning Advice Note 45 Renewable Energy Technologies deals with Environmental Impact Assessment (EIA) requirements for renewable projects. Initial screening and scoping meetings with the local authority should be sought to ascertain the level of detail required to submit a planning application for the site and development. This note states that if the proposed development is located within a 'sensitive area' or involves the installation of more than 2 turbines; or the hub height of any turbine, or the height of any other structure exceeds 15 metres then the need for an EIA must be considered. The likelihood of significant effects will generally depend upon the scale of the development, and its visual impact and other potential impacts. EIA is more likely to be required for commercial developments of 5 or more turbines, or more than 5 MW of new generating capacity. For hydro projects - if an installation is to be located within a 'sensitive area' ; or designed to produce more than 0.5 MW; or includes a dam where the area of the works exceeds 1 hectare, then the need for EIA must be considered. In addition to the physical scale of the hydroelectric development, the potential wider impacts on hydrology and ecology should also be considered. The local planning authority will be able to give you definitive guidance on what is required to submit a robust planning application. Regulations for Environmental Impact Assessments are stated within the Environmental Impact Assessment (Scotland) Regulations 1999 – under these a wind farm in a sensitive area, or one that creates a significant impact may require an Environmental Assessment.

Communities planning a wind turbine project should, where possible, not base a planning submission on one particular turbine type. It is best to submit a planning application that could accommodate a range of turbine heights and rotor diameters, within reason. This allows a community to approach a number of suppliers when it comes to finalising turbine supply and as long as the turbine dimensions fit the consent, new planning permission will not be required. Also, if the switch gear is to be housed externally, ensure provision for this is included in the planning submission. Anemometry can be undertaken under a variation to full planning permission.

Communities are advised to engage with statutory consultees at an early stage to ensure good communication and dialogue is established.

Statutory bodies to be consulted for hydro developments
SEPA, the local district salmon fisheries board, the Fisheries Electricity Committee (being amalgamated into SEPA), SNH, Scottish Water, Historic Scotland

Statutory bodies to be consulted for wind developments
Scottish Water, SNH, National Air Traffic Services, Civil Aviation Authority, Historic Scotland, SEPA, Ministry of Defence, Health and Safety Executive

All of these bodies will be consulted by the planning office, but it is good practice for community groups to establish early dialogue with these bodies before the planning application is submitted. In addition, dialogue with RSPB (Royal Society for the Protection of Birds) is recommended for wind projects even thought they are not a statutory body. They can hold detailed ornithological information which may help ascertain bird flight and roosting patterns on the site.

Many planning consent approvals for renewable projects now come with conditions contained in a 'Section 75 Agreement' including:

- Site specific construction method statements

- Decommissioning bond – a financial bond to ensure there is funds available to decommission the windfarm
- Colour and type of paint requirements
- Reinstatement requirements and decommissioning bonds
- Safety light requirements (passing aircraft)

6.8 Environmental Assessment

If an Environmental Assessment (EA) is required the impacts of a project during construction and operational lifetime will have to be assessed and can include impact assessments on soil, hydrology, wildlife, visual and noise impact, social and economic factors. An Environmental Assessment can be a lengthy and costly exercise dependant on the detail required. If detailed surveys are required the timelines may need to fit in with wildlife breeding seasons which can cause delays to planning application completion. An EA for a wind project can often require detailed visual assessments, sometimes with cumulative assessments considering all other wind farms in the locality. Impact on radar systems and flight paths can also be required, and noise assessments if the turbines are to be located close to housing. Wind development projects are also often requested to undertake bird monitoring surveys to establish potential impacts to birdlife using the site.

For hydro projects there will need to be assessment of the impact on fish life in accordance with regulations under the Electricity Act that generators of electricity are required to, "avoid, so far as possible, causing injury to fisheries or to the stocks of fish in any waters" (Schedule 9 of the Electricity Act 1989). The effect of a hydro-electric scheme on fish depends on: the site, the type of scheme, and the design of its various elements and how they are constructed and operated. The potential effects on fish are from:

- Obstructions in the river; weirs and impounding dams may obstruct passage of fish unless a fish pass is provided.
- Risk from turbines: Screens are normally incorporated into the design of a system so that fish are not able to enter the turbine, and sometimes the tailrace.
- Changes in hydrology: Hydro-electric schemes change the hydrology within the area of the development, and, in cases of catchment transfer, beyond it. These changes include:
    - In run of river schemes there can be a large reduction of flow in the river channel between the water intake and the discharge from the generating station. Also an impounding dam of a storage scheme can result in reduced flow. A required residual flow is usually called a 'compensation flow' and SEPA can give guidance on what this should be.
    - If a stretch of river is dammed, the resulting reservoir may create a new fishery for trout or other freshwater fish, but may destroy fish spawning grounds or nursery areas. In storage schemes, depending on the pattern of generation, the flow downstream of the power station may fluctuate markedly and this could adversely affect fish or fisheries. The water level in the reservoir may also fluctuate, affecting fish stocks.

- Fish may be adversely affected by pollution arising during the construction and operation of a scheme. Constructors and operators are required to meet strict standards to prevent such pollution occurring.

6.9 Licensing of Hydro projects

All hydro projects will also need to be assessed under the Controlled Activities Regulations (CAR) and authorised as appropriate. Hydropower plants come under the CAR in that they either abstract or impound water from water bodies.

In Scotland there are three levels of authorisation for abstracting and impounding water depending on the level of water abstracted or impounded:

- General Binding Rules (GBRs)
- registration
- licences

You must comply with General Binding Rules (GBRs) if you abstract:

- less than $10m^3$ of water per day
- less than $150m^3$ of water per year from boreholes.

GBRs provide controls for low risk activities. You do not need to contact SEPA, but you must comply with any rules specific to your activity.

You will need to register with SEPA for:

- abstractions between $10m^3$ and $50m^3$ per day from inland waters such as rivers and lakes
- abstractions of coastal or transitional water (e.g. estuaries) of more than $10m^3$ per day.

Where the environmental risk is higher, then the activity will be authorised using an abstraction licence, allowing for specific controls to be set out for the site.

If you abstract between $50m^3$ and $100m^3$ per day you will need a simple licence. If you abstract more than $100m^3$ per day you will need a complex licence.

Fees for the various levels of authorisations are available on SEPA's website and community groups should contact their local SEPA office to discuss their hydropower plans. The fees that are levied are based on licence application charges activities and annual subsistence charges. Please refer to the SEPA website for up to date information on fees. The Water Environment (Controlled Activities) (Scotland) Regulations 2005 - A Practical Guide (pdf) is available from http://www.sepa.org.uk/water/regulations.aspx.

6.10 Grid connection

Please refer to Annex 1 for detailed information on obtaining a grid connection for your project. Large renewable energy projects will need to be connected to the grid - either to the local distribution network (below 132kV in Scotland) or to the transmission network (above 132kV), or if there is sufficient demand in the locality a private wire (private grid system) network could be developed for large consumers. Many community projects will be directly connected to their local distribution network operated by the Distribution Network Operator (DNO) with 100% export of electricity.

Gaining a connection can be a costly process and communities must have as much information and technical detail as possible before requesting a connection. Currently many parts of the Scottish grid infrastructure are at full capacity and connections for new generation can have quite a long lead in time to become operational. It is important to start discussions with the local DNO company early in the development process.

6.11 Project costing and financial planning

It is important to build a realistic picture of the project's costs and incomes as early as possible in the development process. Early negotiation with turbine suppliers, finance lenders can help develop indicative costs which will allow communities to assess the viability of the project early on.

Project costs will arise from:

- Project development and planning consent – environmental surveys, consultancy work, planning report, ancillary costs for travelling to meetings etc
- Advice for, and setting up of, any trading company
- Grid connection costs
- Financing costs – loan repayments, overdraft interest, preference share dividend Section 75 Bond financing, ROC administrative costs, accountancy advice
- Insurance costs - for both during construction and operation
- Turbine and civil infrastructure costs
- Operational costs –
    - business rates
    - land rental
    - administration - staff salaries etc
    - non warranty service and maintenance
    - warranty
    - turbine monitoring – BT lines etc
    - contingency

For large scale projects costs are likely to run over a million pounds, e.g. a 900kW scale single wind turbine project, taking into account all necessary works, is likely to be cost in the range of £1.3 – £1.5m. It is very unlikely that grant funding will be available for this scale of costs and so borrowing (i.e. loan finance) will be required.

Larger projects could be more cost effective by taking advantage of economies of scale for infrastructure and transport costs, but would require a higher level of borrowing. For banks to lend to projects such as these, they need to be convinced that the community team managing the project is competent and professional in its approach. See finance section for further information in section 9.

Project income will come from

- Sale of electricity
- Sale of Renewable Obligation Certificates (ROCs), Levy Exemption Certificates (LECs) and Renewable Energy Guarantee of Origin certificates (REGOs)

For most generation projects, the sale of electricity and ROCs is organised through the establishment of a Power Purchase Agreement (PPA) with a supplier of electricity to the general market. PPA values will vary between projects and can be supplied on a variety of terms, e.g. 1 year, 3 year or 5+ year PPA agreements. It will be necessary to register the site with OFGEM for ROCs to become payable. Communities developing a project should initiate PPA negotiations once wind monitoring has been well established and planning applications are underway, or earlier, so that an overview of potential project returns can be established. Please see Annex 1 for more information on ROCs and ROC levels for different technologies.
A number of companies offer PPAs. All are UK licensed electricity suppliers. These include the integrated utility companies, plus a number of other niche businesses, of which some are focussed on the renewables market. The UK wholesale electricity market is a volatile commodity marketplace and as such PPA prices should be checked regularly before conclusion, to update inputs to financial models.

Currently the sale of electricity in conjunction with claiming or selling ROC's is the only option for communities wishing to generate income from renewable energy projects. The UK government is currently trying to simplify the processes for small scale electricity projects by introducing a form of Feed in Tariff (FIT) – which would mean less administrative burden on small generators and potentially a fixed tariff for energy generated. This could greatly incentivise the uptake of small scale renewable generators and provide a good level of income for small projects.

The UK government also intends to introduce a renewable heat incentive (RHI) - which would provide a financial incentive aimed at increasing the uptake of heat provided from renewable sources. This again could prove very beneficial for communities looking at heat energy provided from renewable installations. Both the FIT and the RHI will be implemented on a UK wide scale and will change dramatically the financial landscape for small scale renewables. These changes will take place over the period 2009/2011.

6.12 Negotiating the supply of a turbine

6.12.1 Wind

The specifics of turbine supply and cost will depend on the project site and grid connection requirements. Prior to planning consent, attention should be focused on identifying the most appropriate turbine suppliers for a project. This will depend on a number of factors:

- The wind characteristics of the project site. Some turbines have optimal performance in lower wind speeds and some in higher. Postcodes can be entered in the following UK Government website to gain average wind speed data Windspeed database. http://www.berr.gov.uk/whatwedo/energy/sources/renewables/explained/wind/windspeed-database/page27326.html
- The nature of the grid connection - the turbine connection may require different technical capabilities for grid connection at different sites. The network operator will be able to provide details on what will be required. Some turbines now come with DVAR – dynamic voltage active regulation technologies that can help with weak connections.
- Turbines require regular servicing and if there are certain turbine models already installed in the area, it is likely that there is a service crew located nearby or there is service provision from a regional base. Sourcing turbines from the same manufacturer may prove easier in terms of service provision and local service personnel.

Turbines typically come with a warranty and performance guarantee which ensures a certain level of performance availability per year, with compensation for missed revenue if technical reasons prevent this. However this guarantee depends on the availability of a maintenance crew, and in remote locations distant from maintenance bases this full warranty may not be available - this has been the case for some community projects recently negotiating turbine supply.

Some communities (e.g. Isle of Gigha) have sourced second hand turbines for their projects. There is a burgeoning second hand turbine market as older sites are re-powered with newer larger turbines, releasing the older turbines for re-use. There is an obvious cost advantage with second hand turbines, but with this comes the potential increased need for maintenance, reduced warranty, potential greater difficulty of sourcing bank finance as the project may be seen as riskier. If there are specific grid conditions on site then it may be more difficult to integrate an older turbine into a weak grid network. Also it can be quite difficult to source turbines that will match the conditions of the site - many of the turbines currently available on the second hand market are from European sites and as such are generally designed for lower wind speeds so may not be suitable for Scottish sites. As second hand turbines will be older models, communities should ensure that there will be a good supply of spare parts to cover repair and maintenance needs over the lifetime of the project. Current second hand turbine availability includes models of rated output from 150kW to 1.5MW. Further information on second hand turbines is available here:

http://www.windbrokers.com
http://www.danishusedwindturbines.com
http://www.mainwind.eu
http://www.repoweringsolutions.com
http://gebrauchtewindkraftanlagen.com/
http://www.pjwindpower.com/

6.12.2 Hydro

As there are not currently many communities developing large hydro projects in Scotland there is not much established community experience in sourcing hydro turbines. Hydro turbines are more normally supplied as part of a turnkey contract with provision of site design and site works construction. Experience from hydro projects less than 500kW has shown that it is easier to source turbines and services than in the wind turbine sector. The design of the site and the hydro resource will drive the selection of turbine.

6.13 Financing a revenue generating project

For community groups developing a revenue generating project the financing of such a project is a large undertaking. Projects of this size can cost well over £1million to install, and have significant operational costs. Good business planning and financial skills, in-house or outsourced, will be required to ensure the project is successful.

There are different stages of financing a large project;

- Pre development
- Planning preparation
- Post planning through to construction

Many of the communities in Scotland currently taking revenue generating projects forward are financing their projects with a mix of debt (bank), grant and equity (investment from the community and social investors). It is likely that most large scale community projects will require a mix of finance to become viable.

The initial stages of pre-development and planning preparation are the riskiest stages, and will most likely require secure funding for these stages – see section 9, Funding and financing your project, for current fund availability. The final phase, once planning consent and a grid connection have been confirmed, should attract commercial finance from banks and other lenders, if the project can be shown to be financially viable and offer a suitable rate of return for investors.

For accessing funding for the final phase from all types of lenders and grantors the community involved will need to have up to date and accurate business plans, cash flow projections for operational project, and projected Profit & Loss and balance sheets. If there is a mix of investors in the project, it is likely there will be differing funding requirements from each which will need to be addressed. Each funder will wish to see their investment safeguarded if the project defaults at any point, and may want to 'step in' and secure the value of their investment if this does happen. Therefore in a project that has a number of financial investors (bank, social investors, and grant funders) it may be necessary to gain agreement between funders (prior to financial closure) with regard to the joint 'step in' rights if the project defaults at any point.

As the project progresses in terms of financing all funders will perform some due diligence on the project – i.e. an independent assessment of the viability of the project. The community will need to be able to supply requested information to help complete this review, and information such as resource assessment certification, turbine contracts, land rights etc will most likely be required. It will be essential for communities to have access to informed legal advice to protect their rights.

6.14 Construction of project

6.14.1 Wind

There are two main project contract structures that communities could use when progressing:

- A turnkey contract is one where a company contracts with the community to deliver the entire project – this incorporates full project management of the entire construction phase, and deals with turbine supply, infrastructure requirements, transport issues etc.
- A second contract structure is for a community to contract with turbine manufacturers for installation of turbine, the district network operator for the supply of the non–contestable (and perhaps contestable) grid connection works, and contract with a balance of plant (BOP) supplier for the remainder of the works (civils and perhaps contestable electrical).
- A third structure of the community undertaking the contracts with all suppliers and project managing the installation is another possibility, but as this would increase risks exposed to community organisations it could prove difficult to get financial lenders to fund such a structure.

As most wind turbine manufacturers will only provide a warranty if the installation and commissioning is completed by their own engineers it is likely the turbine company will be on site for the construction phase. If a turnkey contract is provided by a company other than the wind turbine company, then the turbine manufacturer would act as a subcontractor to the turnkey company. The project management and risk cover costs for the turbine elements can therefore be quite high and can increase the total project cost compared to a project installed under separate turbine supply BOP contracts. However, this increase in cost may offset the increased risk that the community may be exposed to under the second and third structures. The community involved should discuss and ensure they understand the details of each structure before deciding which option best suits their project. Communities should also be aware of their requirements under health and safety legislation during construction – please see here for more details

http://www.bwea.com/safety/index.html.

6.14.2 Hydro

Project construction contracts for hydropower installations tend to be run on a turnkey contract basis. Crucial to a hydropower project is the match between project design and installation, as the power production will depend very much on the design of the water intake and delivery system. If the project has been designed by a company different to that constructing and installing the infrastructure and turbine, then it is essential that there is a good handover between designer and installer.

6.14.3 Long term operational issues

For revenue generating projects maintenance and servicing of the technologies and infrastructure will be required for the lifetime of the project. It is essential that there is provision for these included in the supply of a turbine, and that this is accounted for in business and financial planning. This may be provided under warranty for the first few years of the project, and can sometimes be extended throughout the lifetime of the project. It is also possible to source such operation and maintenance (O&M) services from other independent companies operating in the sector.

It is also essential to have local support available for minor technical issues, so that these can be managed and rectified quickly without the need to call out the full maintenance team. Many turbine manufacturers are willing to train local people in basic skills needed to identify minor issues and to rectify these. Having this resource locally will ensure that there is little down time in generation for the project, and also increase opportunities for local employment.

It is important that the owners of a wind farm recognise their responsibilities under the Health and Safety and Work Act and how it applies to windfarms. BWEA have published specific guidance on this on their website - http://www.bwea.com/pdf/HSGuidelines.pdf and http://www.bwea.com/safety/index.html.

6.14.4 Key learning points from actual community projects

A summary of developing a large revenue generating project by a community currently engaged in the process will be included in Annex 1.

Information on the Gigha windfarm is on the following link
www.gigha.org.uk/windmills/TheStoryoftheWindmills.php

Information on the Westmill windfarm is on the following link
www.westmill.coop

Section 7: Securing community benefit from commercial renewable energy developments – private, commercial and mixed ownership

7. Securing community benefit from commercial renewable energy developments – private, commercial and mixed ownership

This section will discuss commercially owned projects which deliver a financial 'benefit' to local communities either through providing some income or through shared ownership options. It provides some basic information on this topic, outlining the development control process, some key points on commercial wind farm development and how to go about negotiating a benefit arrangement. Further detailed information on securing community benefit from commercial schemes can be found in 'Delivering Community Benefit from Wind Energy Development: A Toolkit (May 2007 – A Report for the Renewables Advisory Board and DTI).

[BIS: Delivering Community Benefits from wind Energy Development: a Toolkit]

7.1 Role of commercial renewable energy developments

On shore wind developments are set to become more common and an important contributor to Scotland's low carbon energy mix. By 2010, there could be as much as 3,400 MW of installed onshore wind generation. Currently, there is just over 1,400MW of installed wind generating capacity in Scotland. The majority of these installations are in commercial wind farm developments. These wind developments are key to Scotland meeting its renewable and carbon reduction targets. There are a range of options available to communities if they wish to gain benefit from a wind farm or other renewable technology installation in their locality. The development of large wind farms can also help the local economy as a result of local firms gaining work during construction, local businesses and accommodation benefitting from construction teams in the locality and a local maintenance crew being established. It should be recognised also that commercial wind developments usually result in the site landowners gaining some form of rental payments, which can be re-invested in their local businesses and subsequently back into the local economy.

7.2 Private commercial ownership with financial community payments

Commercially developed projects often instigate a payment to a local community so there is some community wide benefit from a development. It should be recognised that there is no legal obligation to do this, but it is however becoming established as a norm and is generally known as 'community benefit' payment. It typically involves payments to a local representative body to fund initiatives and actions that will benefit the whole community. Taking the simplest form of community benefit payment as a guide (say £2,000 per MW installed) this could mean that by 2010, there could be a potential total revenue of over £6,800,000 pa flowing into communities in Scotland from onshore wind farms. This represents a significant opportunity for communities to benefit from commercial wind farm developments. In comparison with a community owned and developed project, the income for the community from a commercial benefit payment could be significantly less, but it also comes with much less risk, and much less work required by the community.

7.3 The development control process

As discussed in section 6.7, planning permission, projects under 50MW (under 1MW for hydro, wave and tidal) are determined by Local Authorities under the Town and Country Planning (Scotland) Act 1997, whereas projects of greater capacity are determined under section 36 of the Electricity Act 1989 by the Scottish Ministers.

The law requires a strict separation between the planning process through which a wind farm application must pass to gain consent, and any negotiations regarding community benefit. Due diligence must be observed when dealing with community benefit discussions with local authorities and all interested parties must declare if there are any conflicts of interest.

> It is essential that community groups investigate what their local authority policy is on community benefit payments.

However, for a community to gain benefit from such a development, it is vital to be well informed about the nature of commercial wind farm development and the planning process. It will be important to approach negotiations with a developer in a professional way and, critically, be able to express clear reasons why and how your community should benefit from the development. These points are covered in turn below. A community liaison group could be established to advance negotiations with the project developer and to ensure good communication with the wider community.

7.4 The nature of commercial wind farm development

Commercial wind farm development is largely undertaken by businesses which can spread their risk across a range of projects and who can gain economies of scale across the project development cycle. As with community wind farm development the pre planning phases are the riskiest and a project developer will need to focus on the project's financial viability to offset the costs and risks involved in bringing the project to successful operation.

For a commercial developer choosing to develop a site will depend on three main criteria, just as a community seeking to develop a site. Please refer to the wind specific sections in Section 6 for further detail.

- A good wind resource
- An economic grid connection
- Planning consent

Community engagement by the wind industry is being integrated into Scottish planning guidance.

http://www.scotland.gov.uk/Publications/2007/03/22084213/20

It is important to get effective community engagement, especially around the potential significant environmental effect of a project, at the earliest possible stages irrespective of any separate initiative to agree community benefit payments.

Some wind farm developers will engage in community benefit negotiations prior to any planning decision being made. Other developers have a policy of not engaging in such discussions until a project is consented.

7.5 Establishing a community benefit payment scheme

7.5.1 Engage in the development process

Entering into a dialogue with a large developer will require some time commitment from a community group but the benefits could be significant – many developments are now over 20MW installed capacity and payments can therefore be significant. It is important that the community shows an interest in the development and avails of the opportunity to engage in open days and public meetings with the developers as and when these are organised. It is also important to establish if the developer has a policy on community benefit payments and whether discussion can be initiated on this before planning consent is in place.

It is essential that a community investigates the local authority policy in relation to community benefit payments – some of the Scottish Local Authorities have a local fund and policy in place that developers have to channel funds through, and so this would remove some of the need for communities to become heavily involved in discussion with the developer. Communities are advised to contact their relevant Local Authority for their policy on community benefit payments.

In order to improve the chances of getting the best deal it's important that all dealings are dealt with professionally, with a clear consistent approach towards negotiations. It may be beneficial for community groups wishing to enter such negotiations to contact other communities that have gained community benefit payments from a wind development owner to establish the levels of payment and gain an overview of the processes involved. Some community benefit payments are based on a figure per MW installed – as a guide windfarm developers may offer in the region of £2,000 per MW installed per year, and may link a variable payment to the benefit. This variable element would be linked to the actual fortunes of the wind farm, based on actual performance measured in Mega Watt hours or MWh or, for larger wind farms, Giga Watt Hours or GWh (1GW = 1000 MW – see Energy Basics in Section 1), or ROC income. In highly productive years, benefit payments will be greater and vice versa in less windy years. For example, if there is significant down time (e.g. for significant maintenance or damage repair), payments will be less.

A developer will want to see some worthwhile projects benefitting from the funds, and a simple scheme to deliver benefit payments. They will also need to be certain the group representing the community is open to all the community and is capable of undertaking projects and actions that will benefit the community as a whole.

7.5.2 Make clear contact with the developer

A clear, positive professional approach is required from the start. Establish the contact within the company developing the project in your area and write to them stating clearly who you represent and your desire to discuss the development / potential benefits to the community.

7.5.3 Investigate options for managing community benefit payments

There are different models currently in use that relate to the administration and spend of community benefit payments from commercial windfarms. If the local authority does not have a policy of local authority managed funds then the options could be

- Community Trust – where the community themselves receives payment directly from developer and takes on the administration and responsibility of maintaining a trust body and assessing and administering benefit payment spend
- Third party involvement – where the community and developer liaise with a third party to act as banker and administrator of the fund, where decisions on fund spend are made by the community
- Developer as grant maker – where the developer provides resource to manage the fund and assess and decide what the benefit payment can be spent on

Community trust
If a community group wishes to negotiate and control community benefit payments check with the local authority, community council, other community organisations and the local enterprise authority to see who wishes to be involved in discussions. It is advisable to form a consortium or liaison group with members from all groups to present a single coherent opinion and prevent division. This group will need to be able to objectively gauge local opinion, effectively represent the views of the local population and negotiate with a clear community remit. There will also be administration and resource requirements to maintain a community trust and service a committee, and responsibilities for assessing and managing spend of the community fund.

Third Party involvement
Communities should also be aware of the service provide by the Scottish Community Foundation (SCF) which currently provides a service for many communities and developers in managing the benefit payments related to windfarms. The Scottish Community Foundation enables a fund for a specific community to be established, and manages and distributes the charitable gift to the community. Decision making on the fund spend is retained by the community, and the SCF can help in setting up a community panel. The SCF provides an administration role and monitors the fund reporting to both the developer and the community. This service is provided at a charge by the SCF, which is related to the size of the fund and the level of involvement needed to establish and maintain the programme. The costs of establishing a fund with the Foundation are normally less than setting up a new charitable trust.

More information is available here http://www.scottishcf.org/helping-you-give/developers-and-community/ and here http://www.scottishcf.org/helping-you-give/developers-and-community/grants-programme-in-partnership/

Developer as grant maker
This is an approach that has been seen from some commercial developers where they are involved in decisions on the spend of a community benefit fund. This could encourage close liaison between developer and community, but would require a lot of resource from a developer and skills in assessing community projects eligible for funding.

7.5.4 Organise formal meetings to negotiate community benefit

Most developers will be happy to meet well organised local groups to discuss community benefit funds, although some developers may have a policy of waiting until planning consent is available until initiating such discussions. All groups involved should be represented at the meeting, and the local authority invited. Minutes of the meeting should be taken and distributed to all involved soon after. Current communities' experiences show that the presence of strong negotiation skills and a good development plan within the community serve to secure a good level of benefit payment. It is however critical that all participating community groups have the same consistent, joint approach to the development.

7.5.5 Community benefit payment processing and a community organisation

Developers want to see a well organised group who, once established, are capable of delivering local benefit without difficulty. If it is a community trust approaching a developer, it is important to promote any previous work the community group has delivered, state the potential support the group can offer and show a clear framework for delivering the funds once they are secured.

If it is a third party in conjunction with a community both groups will need to be able to demonstrate the benefits of the proposed programme and the track record of the third party in fund administration and grant awards.

7.5.6 Finalise an agreement

Once agreement is made it is important to ensure any offer is legally binding and the group or third party have clear control over the funds for local benefit. For community benefit programmes that look to have the developer as grant maker it should be recognised by the community that it will be important to highlight and agree to a community development plan or long term strategy. Independent legal advice is advised when dealing with this stage.
It is important that the whole community is involved in the decision on finalising an agreement with a developer, as the decision will affect the benefits and activities that result from any funds established.

7.5.7 Prepare a good development plan

Community benefit payments offer the local area access to a long term funding stream for community improvement and regeneration. A strong case will rest on being able to show that any payment received will be put to good use meeting actual needs in the community. Ideally, these should be needs that have been properly identified through an open process of community consultation and which are clearly supported by local residents (for more information on preparing a development plan, see Section 8). An agreed plan will also be helpful in avoiding any disputes that may arise in the event of success in securing benefit income. If a community trust is administering the fund it is important to have a investment policy and procedure that sits within the confines of charity and company law.

It is best to have a well structured and agreed plan for allocation of funding. In administering these funds, the community needs to develop clear assessment criteria and a scoring/weighting system to identify the merits of one proposal over another. The community also needs to ensure these criteria are made available to all and that any decision-making is fully transparent.

7.6 Shared ownership and community investment

Partial or shared ownership of wind farms has become more prevalent in recent years, and provides an opportunity for communities to become involved in a particular wind farm without the development work and associated risks involved with progressing a wholly community owned project.

7.6.1 Part ownership of the wind farm

This can take the form of part ownership of a commercial windfarm, or ownership of some turbines within a commercial windfarm.

There is currently one example in Scotland where a local community group has secured a part-ownership arrangement with a commercial wind farm developer. Fintry Renewable Energy Enterprise (FREE) owns the rights to one 2MW turbine within a commercial development of 15 in Stirlingshire. FREE worked with the developer to add an extra turbine to the planned development of 14 2MW turbines. Finance for the Fintry turbine was secured through its inclusion in the bank loan for the main windfarm. FREE now receive an income equivalent to 1/15th of the site's net income minus the costs of the loan repayment. This means that the developer (Falck) owns the turbine, but there is an agreement which states it will consider a change of ownership (to the community group) once the loan is paid off. However, as the model does rely on substantial assistance from the commercial developers and financiers, and active, ongoing community participation in the planning, development and finance process; it will therefore not be feasible for all communities.

The annual income from the scheme is estimated at £50,000-£100,000 per annum depending on the site's performance, and to date the scheme has performed well. Fintry pursued a positive approach with the emphasis on working together, rather than viewing community consultation and benefit as an obstacle. The first funds have now been received and the group are currently working on the best mechanism to deliver local energy savings and progress the community towards a low carbon lifestyle. Fintry are currently assisting eight other groups looking to develop similar arrangements or looking to maximise community benefit funding, normally entering discussions prior to planning and working with smaller developers. To date, Fintry remain the only group to have obtained this type of deal. For more information see http://www.frost-free.co.uk.

There are two examples of community co-operatives in the UK owning some of the turbines on a commercial wind farm. The most recent instance is Fenland Green Power Co-op, which now owns two 2MW turbines on a site at Deeping St Nicholas, on the Lincolnshire/Cambridgeshire border, where Fenland Windfarms operates the other 6 turbines. A successful share offer raised over £2.6 million from the 1,100 members of Fens Co-op. Returns to Members of the Co-op are dependent on the commercial performance of the windfarm, but are expected to be between 8% and 12% per annum over the life of the project. A percentage of the commercial income is devoted to community projects. Information on this model is available at http://www.fens.coop

7.6.2 Community Share Offer for a Royalty Instrument stake in a windfarm

This approach establishes a local Co-op to raise funds from individual investors in and around the local community through a public share offer in the area around the wind farm. The fund generated is then used to purchase a share in the revenue from the wind farm. This model allows local individuals to invest in a commercial wind farm, and accrue benefits from the performance of the windfarm, without the complications of actually owning a turbine.

Co-operatives linked to commercial wind farms in Aberdeenshire (Boyndie www.boyndie.coop), Skye (Ben Aketil www.skye.coop), Inverness-shire (Invergarry www.greatglen.coop) and Sutherland (Kilbraur www.kilbraur.coop) have been established.

It is important to note that the Royalty Instrument Agreement is additional to any community benefit payments which the developer and / or co-op may elect to give.

For more information on this type of project, see www.cdscotland.co.uk and www.energy4all.co.uk.

Section 8: Organisation, Consultation and Development Planning

8. Organisation, Consultation and Development Planning

This section discusses the reasons behind, and a selection of ways to organise and consult with the local community on both small and large scale projects. Assistance on why and how to create a development plan is also given.

8.1 Why and how to be organised

To take forward any project on behalf of a community requires a level of organisation. Whilst it may be possible to undertake a low-risk voluntary activity that does not involve any financial transactions as an informal group, any project entailing funding and risk should only be undertaken by a legally constituted organisation.

The level and complexity of the organisation depends on the scale and complexity of the project and how the community may benefit from it.

The Organisation and Planning table in Annex 1 summarises the main legal structure options in relation to the type of project envisaged.

8.2 Community Consultation

8.2.1 Why is it essential?

If presenting a project as a community project and seeking funding on that basis, it is essential to demonstrate a mandate for representing the community and that the community's priorities or requirements have been taken into account. Progressing with what may become a complex project only to find that there is strong opposition to it locally will affect credibility with funding bodies and may cause lasting local antagonism.

For larger-scale projects, strong community support allied with a clear description of how the project will meet demonstrable local needs will be influential in the planning consent process.

Although there are always likely to be local individuals who do not like change, their impact is much less if it can be shown that there is strong support for the project locally.

Note: Community consultation does not remove the need for any statutory consultation (e.g. with neighbours) required under planning law.

8.2.2 How much community consultation is required?

There is no particular standard for the level of community consultation, but it is prudent to scale this according to the nature of the project. The following rule of thumb can be applied:

Type of project	Level of consultation
Heat and power installations in buildings	• All building users • Potential users (this is useful anyway to help scale potential heat requirements) • Neighbouring households / land holders (e.g. if wind turbine is under consideration)
District heating	• All building owners and households that could connect onto the scheme • Householders / landholders neighbouring boiler house.
Wind or hydro project designed to generate and sell electricity	• Consultation (e.g. based on electoral roll) to identify and prioritize community needs • Present in development plan format • Information provision at critical stages e.g. using displays in local libraries or other community venues, events, website, etc • Consider vote prior to submission of planning application
Securing benefit from nearby commercial wind farm	• Consultation to identify and prioritize community needs • Confirm development plan

8.2.3 How to carry out consultation on larger projects

There is no set procedure for community consultation on larger scale projects (e.g. such as a large wind turbine to generate and sell electricity) and each community will have different circumstances. However, good practice is emerging from a number of different community projects. This can be summarised as follows:

Step 1
Hold open meeting to outline project idea and gauge support and volunteers

Speaker from community project elsewhere or local development officer
Seek mandate to undertake local renewable energy assessment if necessary
Seek mandate to consult on local community needs if necessary
Seek mandate to undertake feasibility study
Seek mandate to constitute group or subcommittee of existing organisation
Consider local events, displays, website, and articles in local newspaper or community newsletter.

Step 2
Hold open meeting to
- report findings of assessment
- report findings of feasibility study
- agree preferred options
- agree process and timescale for consultation on preferred options

If possible, prepare display for local people to visit and comment
Consider article in local newspaper or community new sheet and/or website

Step 3
Hold open meeting to confirm preferred option
Seek mandate to proceed to detailed development
Confirm development plan priorities and ultimate objectives for project

Step 4
Hold open meeting to
- agree planning application
- consider, if necessary, community vote on project

Step 5
Hold final open meeting to
- Address any outstanding issues
- Conclude and report on community vote - this could be done through a website or newsletter

8.3 Community development plans

For maximum benefit from a large scale, revenue generating, renewable energy project (or to take advantage of someone else's) then some form of community-wide development planning is invaluable, if not essential.

Equally, if there is an aspiration within a community to become more sustainable by using renewable energy to reduce the collective carbon footprint, then this process can help clarify and identify needs/opportunities. A community development plan will help focus on the best way to address these.

However, if a project is such that:

- it is not going to generate substantial investment revenue
- there is presently a focus on one particular smaller scale project on a single site
- there is an established community group with no desire to get involved in wider community development

then the advantage of this process may not immediately be obvious. Nevertheless, it will probably still be a benefit to go through an equivalent process on a smaller scale to help produce a clear project development plan for any proposal. In addition, the process may uncover broader community needs or aspirations that inform the group's work.

With this range of interest in mind, the main emphasis of this section of the guide focuses on the first two scenarios that require wider community development planning. If successful, this section should help plan a path for renewable energy development that: best chimes with the community's vision for the future, that is supported by a group and the community it represents, will address key needs that a community has identified, and ensures that any projects undertaken can clearly relate to the meeting of one or more of these needs.

Many development trusts have been through such a process of community appraisal and have produced community strategies as a result. The Development Trusts Association Scotland can provide further information and may be able to put you in touch with trusts who have taken this approach. Visit www.dtascot.org.uk for contact details.

> See case study 19, Rousay, Egilsay and Wyre, Orkney Islands as an example of a group which has undertaken development planning; the case study covers the key issues and learning points and the results for the community

This section acknowledges other previous guidance on this topic, and points the reader to substantial amounts of information contained in earlier publications such as:

Community Toolkit: Could your community benefit from renewable energy development? (The Highland Council/HIE)
Re: Sourcebook – planning for your community (Alan Caldwell Associates)
Developing a community project idea & Funding for community projects (Forward Scotland Guidance Notes 1 and 2)
Delivering Community Benefits from Wind Energy Development: A Toolkit (DTI)
Small Town and Rural Development (STAR) group

8.3.1 Why create a community development plan?

There are no set rules or structures as to what a community's development plan should be. However, a well thought out community development plan should:

- Identify key aspirations, needs and resources within a community
- Check that proposed ways of meeting these are widely welcomed and actively supported,
- Create a clear strategy for involving the community in decisions on how local income is to be spent
- Create a clear procedure and process for updating and reviewing spend priorities
- Provide a good practical management framework and structure to turn general good aspirations into practical realisation of actual projects on the ground
- Identify any resources, possible partners and timescales for making this happen

In addition to this, a good community development plan can also be a very useful tool for interacting with the wider community. It is especially good as a way of making sure activities remain in line with the aspirations of a community. It illustrates to potential funders and permitting bodies how activities and projects can really contribute to the identified needs within that community. It provides a tool to inform the community of the plans, provides evidence to funders that the community has shaped the plan and provides a means of measuring progress.

Section 9: Funding and Financing your Project

9. Funding and financing your project

This section outlines the basics of grant funding and some of the issues to watch out for. For many groups, the successful award of funding to a project is the culmination of a great deal of work. It is also the point at which the project becomes 'real' and when a focused and meticulous approach to project delivery is required.

9.1 Funding and finance – what's the difference?

'Funding' is usually taken to mean grant, whereas 'finance' usually means loan or more advanced forms of investment such as a shareholding. Finance is usually only appropriate for a project if it likely to generate a significant financial surplus, which can then be used to pay off a loan plus interest or to pay dividends and interest on shareholdings.

9.1.1 Grant Funding

Funding is available to assist renewable installations heat or power buildings – finance will not be appropriate unless significant revenue savings are likely to result in an ongoing financial surplus to the group, which would allow a loan to be paid off. Grant providers rarely provide 100% of the costs of a project. This means groups may need to look at various grant programmes for match funding. In the first instance, groups should consider the sources which are likely to offer the highest contribution to costs. Currently, these are:

- The Scottish Community and Householder Renewables Initiative (SCHRI). This is a Scottish Government programme that has been delivered to communities by Community Energy Scotland in the Highlands & Islands area and the Energy Saving Trust in the Southern, Central and North East of Scotland. Up to 50% grant is usually available. However, from April 2009 the Scottish Government will introduce a new scheme which will focus solely on supporting community renewables - The Scottish Government's Communities And Renewable Energy Scheme (CARES) For more details see
  http://www.scotland.gov.uk/Topics/Business-Industry/Energy/19185/Communities
  http://www.communityenergyscotland.org.uk/schri.asp;
  http://www.energysavingtrust.org.uk/scotland/Scotland/Scottish-Community-and-Householder-Renewables-Initiative-SCHRI
- The Low Carbon Building Programme (LCBP). This is a UK Government programme managed by the Buildings Research Establishment. Up to 50% may be available, but this cannot be matched with SCHRI grant. This programme is currently due to close mid 2009. http://www.lowcarbonbuildings.org.uk/home/
- The Scottish Rural Development Programme (SRDP). This Scottish Government programme brings together a number of funding schemes, some of which are part-funded by Europe. The most likely sources of funding in the SRDP for renewable energy projects in community facilities are Rural Priorities and LEADER. For more information see http://www.scotland.gov.uk/Topics/Rural/SRDP

- The Climate Challenge Fund. This is a Scottish Government fund established to support community projects that aim to reduce greenhouse gas emissions. In relation to renewable energy projects, only grant for feasibility studies will be available. For more information see http://www.keepscotlandbeautiful.org/ccf.asp
- Private trusts and Utility grants. There are a large number of private charitable trusts that may provide grants for renewable energy installations. Utility companies also offer grants under certain circumstances. See annex 1
- Funding is available from Co-operative Development Scotland if a community should wish to develop a renewable energy co-op or adopt a co-op model as part of their project (see www.cdscotland.co.uk)

9.1.2 Key points about grant funding

The main points about grant funding from any source are:

- It is usually discretionary – there is rarely any right to a grant;
- Funders will normally make it clear what costs in a project are **eligible** for grant aid. Any non-eligible costs will have to be excluded – but make sure you know how these will be paid for.
- Grants are often conditional – ensure your group can meet these conditions.
- It is unusual to get a grant for 100% of the costs of a project from one source– 50% or less is the more common amount.
- You must never commit expenditure for a project if you have not had a formal, written offer from the funding body. This will expose your group to a high financial risk if a grant application fails.
- Most funding bodies (especially public bodies) will only provide grant if their funding has an additional impact – i.e. their funding means that the project will go ahead, or will be better, or achieve more. If you have already started a project prior to seeking grant aid, or it appears that the project could proceed without the grant, most grant giving bodies will conclude that grant was not required and therefore there is no 'additionality'.
- It is essential to check and plan for funders' deadlines (i.e. when they will make a decision on your application) across all your potential funders. Try to ensure these work for your project as differences in these dates can cause delays.
- If a community has a charitable organisation with a trading subsidiary it is not normally possible to fund the trading body through grant. Funds can be passed from charitable body to subsidiary at commercial loan rates in keeping with the Office of the Scottish Charity Register (OSCR) on charity regulations. Communities wishing to action developments or improvements that require grant funding through a trading arm subsidiary are advised to discuss the matter with OSCR- www.oscr.org.uk

9.1.3 Contributions in kind

In approaching grant funding body, you should always check whether the funder allows 'contribution in kind'. A contribution in kind is a financial quantification of voluntary time undertaken by members of a project group. It can also be a donation such as a piece of equipment from a local firm.

The work on a project undertaken by community group members is likely to have a value because it is offsetting what would have been a larger cost (for example of employing consultants). It is important that the total cost of a project **includes** any contribution in kind as it is the total cost which determines the actual cash value of the grant. If you exclude the voluntary time necessary to develop a project from its total cost, you are undervaluing your voluntary contribution and may get less grant than would otherwise be the case. Indicative values to ascribe to contributions in kind are summarised below:

Type of volunteer help	£per hour	£per day
General unskilled labour	6.25	50
Specialist skilled trained labour	18.75	150
Professional services (e.g. lawyers, accountancy)	50	350

NB. These are provided for guidance purposes only – much will depend upon the policy of the funding body.

9.2 Financing larger-scale projects

A group taking forward a project should always seek independent financial advice to ensure the proposed structure is fit for purpose and flexible enough to meet a number of different potential funding scenarios. This section of the Toolkit provides general introductory guidance only and should not be taken as investment guidance.

Background
Section 6 provides an introduction to larger-scale projects designed to generate long-term source of funds for a community organisation. At the moment wind and hydro power are the main options, although the sale of heat and / or power through district heating and combined heat and power may become more viable in the future.

Financing a project is a complex process, and unless a community can finance a project 100% from their own resources then it is likely that some investment and/or loans from a bank will be required.

9.2.1 Financing Scenarios

There are three broad financing scenarios:

- The community has significant reserves that it is willing to invest, or has been successful in securing significant grant for the project. In this scenario, a loan may still be required. If the project is likely to be highly profitable mainstream banks are likely to be interested in providing loan finance. In this situation, a number of potential providers should be invited to review your project and propose their terms for a loan. Communities should look carefully at the full range of services a bank may provide – not just the headline interest rate. A bank that understands community organisations may prove a better choice than a bank more used to dealing with commercial companies if the financing offers are somewhat similar.

If it is proving difficult to secure a loan from a mainstream bank, or the terms are too onerous, it may be possible to source finance from certain financial institution specifically established to support social enterprise development. Social Investment Scotland was established with this purpose and have produced a clear guide on taking out a loan 'Taking a Loan of Finance', www.socialinvestmentscotland.com. Triodos, Charity Bank and Unity Bank also offer loans /equity capital.

- The community has limited funding of its own which is not enough to provide security for a loan provider. In this scenario, it will need to find other potential investors who would be interested in the project. In all cases this will entail giving up some ownership and probably some control over the project. There are several ways of doing this:
    - Identify a like-minded organisation who would be interested in undertaking a 'joint venture' and is able to bring cash to the project;
    - Issue a share offer to attract shareholders. see section 9.3 – The Co-operative Model;
    - Identify social investors who would be willing to invest in a project in a way which does not involve taking control of it as a means of helping the project construct a viable financial structure. For established social enterprises, the Scottish Investment Fund managed by Social Investment Scotland may be an appropriate way forward.

The Highlands and Islands Community Energy Company (now Community Energy Scotland) has developed a general 'step by step' guide to financing which aims to help community groups understand the financing process. A copy of the guide is available from Community Energy Scotland's website www.communityenergyscotland.org.uk. An interactive CD ROM is also available from Community Energy Scotland, which enables the user to consider the implications of different equity and loan mixes under differing site conditions.

9.3 The Co-operative Model

The Co-operative model is the accepted form of community ownership in most of mainland Europe. 23% of Denmark's wind energy is co-operatively owned and the City of Copenhagen co-operative is currently constructing an offshore wind farm. However the model is generally less well used in the UK.

The Co-operative model allows large sums of money to be raised from individuals through a share offer approved by the FSA. Combined with bank borrowing, this has permitted projects to proceed on a larger scale than may be possible using grant funding only.

Co-operatives are governed by Industrial and Provident Society legislation, and each Co-operative is registered with the FSA. Each Co-op has rules which ensure that it is governed in an ethical and democratic manner. Each individual Member has a vote no matter what the level of individual investment.

There are several different examples in the UK of how co-operatives can work in the renewable energy field.

The largest co-operative owned wind farm in the UK is the Westmill Wind Farm Co-operative, which developed and now owns and operates five 1.3MW turbines. The Co-operative has over 2,000 Members and raised over £4 million (plus a similar amount of bank finance) for the project. Returns are expected to range between 7% and 11%. More information is available at www.westmill.coop.

The Baywind Wind Farm Co-operative has the oldest community owned wind farm in the UK, and has been generating energy from it for over 12 years. Baywind also owns a number of turbines on a shared ownership commercial wind farm. Returns have averaged 8% over the life of the projects to date. See www.baywind.coop

The Fens Green Power Co-operative owns two 2 MW turbines on a shared site. Returns are expected to range between 8% and 12% per annum over the life of the project. See www.fens.coop

There are also to date four community co-ops in Scotland which own an interest in the income stream from their local wind farm, for example www.greatglen.coop. Income to Members from these co-ops is expected to be of the order of 10% per annum for the life of the project.

Findhorn's wind turbines have been partly financed by a loan from a community wind farm co-operative.

Each of the co-ops expects to repay Members their original capital at the end of the project's life. Each Co-op has a fund for local community projects.

The Co-operative model delivers economic and social benefits to the local community, ethical investment opportunities, and permits larger developments to be undertaken, which are usually more efficient.

For more information and assistance with the Co-operative model for renewable energy, contact Co-operative Development Scotland www.cdscotland.co.uk or www.energy4all.co.uk.

9.4 A note on 'State Aid'

Funding of income generating projects from public grant money must be compliant with EU State Aid regulations. State Aid is funding from a public body, or publicly-funded body, to undertakings (organisations involved in economic activity). State Aid must not distort competition and affect trade between Member States of the European Union, and may have to be approved by the European Commission. State aid is illegal under EU rules except under designated exemptions and within certain limits. Public bodies awarding grants must ensure any award is compliant with state aid rules.

Community Renewable Energy Toolkit
Annex 1 – Further reading

Community Projects in Scotland

Referred to in section the Toolkit Introduction

Note 1: This information is provided as part of a Community Renewables Toolkit being developed by Community Energy Scotland for the Scottish Government.

Note 2: Organisation contact details (contact name, telephone number and address) cannot be made publicly available due to Data Protection laws (see Note 3)

Note 3: Interested parties may contact the Support Organisation regarding a project they are interested in visiting. They will then contact the local organisation and ask if they are willing to host a visit. The acronyms of these organisations are
SCARF – Save Cash and Reduce Fuel
CES – Community Energy Scotland
ESSAC - Energy Saving Scotland Advice Centre

Note 4: Info below only includes capital projects. It does not include technical feasibility or capacity building projects.

Note 5: Entries are listed alphabetically by Local Authority, then by organisation name.

Organisation Name	Project Name	Local Authority	Technology	Support Organisation	Contact Number
Aberdeen City Council	Aberdeen City Council Farm Fuel Poverty Pilot	Aberdeen City	GSHP	SCARF	01224 213005
Aberdeenshire Council	Aboyne Academy Wood Burning Boiler	Aberdeen City	Biomass	SCARF	01224 213005
Camphill Village Trust	Newton Dee Village	Aberdeen City	Solar Water	SCARF	01224 213005
Castlehill Housing Association	Blackhall Road Housing Development	Aberdeen City	Solar Air	SCARF	01224 213005
Cults Primary School	Cults Primary Eco Power	Aberdeen City	Wind	SCARF	01224 213005
Tenants First Housing Cooperative	Peterhead Retrofit	Aberdeen City	Solar Air	SCARF	01224 213005
Aberdeenshire Council	Balmedie Primary School Heat Pump	Aberdeenshire	GSHP	SCARF	01224 213005
Aberdeenshire Council	Elrick Primary School - Ground Source Heat Pump	Aberdeenshire	GSHP	SCARF	01224 213005
Enterprise North East Trust Ltd	Crichiebank Business Centre Woodfuel Project	Aberdeenshire	Biomass	SCARF	01224 213005
Fetterangus Community Association	PUFF Power	Aberdeenshire	Wind	SCARF	01224 213005
Forestry Commission Scotland	Office heating improvements for Forestry Commission office	Aberdeenshire	Biomass	SCARF	01224 213005
St James Church Vestry Committee	St James Church - Ground Source Heat Pump Project	Aberdeenshire	GSHP	SCARF	01224 213005
Strichen Gala Committee	Ritchie Hall Solar Panel Heating	Aberdeenshire	Solar Water	SCARF	01224 213005

Angus Council	Arbroath Solar Water Heating Project	Angus	Solar Water	SCARF	01224 213005
Angus Council	Angus Council - Airlie Primary School	Angus	Biomass	SCARF	01224 213005
Kilry Village Hall Demonstration Project	Kilry Village Hall Renewable Energy Project	Angus	Biomass	SCARF	01224 213005
Kingsmuir Hall Committee	Sustaining Kingsmuir Hall	Angus	Air source heat pump	SCARF	01224 213005
Letham Village Hall Committee	Letham Hall Solar Project	Angus	Solar Water	SCARF	01224 213005
Lethnot Village Hall Committee	Lethnot Village Hall Renewable Energy Project	Angus	Solar Air	SCARF	01224 213005
Menmuir Village Trust	Menmuir Renewable Energy Project	Angus	Hydro	SCARF	01224 213005
Padanaram Community Council	Padanaram Community Hall - Biomass	Angus	Biomass	SCARF	01224 213005
The Glenesk Trust	Glenesk Trust GSHP Project	Angus	GSHP	SCARF	01224 213005
An Talla Limited	An Talla Tiree Community hall turbine	Argyll & Bute	Wind	CES	0141 4165223
Ardroy Outdoor Centre	Ardroy Outdoor Centre	Argyll & Bute	Solar water	CES	0141 4165223
Argyll & Bute Council	Campbeltown Leisure Centre biomass	Argyll & Bute	Biomass	CES	0141 4165223
Argyll and Bute Council	Port Charlotte Primary School	Argyll & Bute	Wind	CES	0141 4165223
Argyll College	Construction Skills Centre	Argyll & Bute	GSHP	CES	0141 4165223
Cairn Housing Association	Cairn Housing Lorne Court, Campbeltown	Argyll & Bute	Solar	CES	0141 4165223
Cairndow Village Hall Committee	Cairndow Village Hall	Argyll & Bute	Solar	CES	0141 4165223
Craignish Village Hall Committee	Craignish Village Hall heat pump	Argyll & Bute	GSHP	CES	0141 4165223
Fyne Homes	Campbeltown houses biomass	Argyll & Bute	Biomass	CES	0141 4165223
Fyne Homes	Whitegates, Lochgilphead biomass	Argyll & Bute	Biomass	CES	0141 4165223
Fyne Homes	Campbeltown solar ventilation	Argyll & Bute	Solar Air	CES	0141 4165223
Fyne Homes	Isle of Gigha solar	Argyll & Bute	Solar	CES	0141 4165223
Fyne Homes	Blarbuie Road, Lochgilphead	Argyll & Bute	solar water	CES	0141 4165223
Fyne Homes	Argyll Street, Campbelltown	Argyll & Bute	Air recovery heat pumps	CES	0141 4165223
Fyne Homes	Fyne Homes - Mansfield Place, Rothesay	Argyll & Bute	Solar	CES	0141 4165223
Iomairt Chille Chomain	Port Charlotte Centre, Islay	Argyll & Bute	Wind	CES	0141 4165223

Isle of Gigha Heritage Trust	Isle of Gigha Community Wind Turbines	Argyll & Bute	Wind	CES	0141 4165223
Isle of Gigha Heritage Trust	Refurbishment of community owned housing	Argyll & Bute	Solar	CES	0141 4165223
Lismore Historical Society	Lismore Museum heat pump	Argyll & Bute	GSHP	CES	0141 4165223
Mid Argyll Community Enterprise Limited	Mid Argyll Comm Pool Boiler Upgrade	Argyll & Bute	Biomass	CES	0141 4165223
Mull & Iona Community Trust	MICT slaughterhouse	Argyll & Bute	Solar air	CES	0141 4165223
Mull Theatre	Mull Theatre Heat Air Source Heat Pump	Argyll & Bute	ASHP	CES	0141 4165223
Oban & Lorne Rugby and Football Club	Lorne Rugby Club, Oban	Argyll & Bute	Solar	CES	0141 4165223
Port Ellen Primary School	Port Ellen Primary School turbine	Argyll & Bute	Wind	CES	0141 4165223
The Dochas fund	The Dochas Centre, Lochgilphead	Argyll & Bute	GSHP	CES	0141 4165223
The Iona Community	Camas Centre The Iona Community	Argyll & Bute	Wind	CES	0141 4165223
West Highland Housing Association	Bowmore Heat Pump	Argyll & Bute	GSHP	CES	0141 4165223
West Highland Housing Association	Glenshellach Biomass District heating	Argyll & Bute	Biomass	CES	0141 4165223
West Highland Housing Association	WWHA Port Charlotte	Argyll & Bute	GSHP	CES	0141 4165223
West Highland Housing Association	WHHA Jura Care Centre	Argyll & Bute	GSHP	CES	0141 4165223
West Highland Housing Association	Glenshellach Housing Phase 2	Argyll & Bute	Biomass	CES	0141 4165223
West Highland Housing Association	WHHA Tiree Housing solar	Argyll & Bute	Solar	CES	0141 4165223
Clackmannanshire Council	Menstrie Primary Extension	Clackmannanshire	Wind	SCARF	0141 5520799
Barvas and Brue Community Centre	Barvas and Brue Comm Centre heat pump	Comhairle nan Eilean Siar	GSHP	CES	01851 707344
Comhairle nan Eilean Siar	Sir E Scott School, Tarbert solar	Comhairle nan Eilean Siar	Solar	CES	01851 707344
Comhairle nan Eilean Siar	Tong School, Isle of Lewis	Comhairle nan Eilean Siar	Wind	CES	01851 707344
Hebridean Housing Partnership	Newvalley Housing Association	Comhairle nan Eilean Siar	GSHP	CES	01851 707344
Hebridean Housing Partnership	Bayhead Bridge Centre, Stornoway	Comhairle nan Eilean Siar	GSHP	CES	01851 707344
Hebridean Housing Partnership	Galson and Back heat pump	Comhairle nan Eilean Siar	ASHP	CES	01851 707344
Hebridean Housing Partnership	Milkinghill, Tong, Isle of Lewis	Comhairle nan Eilean Siar	ASHP	CES	01851 707344
Lews Castle College UHI training	UHI college renewable training centre	Comhairle nan Eilean Siar	GSHP	CES	01851 707344

Ness Sports & Recreation Association	Spornis	Comhairle nan Eilean Siar	GSHP + wind / solar	CES	01851 707344
Orinsay Village Association	Orinsay Community Hall, South Lochs	Comhairle nan Eilean Siar	GSHP	CES	01851 707344
Shawbost Old School committee	Shawbost Old School Renewables	Comhairle nan Eilean Siar	GSHP	CES	01851 707344
Shawbost Old School Trust	Shawbost Old School Trust	Comhairle nan Eilean Siar	Wind	CES	01851 707344
Stornoway Amenity Trust	Stornoway Waterwheel, Lews Castle	Comhairle nan Eilean Siar	Hydro	CES	01851 707344
Uig Development Trust	Uig Community Shop renwables	Comhairle nan Eilean Siar	Wind	CES	01851 707344
Comann Eachdraidh Uibhist a Deas	Kildonan Museum wind turbine	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Berneray Community Association	Berneray Hall wind turbine	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Comhairle nan Eilean Siar	Lochmaddy ferry waiting room heat pump	Comhairle nan Eilean Siar	GSHP	CES	01870 604932
Comhairle nan Eilean Siar	South Uist Care Centre	Comhairle nan Eilean Siar	GSHP	CES	01870 604932
Cothrom Limited	Cothrom training centre, South Uist	Comhairle nan Eilean Siar	GSHP	CES	01870 604932
Eriskay Hall Committee	Eriskay Hall Wind2Heat system	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Hebridean Housing Partnership	Balivanich Office development heat pump	Comhairle nan Eilean Siar	ASHP	CES	01870 604932
Hebridean Housing Partnership	Berneray School House	Comhairle nan Eilean Siar	ASHP	CES	01870 604932
Hebridean Housing Partnership	Eoligarry Houses ASHP	Comhairle nan Eilean Siar	ASHP	CES	01870 604932
Lewis Castle College, Castlebay	Lewis Castle College, Castlebay	Comhairle nan Eilean Siar	ASHP	CES	01870 604932
Northbay community init	Northbay Hall	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Stoneybridge Hall, South Uist	Stoneybridge Hall wind turbine	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Uist Buildings Trust	Nunton Steadings	Comhairle nan Eilean Siar	Wind	CES	01870 604932
Urrachadh Uibhist	Claddach Kirkibost centre, North Uist	Comhairle nan Eilean Siar	GSHP	CES	01870 604932
Beattock Hall Committee	Beattock Hall - Heat Pump Project	Dumfries and Galloway	GSHP	ESSAC South West	01292 521896
Gatehouse Development Initiative Ltd	Gatehouse Wind Project	Dumfries and Galloway	Wind	ESSAC South West	01292 521896
Glenkens Community, Arts and Education	Glenkens - Wood Pellet Heating Project	Dumfries and Galloway	Biomass	ESSAC South West	01292 521896
Samye Ling (Rokpa Trust)	Samye Ling Eco-Village Solar Project	Dumfries and Galloway	Solar Water	ESSAC South West	01292 521896

Auchencairn Initiative	Auchencairn Enterprise Centre Heat Pump Project	Dumfries and Galloway	GSHP	ESSAC South West	01292 521896
Dundee City Council	Morgan Academy Restoration - GSHP	Dundee City	GSHP	SCARF	01224 213005
Abertay Housing Association	Fintry North Phase 1, Dundee - Solar Air Project	Dundee City	Solar Air	SCARF	01224 213005
Dundee City Council	St Johns High School Extension	Dundee City	Solar Water	SCARF	01224 213005
Abertay Housing Assocition Ltd	21 No Houses @ Dunholm Road, Charleston, Dundee, Solar Hot Water and Air Project	Dundee City	Solar Air	SCARF	01224 213005
Bharatiya Ashram	Conversion of Dudhope Centre	Dundee City	Air source heat pump	SCARF	01224 213005
Servite Housing Association	Affordable Green and Clean Heating	Dundee City	Air source heat pump	SCARF	01224 213005
New Cumnock Environmental Regeneration Volunteers	New Cumnock Pool Heatpump project	East Ayrshire	Air source heat pump	The Wise Group	01292 521896
East Ayrshire Council	Glaston Primary School - GSHP Project	East Ayrshire	GSHP	The Wise Group	0141 552 0799
East Ayrshire Council	Hillside School - Wind Turbine	East Ayrshire	Wind	The Wise Group	01292 521896
Craighead Primary School	Craighead Primary School - wind turbine project	East Dunbartonshire	Wind	The Wise Group	0141 552 0799
Abbeyfield East Linton Society	Solar Water Heating in Sheltered Home	East Lothian	Solar Water	Changeworks	0131 555 4010
East Lothian Housing Association	West Windygoul, Tranent, East Lothian	East Lothian	GSHP	Changeworks	0131 555 4010
Gullane Primary School	Wind and PV Project for Gullane Primary	East Lothian	Wind	Changeworks	0131 555 4010
Hallhill Healthy Living Centre	Dunbar Health Living Centre Wind Project	East Lothian	Wind	Changeworks	0131 555 4010
Hallhill Healthy Living Centre	Hallhill Healthy Living Centre wind turbine relocation	East Lothian	Wind	Changeworks	0131 555 4010
Scottish Seabird Centre	Scottish Seabirds solar and wind project	East Lothian	Wind	Changeworks	0131 555 4010
Bield Housing Association	Kintail Gardens, Darnley	Edinburgh City	GSHP	Changeworks	0131 555 4010
Canmore Housing Association	Installation of micro-wind in social housing	Edinburgh City	Wind	Changeworks	0131 555 4010
Canmore Housing Association	419 Gorgie Road Solar Water Heating Project	Edinburgh City	Solar water	Changeworks	0131 555 4010
City of Edinburgh Council	Sheltered Housing Solar Project	Edinburgh City	Solar Water	Changeworks	0131 555 4010
City of Edinburgh Council	Portobello Solar Toilet Block	Edinburgh City	Solar Air	Changeworks	0131 555 4010
City of Edinburgh Council	Russell Road Depot Biomass Project	Edinburgh City	Biomass	Changeworks	0131 555 4010
Dunedin Canmore Housing Association	120 Lasswade Road	Edinburgh City	Biomass	Changeworks	0131 555 4010
Hillcrest Housing Association	9 & 11 Gilmours Close	Edinburgh City	GSHP	Changeworks	0131 555 4010

Napier University	Building integrated sustainable energy research	Edinburgh City	Wind	Changeworks	0131 555 4010
Prospect Community Housing	Prospect Housing Association - Solar Water Heating Project	Edinburgh City	Solar Air	Changeworks	0131 555 4010
Bridge of Allan Parish Church	Bridge of Allan Parish Church Halls Heat Pump	Falkirk	Solar Water	The Wise Group	0141 552 0799
Dunbog Hall	Dunbog Hall	Fife	Solar Water	Changeworks	0131 555 4010
Dynamic Woods	Scottish Wood - Wood chip heating system	Fife	Biomass	Changeworks	0131 555 4010
Fife Council	Rossyth School Solar Water Heating Project	Fife	Solar Water	Changeworks	0131 555 4010
Fife Council	Solar Pilot Project, Krikcaldy, Leslie and Springfield	Fife	Solar Water	Changeworks	0131 555 4010
Fife Council	Fife Primary Schools wind project	Fife	Wind	Changeworks	0131 555 4010
Fife Council	Dunfermline Business Centre - Biomass	Fife	Biomass	Changeworks	0131 555 4010
Homarna Ecostore Limited	Solar Heating of Community Building in Dunfermline	Fife	Solar Air	Changeworks	0131 555 4010
Lauder College	SDC & ASPIRE	Fife	Solar Water	Changeworks	0131 555 4010
Monimail Tower Project	Solar water heating for eco community building	Fife	Solar Water	Changeworks	0131 555 4010
Sustainable Communities Initiatives	Earthship Fife Renewable Energy Project	Fife	Solar Water	Changeworks	0131 555 4010
British Waterways	Auchinstarry Facility Block Heat Pump	Glasgow City	GSHP	The Wise Group	0141 552 0799
Castlemilk Economic Development Agency	Castlemilk & Carmunnock Community Windpark	Glasgow City	Wind	The Wise Group	0141 552 0799
Easthall Park Housing Co-operative	Glenburn Centre	Glasgow City	Wind	The Wise Group	0141 552 0799
Glasgow Building Preservation Trust	Castlemilk Stables Block	Glasgow City	GSHP	The Wise Group	0141 552 0799
Glasgow School of Art	Wind turbines on multi storey buildings - a pilot project	Glasgow City	Wind	The Wise Group	0141 552 0799
Glasgow Science Centre	Glasgow Science Centre Wind Turbine	Glasgow City	Wind	The Wise Group	0141 552 0799
John Wheatley College	John Wheatley College New Campus	Glasgow City	Multiple	The Wise Group	0141 552 0799
Partick Housing Association	Crathie Drive	Glasgow City	Solar Water	The Wise Group	0141 552 0799
Scripture Union Scotland	Lendrick Muir Renewable Energy Project	Glasgow City	Biomass	The Wise Group	0141 552 0799
Sighthill Community One Stop Shop	Sighthill Community One Stop Shop	Glasgow City	Solar water	The Wise Group	0141 552 0799
The Coach House Trust	Balmore Biomass System	Glasgow City	Biomass	The Wise Group	0141 552 0799

Thenew Housing Association	Kirkhaven Hostel	Glasgow City	GSHP	The Wise Group	0141 552 0799
Acharacle Community Company	Acharacle Community Company biomass	Highland	Biomass	CES	01397 708266
Acharcle Community Council	Sgoil na Coille, Acharacle	Highland	Solar (Small pv)	CES	01397 708266
Albyn Housing	Albyn Housing, Alness, solar	Highland	Solar water	CES	01408 635102
Albyn Housing Association	Albyn Housing Kingussie	Highland	Solar water	CES	01479 841859
Albyn Housing Association	Aviemore biomass	Highland	Biomass	CES	01479 841859
Alness Golf Club	Alness Golf Club wind turbine	Highland	Wind	CES	01408 635102
Alness Heritage Centre	Alness Heritage Centre pellet boiler	Highland	Biomass	CES	01408 635101
Ardross Community Hall Association	Ardross Community Hall	Highland	GSHP	CES	01408 635102
Assynt Foundation	Glencanisp biomass	Highland	Biomass	CES	01408 635102
Averon Leisure Centre	Averon Leisure Centre heat control	Highland	Biomass	CES	01408 635102
Averon Leisure Limited	Averon Leisure Centre, Alness modifications	Highland	Biomass	CES	01408 635102
Balloch Community Association	Balloch Community Association heat pump	Highland	ASHP	CES	01479 841859
Boat of Garten Community Hall	Boat of Garten Community Hall	Highland	GSHP	CES	01479 841859
British Waterways	Gairlochy Facility Block heat pump	Highland	Water source heat pump	CES	01397 708266
Castlehill Heritage Society	Castletown Heritage Centre biomass	Highland	biomass	CES	01408 635102
Columba 1400	Columba 1400 community centre heat pump	Highland	GSHP	CES	01397 708266
Cromarty Arts trust	Cromarty stables	Highland	GSHP	CES	01408 635102
Durness Village Hall comm	Durness Village hall GSHP	Highland	GSHP	CES	01408 635102
Duror & Kentallan Community Hall	Duror & Kentallan Community Hall pellet boiler	Highland	Biomass	CES	01397 708266
Eden Court Theatre	Eden Court Theatre solar	Highland	Solar	CES	01349 860125
Environmental Research Institute	Low Carbon Retrofitting	Highland	Solar	CES	01479 841859
Farr Community Hall Management Committee	Farr Community Hall heat pump and solar	Highland	ASHP	CES	01479 841859
Fountain Road Hall Development Group	Fountain Road Hall wood pellet	Highland	Biomass	CES	01408 635102

Glendale Hall	Glendale Hall sustainable heating GSHP and wind	Highland	GSHP	CES	01397 708266
Glenelg & Arnisdale Development Trust	Glenelg & Arnisdale Community Hall	Highland	GSHP	CES	01397 708266
Glengarry & District Community Centre	Glengarry Community Centre	Highland	Solar	CES	01397 708266
Glengarry Shinty Club	Glengarry Shinty Club Solar Water	Highland	solar	CES	01397 708266
Hilton Community Cafe	Hilton Community Cafe solar	Highland	Solar Water	CES	01349 860126
Historic Assynt	Assynt Old Parish Church centre restoration	Highland	GSHP	CES	01408 635102
Inverness College	College School of Construction	Highland	Solar water	CES	01349 860125
Isle of Eigg Heritage Trust	Isle of Eigg Pier Hydro	Highland	Hydro	CES	01397 708266
Isle of Eigg Heritage Trust	All-island electrification project	Highland	Wind	CES	01397 708266
Knoydart Forest Trust	Knoydart Forest Trust wood splicer	Highland	Biomas	CES	01397 708266
Knoydart Renewables	Knoydart hydro monitoring	Highland	Hydro	CES	01397 708266
Lairg Community Association	Lairg Community Centre	Highland	Solar (water/air)	CES	01408 635102
Lochaber College	Lochaber College biomass	Highland	Biomass	CES	01397 708266
Lochaber Mountain Rescue	Lochaber Mountain Rescue heat pump	Highland	GSHP	CES	01397 708266
Lochaber Yacht Club	Lochaber Yacht Club	Highland	Solar	CES	01397 708266
Lochalsh & Skye Housing Association	LSHA Homefarm, Portree	Highland	GSHP	CES	01397 708266
Lochalsh & Skye Housing Association	Coishletter housing, Edinbane solar	Highland	Solar	CES	01397 708266
Lochalsh & Skye Housing Association	LSHA disabled adaption programme	Highland	ASHP	CES	01397 708266
Lochalsh & Skye Housing Association	LSHA Bank Street, Plockton	Highland	Air recovery heat pumps	CES	01397 708266
Mey Village Hall trust	Mey Village Hall ground source HP	Highland	GSHP	CES	01408 635101
Milton Community wwodland Trust	Milton Community Logbuild	Highland	Solar	CES	01408 635102
North Sutherland Community Forest Trust	NSCFT Borgie log build	Highland	Biomass	CES	01408 635102
Ormlie Community Association	Ormlie Community Association solar	Highland	Solar	CES	01408 635102
Pentland Housing Association	Pentland Housing Ass, Janet St, Thurso	Highland	Solar	CES	01408 635102
Raasay Village Hall Association	Raasay Village Hall heat pump	Highland	GSHP	CES	01397 708266

Rosehall primrar school	Rosehall Primary School, Lairg	Highland	Wind	CES	01408 635102
Roy Bridge Old Schoolhouse	Roy Bridge School heat pump	Highland	GSHP	CES	01397 708266
Sabhal Mor Ostaig	SMO Biomas District heating	Highland	Biomass	CES	01397 708266
Scoraig teaching group	Scoraig teaching group	Highland	Solar	CES	01408 635102
Scottish School of Forestry	Scottish School of Forestry Balloch biomass	Highland	Biomass	CES	01349 860125
Scottish Youth Hostel Association	Torridon Youth Hostel	Highland	GSHP	CES	01408 635101
Scripture Union	Altnacriche Centre, Aviemore	Highland	GSHP	CES	01479 841859
Sleat Community Trust	Ardvasar Hall, Sleat, Isle of Skye	Highland	Solar	CES	01397 708266
Tarbat Community Hall group	Tarbat Carnegie Hall Portmahomack	Highland	GSHP	CES	01408 635102
The Highland Council	Holm Primary School Inverness	Highland	Solar	CES	01479 841859
The Highland Council	Grantown Grammer Leisure Centre	Highland	GSHP	CES	01479 841859
The Highland Council	Scoraig Primary School	Highland	Wind	CES	01408 635102
The Highland Council	Dingwall Primary School biomass	Highland	Biomass	CES	01408 635102
The Highland Council	St Clements Primary School	Highland	ASHP	CES	01408 635102
The Highland Council	Avoch Primary School	Highland	Biomass	CES	01408 635102
The Highland Council	Hilton of Cadboll Primary School	Highland	biomass	CES	01408 635102
Timespan Heritage Centre	Helmsdale Timespan woodchip	Highland	Biomass	CES	01408 635101
Tongue & Farr Sports Association	Bettyhill School biomass chip blower	Highland	Biomass	CES	01408 635102
Torridon & District com assoc	Torridon & District Village Hall	Highland	GSHP	CES	01408 635101
West End resident assoc	West End Hall Alness	Highland	GSHP	CES	01408 635102
Inverclyde Council	Inverclyde Prudential Code Schools	Inverclyde	Wind	The Wise Group	0141 552 0799
Midlothian Council	Vogrie Country Park Wood fired Heating	Midlothian	Biomass	Changeworks	0131 555 4010
North Middleton Village Hall Committee	Proposed New Village Hall, North Middleton	Midlothian	GSHP	Changeworks	0131 555 4010
Scottish Solar Energy Group	SSEG Green Machine - Demonstrating Solar Energy in Scotland	Midlothian	Solar Water	Changeworks	0131 555 4010
The Ashgrove Project	Cousland Equestrian Centre	Midlothian	GSHP	Changeworks	0131 555 4010

Findhorn Foundation	Findhorn Community Solar	Moray	Solar (Water/air)	CES	01479 841859
Moray Arts Centre	Moray Arts Heat Pump	Moray	GSHP	CES	01479 841859
Moray Council	St Thomas Primary School	Moray	Wind	CES	01479 841859
Moray Housing Partnership	Burghead and Garmouth ASHP Pilot	Moray	Multiple	SCARF	01224 213005
Moray Wastebusters	Moray Wastebusters solar	Moray	Solar Water	CES	01479 841859
Mortlach Mem	Mortlach Memorial Hall Solar	Moray	Solar Water	CES	01479 841859
Richmond Hall	Richmond Hall, Tomintoul	Moray	Solar Water	CES	01479 841859
North Ayrshire Council Education Services Department	Kilmory Primary School Wind Power Project	North Ayrshire	Solar Water	ESSAC South West	01292 521896
Scottish Sports Council Trust Company	Cumbrae Solar Project	North Ayrshire	Solar Water	ESSAC South West	01292 521896
Scottish Sports Council Trust Company	Inverclyde Solar Project	North Ayrshire	Solar Water	ESSAC South West	01292 521896
The Scottish Sports Council trust Company	Inverclyde National Sports Centre Wind Power Project	North Ayrshire	Wind	ESSAC South West	01292 521896
The Scottish Sports Council trust Company	Inverclyde National Sports Centre Wind Power Project	North Ayrshire	Wind	ESSAC South West	01292 521896
Central Scotland Forest Trust	Colizum House Biomass Project	North Lanarkshire	Biomass	The Wise Group	0141 552 0799
Central Scotland Forest Trust	Drumpellier Glasshouses Biomass Project	North Lanarkshire	Biomass	The Wise Group	0141 552 0799
Central Scotland Forest Trust	Taylor High School Biomass Project	North Lanarkshire	Biomass	The Wise Group	0141 552 0799
Central Scotland Forest Trust	Calderhead High School Biomass Project	North Lanarkshire	Biomass	The Wise Group	0141 552 0799
North Lanarkshire Council	Baird Memorial Primary School	North Lanarkshire	Wind	The Wise Group	0141 552 0799
Burray Community Association	Burray Community Centre Wind2heat	Orkney	Wind	CES	01595 830206
Eday Heritage Trust	Eday Heritage Centre	Orkney	Wind	CES	01595 830206
Eday partnership	Eday Gateway House heat pump	Orkney	GSHP	CES	01595 830206
Friends of North Hoy Kirk Trust	North Hoy Kirk Centre 6kw Eoltec turbine	Orkney	Wind	CES	01595 830206
HITRANS	Hitrans Solar Bus Shelter	Orkney	solar	CES	01595 830206
Holm Community Associatioon	Holm Hall Orkney Wind2heat	Orkney	Wind	CES	01595 830206
Kirkwall Squash Club	Kirkwall Squash Club Wind2heat	Orkney	Wind	CES	01595 830206

North Ronaldsay Heritage Trust	N Ronaldsay Interpretive Centre Wind2heat	Orkney	Wind	CES	01595 830206
Orkney Blide Trust	Orkney Blide Trust heat pump	Orkney	GSHP	CES	01595 830206
Orkney Housing Association	Orkney Housing Association solar ventilation	Orkney	Solar (water/air)	CES	01595 830206
Orkney Housing Association	OHA Great Western Road heat pumps	Orkney	GSHP	CES	01595 830206
Orkney Housing Association	OHA Wellington Road solar	Orkney	Solar	CES	01595 830206
Orkney Housing Association	OHA Lynn Road District Heating	Orkney	GSHP	CES	01595 830206
Orkney Islands Council	Orkney Islands Council school turbines	Orkney	Wind	CES	01595 830206
Orkney Islands Council	Dounby Care Centre	Orkney	GSHP	CES	01595 830206
Orkney Islands Council	Westray Care Centre	Orkney	GSHP	CES	01595 830206
Orkney Islands Council	Westray Care Centre Wind2heat	Orkney	Wind	CES	01595 830206
Papay Development Trust	Nouster Store Papay Wind2heat	Orkney	Wind	CES	01595 830206
Rousay Congregational Board	Rousay Congregational Board 6kw Wind2heat	Orkney	Wind	CES	01595 830206
South Ronaldsay & Burray Kirk Session	South Ronaldsay & Burray Kirk Session	Orkney	GSHP	CES	01595 830206
South Ronaldsay Kirk	South Rondaldsay Community Kirk refurbishment	Orkney	GSHP	CES	01595 830206
Stronsay Community Council	Stronsay fish market heat pump	Orkney	GSHP	CES	01595 830206
Westray Development Trust	Hofn Youth Centre wind turbine	Orkney	Wind	CES	01595 830206
Westray Development Trust	Orkney Biofuels ethanol project	Orkney	Biofuel	CES	01595 830206
Westray Development Trust	Wind Turbine Project	Orkney	Wind	CES	01595 830206
Westray Heritage Trust	Westray Heritage Centre extension	Orkney	GSHP	CES	01595 830206
Westray Kirk session	Westray Kirk Centre wind2heat	Orkney	Wind	CES	01595 830206
Auchtergaven and Moneydie Parish Church (Bankfoot)	Bankfoot Community Project	Perth and Kinross	GSHP	SCARF	01224 213005
Guildtown Community Association	Guildtown Community Association - Village Hall Capital Project	Perth and Kinross	Solar Water	SCARF	01224 213005
Guildtown Community Association	Community Sports - Wind Generator	Perth and Kinross	Wind	SCARF	01224 213005
Renfrewshire Council	St John Boscoe School	Renfrewshire	Wind	ESSAC South West	0141 552 0799

Berwickshire Housing Association	Todberry New Building Social Housing	Scottish Borders	Solar Air	Changeworks	0131 555 4010
Berwickshire Housing Association	Whitsome New Build Social Housing Project	Scottish Borders	Solar Water	Changeworks	0131 555 4010
Berwickshire Housing Association	Summerhill Park - Level 3 Green House	Scottish Borders	Wind	Changeworks	0131 555 4010
Eildon Housing Association	Eildon Housing Association - Solar air heating for Woodside Gardens	Scottish Borders	Solar Air	Changeworks	0131 555 4010
Lamancha & District Community Association	Creating the hub	Scottish Borders	Solar Water	Changeworks	0131 555 4010
Woodschool Ltd	Buy Design - Market Collective Biomass Project	Scottish Borders	Biomass	Changeworks	0131 555 4010
Burravoe Community Hall	Burravoe Wind to Heat	Shetland	Wind2heat	CES	01595 830206
Cullivoe Community Association	Cullivoe Community Hall Wind2heat	Shetland	Wind2heat	CES	01595 830206
Cunningsburgh Public Hall	Cunningsburgh Public Hall	Shetland	GSHP	CES	01595 830206
East Yell Public Hall Committee	East Yell Hall Wind2Heat	Shetland	Wind2heat	CES	01595 830206
Fetlar Community Hall	Fetlar Community Hall Wind2heat	Shetland	Wind2heat	CES	01595 830206
Fetlar Interpretive Centre	Fetlar Interpretive Centre	Shetland	Wind	CES	01595 830206
Foula Electricity Trust	Foula electricification scheme	Shetland	All island	CES	01595 830206
Livister Youth Centre	Whalsay Livster youth centre	Shetland	Wind2heat	CES	01595 830206
North Ness Public Hall Committee	North Ness Public Hall Committee Wind2Heat	Shetland	Wind	CES	01595 830206
North Ness Public Hall Committee	North Ness Hall Wind2Heat	Shetland	Wind	CES	01595 830206
North Roe Public Hall	North Roe Hall Wind2heat	Shetland	wind2heat	CES	01595 830206
Sandness Public Hall	Sandness Hall Wind2heat	Shetland	Wind2heat	CES	01595 830206
Sandwick Social Club Wind Turbine	Sandwick Social Club wind	Shetland	Wind	CES	01595 830206
Shetland Islands Council	Solargen Bus Stop	Shetland	Solar	CES	01595 830206
Shetland Islands Council	Skeld Primary wind turbine	Shetland	Wind	CES	01595 830206
Shetland Islands Council	Urafirth & Burravoe	Shetland	Wind	CES	01595 830206
Skerries Public Hall Committee	Skerries Hall Wind2heat	Shetland	Wind2heat	CES	01595 830206
South Nesting Hall Committee	South Nesting public hall Wind2heat	Shetland	Wind2heat	CES	01595 830206
St Olaf Community Club	St Olaf Community Club Ollaberry Wind2Heat	Shetland	Wind	CES	01595 830206

Sullom & Gunnister Public Halll	Sullom Gunnister Hall Wind2Heat	Shetland	Wind2heat	CES	01595 830206
Unst Heritage Centre	Unst Heritage Centre Wind2heat	Shetland	Wind2heat	CES	01595 830206
Walls Hall Wind2heat	Walls Hall Wind2Heat	Shetland	Wind2heat	CES	01595 830206
South Ayrshire Council	Heat Pump Pilot	South Ayrshire	Air source heat pump	ESSAC South West	01292 521896
New Lanark Conservation Trust	New Lanark Heat Pump	South Lanarkshire	GSHP	ESSAC South West	0141 552 0799
South Lanarkshire Council	Solar Court	South Lanarkshire	Solar Air	ESSAC South West	0141 552 0799
Talamh Life Centre	Talamh Life Centre Renewable Energy Project	South Lanarkshire	Hydro	ESSAC South West	0141 552 0799
Abernethy Trust	Abernethy Trust Wind Turbine	Stirling	Wind	The Wise Group	0141 552 0799
Gartmore House	Gartmore House Biomass Project	Stirling	Biomass	The Wise Group	0141 552 0799
Rural Stirling Housing Association	Crimmond and Tigh a Mhomaidh Cottages, Stonachlachar	Stirling	Multiple	The Wise Group	0141 552 0799
Stirling Council	Balfron High School	Stirling	Wind	The Wise Group	0141 552 0799

Pro Forma for a Renewable Energy Feasibility Study

Referred to in section 2.3

When applying for a consultant to bid for a renewable energy feasibility study, these are suggested requirements the community should include. They are not exhaustive.

Aims:	What the proposed project would hope to achieve
Scope:	What this study is to assess
Objectives:	Type of RES to be investigated, location, limitation, design, environmental impact, cost benefit (financial and CO^2), ownership, planning, community involvement and benefit.
Expected outputs:	Format of report including methodology used, persons consulted and documentation used, community meetings etc How many copies needed
Methodology:	Timeline and order of plans e.g. who to meet initially, who is to be consulted for what documentation and any field visits.
Time scale:	An idea of the start of study, the presentation of first draft report And the final report submission
Budget:	Type of group and an idea of the limits of funds at the disposal of the group
Attributes of consultants:	e.g. the consultant should have a good general understanding of renewable energy, an awareness of the Community issues involved and knowledge of the local area.

Renewable Obligation Certificates

Referred to in section sections 3.3.1; 3.9; 4.4.1 & 6.11

The Renewables Obligation legislation (since 2002) places requirements on electricity suppliers in the UK to source a percentage of their supply from renewable generation, and is currently the main subsidy for the development of renewables. The target percentage rises each year, and was 9.1% for the obligation period 2008-09 (April to March). The RO is the main support scheme for renewable electricity projects in the UK. A Renewables Obligation Certificate (ROC) is a 'green certificate' issued for eligible renewable electricity generated within the United Kingdom and supplied to customers in the United Kingdom by a licensed electricity supplier. ROCs are issued according to the following criteria

- The technology used at the generating station.
- The location of the generating station.
- The date that the station commissioned or received preliminary accreditation.
- The installed capacity of the generating station.
- The fuel mix used at the station.

Operators of generating stations can sell ROCs to licensed electricity suppliers, or to other intermediaries. These provide a valuable income stream for generators in addition to the sale of export electricity.

Suppliers can meet their annual obligation by two methods: (i) purchase ROCs from accredited renewable generators; and/ or (ii) pay the "Buyout Price" for any shortfall - the Buyout Price changes annually in line with RPI . Ofgem has stated the expected buy out price for 2009/2010 is £37.19 per MWh.

At the end of each 12-month obligation period the total Buyout Fund is "recycled" by OFGEM to suppliers, pro-rata, based on the number of ROCs presented – this gives a "Recycle Value" per ROC. The Recycle Value in 2007-08 was £18.65. This therefore incentivises suppliers to meet their targets by purchasing ROC's, as to meet their targets by only paying the Buyout price would result in their competitors in the supply market financially benefitting from such payments through the Recycle value.

The nominal out-turn value of a ROC is therefore the sum of the Buyout Price + Recycle Value. But ROCs are normally sold on a forward basis before the Recycle Value is published, so both the generator and purchaser have to estimate and take a risk on the out-turn value in order to agree the sale of ROCs. ROCs can be included as part of a Power Purchase Agreement (PPA) with a supplier, or traded separately, in a number of ways:

- Fixed price: the purchaser pays a fixed sum per ROC after receipt of ROCs from the generator, irrespective of the Recycle Value; this offers the generator certainty, with the purchaser taking the price risk.

- Processing arrangement: the purchaser pays a percentage (up to 100%) of the Buyout Price after receipt of ROCs from the generator, followed by a percentage of the Recycle Value (or the full Recycle Value less a fixed fee) when OFGEM publishes the recycle fund (typically in October); this may offer the generator more value, but there is a cash-flow impact due to waiting for the recycle payment, and also the uncertainty risk.

- ROC auctions.

Renewable generators must be accredited by OFGEM to receive ROCs (and also LECs and REGOs). The process can be started and completed before a generator is operational. The ROC register gives more information on this process and is available on Ofgem's website here www.renewablesandchp.ofgem.gov.uk/.

Small generators (< 50kW) can appoint an agent to manage ROCs on their behalf - output from multiple small generators can also be amalgamated to claim ROCs. A list of agents is available here on Ofgem's website:
http://www.ofgem.gov.uk/sustainability/environment/RenewablObl/Documents1/Renewables%20Obligation%20Agents_weblist.doc

OFGEM publishes separate guidance for generators above and below 50kW on its Environment pages - www.ofgem.gov.uk/Sustainability/Environment/

Until March 2009, one ROC has been issued for each MWh of eligible output. From April 2009 it is proposed that ROCs will be banded according to technology, in order to provide more support to emerging technologies. ROC banding in Scotland is currently proposed to be as follows:

Technology	**ROCs per MWh**
Landfill gas	0.25
Sewage gas; co-firing of regular biomass	0.5
On-shore wind; Hydro; co-firing of energy crops; Energy from Waste combined with CHP; co-firing of biomass combined with CHP; Geopressure	1
Off-shore wind; Dedicated biomass; co-firing of energy crops combined with CHP	1.5
Microgeneration (up to 50kW installed capacity); Advanced Conversion Technologies (including anaerobic digestion, gasification, pyrolysis); Solar photovoltaic; Geothermal; Energy crops (with or without CHP); dedicated biomass CHP; Tidal barrage or lagoon	2
Tidal (where not in receipt of Scottish government grant)	3
Wave (where not in receipt of government Scottish Government grant)	5

Electric Grid Connection

Referred to in section 6.10

Electricity Delivery System

The electricity system has historically been design to deliver electricity from large power stations to business and homes. The large bulk carrier is called Transmission and the lower voltage carrier called Distribution. These systems are monopolies and are regulated by the Office gas and electricity markets (OFGEM).

Transmission

Electricity transmission networks carry electricity from the large generators that are connected to the transmission, the distribution system or to some very large customers. They generally work from 400KV to 132KV in England and Wales. In Scotland it is from 400kV to 33kV.

The systems are operated by the System Operator (SO), National Grid Electricity Transmission (NGET) plc. Electricity transmission assets are owned and maintained by regional Transmission Owners (TOs) being NGET for England, Scottish Power Transmission Limited (SPTL) for southern Scotland, and Scottish Hydro-Electric Transmission Limited (SHETL) for northern Scotland.

Generators and consumers pay transmission charges. Consumers pay for transmission through their suppliers charges and generally account for about 5% of the electricity bill.

The System Operator and each Transmission Owner are subject to regular price controls. This means that once every five years Ofgem approves specific revenue for each company. This gives an incentive to each of NGET, SPTL & SHETL to improve efficiency and to keep transmission costs for electricity and gas customers low. In addition Ofgem agrees the policy of how generators and customers gain access to the system and this information is generally contained on the company's web site.

National grid: http://www.nationalgrid.com
Scottish Power (SPTL) http://www.spenergynetworks.net
Scottish and Southern (SHETL) http://www.ssepd.co.uk

Distribution

Electricity distribution networks carry electricity from the transmission systems (and from some generators that are connected to the distribution networks) to industrial, commercial and domestic users. They generally work from 132kV to 240V (England and Wales). In Scotland it is from 33KV to 240V.

There are 14 licensed distribution network operators (DNOs) in the UK each responsible for a distribution services area. There are also four independent network operators who own and run smaller networks embedded in the DNO networks.
Domestic and most commercial consumers buy their electricity from suppliers who pay the DNOs for transporting their customers' electricity along their networks. Suppliers pass on these costs to consumers. Distribution costs account for about 20% of electricity bills.

As in transmission, electricity distribution networks are monopolies because there is only one owner/operator for each area. Ofgem administers a price control regime that ensures that efficient distributors can earn a fair return after capital and operating costs whilst limiting the amounts that customers can be charged. Price controls are generally set for five year periods and the current price control runs from 1 April 2005 to 31 March 2010. In addition Ofgem agrees the policy of how customers and generators can apply and be granted connections to the distribution network these are published on their website. In Scotland are run by Scottish Power Power Systems http://www.scottishpower.com/EnergyNetworks.htm and Scottish Hydro Electric Power Distribution http://www.ssepd.co.uk/. Their websites charging statements, model agreements, connection methodologies, RPZ and commercial policy.The National Grid network gives a map showing boundaries of all the UK DNO's here http://www.nationalgrid.com/uk/Electricity/AboutElectricity/DistributionCompanies/.

Connections Process – Micro Generation

Small Scale embedded Generator

A Small Scale embedded generator is defined as a generator of less than 16A per phase (3.7kW). The Energy Network Association in conjunction with Distribution Network Operators, trade associations and suppliers, has produced Engineering Recommendation G83/1. The document assists customers, developers and installers to meet their legal obligations and to comply with international, national and industry standards. All installations of less than 16A per phase (3.7kW) must comply with Engineering Recommendations G83/1.

Where a customer wants to install a single generator of less than 16A/phase there is a legal obligation to inform the local DNO before or at the time of commissioning.

Where customers, developers or installers wish to install more than one unit either in a single installation or as part of the development an application must be made to the DNO in advance.

For generators in excess of 16A per phase (3.7KW), connection must comply with engineering Recommendation G59/1. In some instances generators in excess of 16A per phase (but less than 10KW for wind and 5KW for PV) a customer may request a connection to G83. The DNO will need to assess whether appropriate and impact on the low voltage system.

G59/1 and G83/1 are published by the Electricity Networks Association.

Off grid

If the planned system is entirely off grid/mains and is on entirely separate circuits there is no requirement to contact the DNO. However, all electrical and wiring regulations should be adhered to, the appropriate health and safety requirements are made and the circuits are appropriately marked.

Embedded within Buildings Electrical System

If the proposed generator is to be connected to the system after the DNO fuse or electricity system and there is no intention to export electricity onto the grid (with the appropriate technology in place to prevent this from happening) a connection agreement is not required. Again all work should be carried out to the necessary Health and Safety requirements and wiring regulations.

Connection Process Larger Generators

The first point of contact should be the local DNO. They will advise of current procedures and the likely hood of a connection.

Details of contacts are given in the DNO's web site.

The cost of connection

The cost of connection is based on the proximity of the proposed generator to the existing DNO network, the capacity of that network and the local electricity demand. If the proposed generator output exceeds the local demand requiring electricity to be exported or controlled, this can incur additional costs. DNOs are heavy regulated and are required to meet stringent standards on the quality of electricity supplied to our homes and businesses. The connection of a generator may require DNOs to add additional equipment to the system to manage the electrical supply in that area. This cost would be added on to the connection cost.

In some areas of the country electricity supply is single phase which can create a problem for generators to connect to. It can also create a problem for the larger heat pumps.

Indicative costs for connection components such as transformers and cable are contained on the DNO web sites. Connections quotes can be currently obtained free of charge by contacting the local DNO. Any quote for connection will contain information on contestable and non contestable work.

- *Non contestable* work is the work that must be carried out by the local DNO and is generally the work associated with the physical connection to the local distribution network.
- *Contestable work* is the part of the connection that takes the electricity from the generator to the proposed connection point. For example if the point of connection is 1 mile away the contestable element would include that 1 mile of overhead or underground cable. It is possible to get another contractor to do this work.

Securing your Connection

Obtaining a connection to the distribution system is competitive. If a quote for connection that is affordable and within a reasonable timeframe has been received, it is advisable to secure that connection and place in the connection queue. The DNO can supply information on the procedure for this. It may require the payment of a deposit within 30days so it is important to identify a source of the deposit prior deciding to secure a connection. The deposit can be 25% of the cost of the non contestable works.

As the result of the number of generators on the grid in some areas of Scotland such as Argyll, significant upgrades are required before any other connections are possible. Therefore a date when connection is possible is a significant number of years in the future and a result a deposit is not required. It is still worth having a place in the queue as projects further ahead may not go ahead and regulations and technology may change allowing more generators to connect.

Response from Scottish community organisation to a questionnaire for a revenue generating (wind) project – Pre -Construction

Referred to in section 6.14.4

1. What stage is your project at ?

Contract for supply and maintenance of a single wind turbine signed and financial due diligence underway for debt financing.

2. When did you start the project?

2005

3. What community consultation has been taken throughout the project ?

Two open community meetings, updates at Trust AGM's, newsletters.

4. Have the local community fed into a development plan relating to the income from the project and its investment in the community?

Westray Development Trust was set up in 1998 following a community conference held to address depopulation. This led to a community development plan which was updated after five years and is reviewed at AGM,s.

5. Has the local community been supportive?

Yes, there were no objections to the planning application.

6. How long did it take to get from initial idea to starting planning permission submission?

7. Did you encounter any difficulties while preparing planning submission? What were they?

No

8. Have you successfully gained planning permission? If so, when was this? Did you have any conditions on your planning consent?

See attached. We have since applied for a variation to cover the change of turbine supplier and dimentions and as the switchgear housing was not included in the original application. We expect approval this week and an additional condition requiring a decommissioning bond.

9. Have you successfully gained a grid connection? Did you find this process difficult?

Yes. The process was not difficult as it was realised that little capacity remained available and so an application was made early in the process to ensure we secured a connection. S&SE have been very supportive in continuing to make this available even though we have been unable to complete the connection which should have been made during 2006.

10. Have you successfully gained a turbine contract? Did you find this process difficult?

Contract signed January 2009. Discussions commenced with Vestas during 2005 but when we reached a position when detailed discussions could commence during 2006, the market for turbines had taken off and they were not prepared to supply single units to remote sites. The matter was only resolved with HICEC intervention bringing Enercon to Orkney during February 2008 and convincing them that a market existed for multiple units.

11. What are the terms of maintenance and service for your project?

Again, due to remoteness, Enercon will note provide their full EPK contract of provide an availability guarantee until there are 15-20 units in the area which would enable them to build their own maintenance team. Until this position is reached, we rely on engineers travelling from mainland Scotland under best efforts. Where air travel is used, we pick up the cost of this.

12. What form of project structure will you have for construction? Turnkey, Balance of plant?

Balance of plant

13. How much local involvement will there be in the construction?

None from the island, but the balance of plant contract will be let to a mainland Orkney B&CE contractor who will use an Orkney firm for the electrics.

14. Have you successfully gained finance for the projects? Did you find this process difficult?

HICEC introduced 2 potential financiers both of whom were keen to supply. The process is not difficult but the due diligence process is time consuming.

15. When do you expect your project to be operational?

July 2009

16. Are you still currently facing any hurdles ?

Trying to knit together the requirements of Triodos Bank, Charities Regulator and our grant funders the Big Lottery is time consuming but I think this can be put down to all parties being new to each other and the process.

17. Have you any recommendations for community groups about to set out to develop a revenue generating project?

Where debt financing may be required, seek advice at an early stage in the process from potential suppliers to tease out any requirements they may have – this could save time in the long term ad possible cost of rework, e.g.
For turbine projects, they may have:

- **specific requirements for anemometry**
- **approved consultants who may be available at lower cost rates than standard market rates**
- **approved PPA providers**
- **approved suppliers**

Also, find out their due diligence requirements early as this is a major exercise late in the project which could delay financial closure.

Where there is a shortage of in house skills, use industry professionals rather than hiring in generalists. It may cost in the short term but save in the long run.

Organisation and Planning table

Referred to in section 8.1

Project Type	Type of organisation	Key points
Awareness raising, initial consultations	Unincorporated association	Constitution required Inexpensive – no statutory requirements Individuals are liable for property and contracts Only appropriate where there are no / minimal assets or liabilities. Generally not appropriate for any projects involving financial transactions, assets or liabilities as individual members are liable.
Heat and power installations in buildings	Company limited by guarantee (e.g. Hall committee) Non-profit distributing Open membership required if public funding sought	Constitution required Registration with Companies House required Regulated by company law –formal procedures for AGM, accounts etc. Low start-up cost (< £1000) Member's liability limited (usually to £1) Directors are elected from membership (at AGM) Directors can be liable if they act out with their authority www.**companieshouse**.gov.uk
	Industrial and Provident Society (Cooperative)	May be appropriate for a group of individuals wishing to share common costs associated with installations in private houses. IPS can be established for the purpose of plant and equipment purchase, with members (shareholders) each contributing to cost. Any surplus remaining on completion re-distributed to members. Advice and assistance available from Cooperative Development Scotland www.cdsscotland.co.uk
Generate and sell energy for profit	Company Limited by Shares – usually wholly owned by non profit distributing company limited by guarantee	A trading or investment vehicle - a mechanism for taking forward a project whilst minimising risk to parent community organisation. Constitution required Registration with Companies House required Regulated by company law –formal procedures for AGM, accounts etc.
	Industrial and Provident Society (IPS) [also known as cooperatives]	Appropriate if sufficient people are willing to invest in a coop via a share issue Formal constitution required Registered with Financial Services Authority

		Raises funds via share issues to members One member/one vote, irrespective of scale of shareholding Can be profit distributing, or non-profit distributing.
	Community Interest Company (CIC)	Relatively new company form designed to allow private investment in projects that benefit a community, not just shareholders. May be appropriate when there is a potential source of private finance locally. Must pass a 'community interest test' Assets cannot be distributed to shareholders Profits must be dedicated to community purposes Must be registered with the Regulator of Community Interest Companies and Companies House www.**cicregulator**.gov.uk
	Joint Venture	General term for a range of ways in which two (or more) organisations agree to work together to achieve the same aims. May be in the form of - Legal agreement only; or - New company for a specific purpose with joint shareholdings May be appropriate where local landowner or developer is interested in joining with local community company To receive public grants majority community ownership may be required www.businesslink.gov.uk
	Limited Liability Partnership (LLP)	LLPs are a means of minimising liabilities for two or more organisations who wish to work together so are a form of joint venture They are more complex to establish and run, but may offer some tax advantages. See www.businesslink.gov.uk www.companieshouse.gov.uk
	Public Company Limited by Shares (PLC) Investment vehicle Profit distributing	May offer shares to the public generally through a share offer Stringent statutory compliance requirements – share offers are strictly regulated High establishment and administration costs
Benefit payments from nearby commercial wind farms	Company limited by Guarantee	As above – an open and transparent mechanism for distributing funds to agreed community projects
Investment in	Company limited by shares	Appropriate if parent organisation has funds it

nearby commercial wind farms	(as above)	can invest and developer is willing to allow investment
	Industrial and Provident Society (IPS) [also known as cooperatives]	Main model used to date is Energy4All's profit distributing model i.e. a mechanism for individuals in a community to invest and gain a private return. www.energy4all.co.uk www.cdsscotland.co.uk

Sources of grant funding

Referred to in section 9.1.1

Funding bodies are ever changing. The conditions of each fund listed below may change at any time.

Fund	Focus	Contact	Dates	Amount
Abbey Charitable Trust	Community education, training and regeneration	http://www.abbeynational.com/csgs/Satellite?cid=282596177748070&pagename=AboutAbbey%2FGSInformacion%2FPAAI_generic&c=GSInformacion	Ongoing	Within their partnership areas donations can range from £250 to a maximum of £20,000. Outside of these areas the maximum donation they consider is £2,500.
Ashden Awards for Sustainable Energy 2009	Promote the widespread use of local, sustainable energy	http://www.ashdenawards.org/	28 October 2008	First prize of £30,000 and a second prize of £15,000 in each category.
Awards For All	Projects that promote education, the environment and health in the local community	http://www.awardsforall.org.uk/	Ongoing	Between £300 and £10,000
Barclays Community Programme	Helping community groups to improve their local environment, environmental regeneration projects	http://www.investor.barclays.co.uk/results/2002results/annual_report/website/impact/csr13.html	Ongoing	Funding is available between £1,000 and £25,000 on a local or regional basis. Larger grants will also be considered for national projects, or for local projects that will benefit significant numbers of people, or that will have a substantial positive impact
Big Lottery Fund	Any organisations	http://www.diy.com/diy/jsp/bq/templates/content_lookup.jsp?content=/aboutbandq/social_responsibility_2007/&menu=aboutbandq	Ongoing	See webpage
B&Q Better Neighbour Grant Scheme	Schools, community groups and charitable organisations can apply to their local B&Q store for funding to support a local community project.	http://www.diy.com/diy/jsp/bq/templates/content_lookup.jsp?content=/aboutbandq/social_responsibility_2007/&menu=aboutbandq	Ongoing	Materials to the value of £50–£500 of B&Q goods
Charities Aid Foundation Venturesome	Fills the gap between grants and bank loans. Charities and social	http://www.cafonline.org/		Underwriting, unsecured loans or equity-type investments. £20,000 to £250,000

	enterprises. Bridging finance for capital projects, working capital to ease cash flow concerns and development capital for projects to help build income generation capacity.			
Carbon Trust's Applied Research Programme (UK)	Support the development and commercialisation of technology that will reduce CO_2	http://www.carbontrust.co.uk/technology/appliedresearch/	Opens Feb 2007	Up to £250,000
Climate Challenge Fund (Scotland)	The Climate Challenge Fund was set up by the Scottish Government in 2008 to help communities make a difference by significantly reducing carbon emissions. Applicants must be Scottish based and they must also be legally constituted, not-for-profit community groups.	http://www.infoscotland.com/gogreener/303.html	2008-2011	Up to £1,000,000
Coalfields Regeneration Trust	Dedicated to the social and economic regeneration of coalfield communities	http://www.coalfields-regen.org.uk/	Ongoing	Not indicated
Cobb Charity	Encourages cooperative values and supports a more sustainable environment with eco-friendly technologies and the promotion of education	http://www.energysavingtrust.org.uk/cym/Global-Data/Funding-Information/Cobb-Charity	Ongoing	Usually £750
Co-op Community Dividend	Voluntary, self-help, co-operative or not for profit groups who share the Co-op's values of self-help, social responsibility and caring for others, are eligible to apply	http://www.co-operative.co.uk/en/communityfund/	Ongoing	£100 to £5000
The Co-operative Fund	Renewable/sustainable construction for cooperative groups	http://www.co-operative.co.uk/en/fund/	Ongoing	£5,000 - £289,000
DIY Community Action Training and Grant programme	Action-based training and grant programme for tenant and community volunteers offering hands-on courses and inspiring communities to create better places to live, work and play	http://www.traffordhall.com/tenants.html	Ongoing	Those attending training can apply for up to £3,000

Eaga Partnership Charitable Trust	Relief of fuel poverty and the preservation and protection of health by the promotion of the efficient use of energy	http://www.eaga.com/charitable/charitable_trust.htm	Ongoing	No min or max
EDF Energy Green Energy Fund	Installation of and feasibility studies for small scale renewables: Non profit or charitable organisations and/or organisations involved in education and/or work at community level.	http://www.edfenergy.com/products-services/for-your-home/our-green-products/green-energy-fund.shtml	1st Dec & 1st June, yearly	Up to £5000 for feasibility Up to £30,000 capital
Esmée Fairbairn Foundation	Organisations which aim to improve the quality of life for people and communities in the UK	http://www.esmeefairbairn.org.uk	Ongoing	No limit
E.ON Source Fund	Community and NPOs looking to implement sustainable energy projects in their buildings	http://www.eon-uk.com/	3 times a year	Up to £30,000
The Garfield Weston Foundation	Wide range of environmental projects	http://www.garfieldweston.org/policy/ApplicationForm.pdf	Ongoing	No limit
Good Energy's 'Home Generation' scheme	The scheme provides a payment of 4.5p per kWh to small renewable generators for all the electricity which they generate. To join the scheme, generators must buy the rest of their electricity from Good Energy, and must install a simple meter to measure the total kWh generated.	http://www.good-energy.co.uk/home/33_generation.html	Ongoing	4.5p per kWh
Grassroots Scheme	Grants to support the work of small local voluntary organisations	Government	April 2008 till 2011	£80 million in small grants, £50 million endowments programme
Hanson Environmental Fund	Creation and improvement of public amenities;	http://www.hansonenvfund.org	Ongoing	grants between £250 and £4,000 for community amenities
The Henry Smith Charity (Small Grants Fund)	Community Groups. Small grants are given to organisations with an annual income of less than £150,000. Grants can be for one-off capital items such as equipment purchase; these grants must be used within six months of being awarded. Grants can also be	http://www.henrysmithcharity.org.uk	Any time of year	Grants of between £500 and £10,000 are awarded. – typically not for environmental projects or community centres

	towards one year's running costs.			
Innovation Competition	Businesses encouraged to bid for part of the Collaborative Research and Development fund to support innovation in key priority areas including materials for energy and low carbon technologies	http://www.berr.gov.uk/innovation/technologystrategyboard/index.html	Ongoing	£100 million
John Paul Getty Charitable Foundation	Aims to fund projects to alleviate poverty and misery in general and supports unpopular causes in particular	http://www.jpgettytrust.org.uk	Ongoing	Usually in the £5000–£15,000 range
The Kelly Family Charitable Trust	Helping local community projects that make a difference to the lives of people locally.	http://www.energysavingtrust.org.uk/business/Global-Data/Funding-Information/The-Kelly-Family-Charitable-Trust	Twice a year	£1000 to £5000.
Lankelly Chase Foundation	Supports community initiatives to meet local needs. The Foundation tends to concentrate upon smaller charities, many of whom will have only a local or regional remit.	http://www.lankellychase.org.uk	Ongoing	Minimum of £5000
Loan Action Scotland	Interest free loan to SMEs to improve energy efficiency	http://www.scotland.gov.uk/Publications/2007/03/30095557/9	Until March 08	Loans of £5000 to £100,000, cost savings must be >£1000 per annum
Low Carbon Buildings Programme – Phase 2	Microrenewables for schools, NPOs and public sector buildings	http://www.lowcarbonbuildingsphase2.org.uk/	To mid-2009	30 – 50% eligible costs up to £1 million
Lloyds TSB Foundation Grants Programme	Charities in Scotland focused on improving the quality of life of people living in Scotland	http://www.lloydstsbfoundations.org.uk/Pages/Welcome.aspx	Ongoing	Average in 2005: £6,639
The Nationwide Foundation	To achieve real and sustainable benefit to communities	http://www.nationwidefoundation.org.uk	Ongoing	Between £500 and £10,000
O2 Community Fund	Support local environmental, urban renewal and conservation projects.	http://www.itsyourcommunity.co.uk	Ongoing	Up to £1000
Pilkington Energy Efficiency Trust	Financial support for R&D projects which are designed to improve the knowledge or practice of EE in buildings. The Trust will consider funding or	http://www.pilkington.com/europe/uk+and+ireland/english/building+products/for+trade+customers/peet.htm	Yearly, 30 Sept & 31 March = deadlines	Check the website for updates

	co-funding projects from all sectors private, public NFP, individuals			
Polden-Puckham Charitable Foundation	Practical projects of a pioneering nature, and single-issue groups working to achieve a particular change. Amongst the initiatives they have supported are 'simpler living and reducing consumption' and 'energy conservation'	http://www.polden-puckham.org.uk/	Ongoing	£500 and £5,000 for one to three years
Rural Development Programme	Communities in rural Scotland to grow local economies, improve local facilities and conserve the environment	http://www.scotland.gov.uk/Topics/Rural/SRDP/LEADER	Ongoing	£6m in Highlands
Rural Initiatives Scotland	Grants available for setting up community schemes in rural areas in Scotland.	http://www.energysavingtrust.org.uk/Global-Data/Funding-Information/Rural-Initiatives-Scotland	Ongoing	£1000 maximum
Scottish Community Action Research Fund	SCARF gives community groups support to improve their skills and confidence to carry out their own research.	http://www.scdc.org.uk/scarf/	Check the website for updates.	£3,000 - £10,000
The Scottish Biomass Heat Scheme	The Scheme will provide grants for installation of biomass heating systems in small-medium scale enterprises (SMEs). The Scottish Government is also keen to encourage the development of district heating, and would particularly welcome applications for district heating demonstrators from private developers.	http://www.scotland.gov.uk/Topics/Business-Industry/Energy/19185/20805/BioSupport	Check the website for updates	£2 million from April 2009 to March 2011
Scottish Community Foundation	Projects that will benefit the community, improve life quality and life chances for the people of Scotland	http://www.scottishcf.org/	Any time	Small Grant (up to £1000). Main Grant (£5000)
Scottish Community & Householder Renewable Initiative	R&D projects in strategically important areas of science including Low Carbon Energy Technologies	http://www.energysavingtrust.org.uk/schri/ www.communityenergyscotland.org.uk	Till April 2009, replacement after	Technical: 100%, Capital: 50% Up to £100,000
ScottishPower Energy People	Invites not-for-profit organisations and groups	http://www.energypeopletrust.co.uk/i	Ongoing	Check website

Trust	that assist those in fuel poverty to apply for much-needed funds.	ndex.html		
ScottishPower Green Energy Trust	Installation and capital costs (not feasibility) for all renewable technologies for community groups and charities in the UK.	http://www.scottishpowergreentrust.co.uk/content/	Ongoing	Up to 50 per cent of project costs up to a maximum of £25,000. Typically £10,000
Social Change: Enterprise and Independence Programme	Allowing communities to become more sustainable (earning an income) Social enterprises	http://www.esmeefairbairn.org.uk/	None	This trust can supply funding for large projects
Switched on Communities	Up to £5,000 can be awarded to help schools progress through the Eco-Schools programme	http://www.eco-schools.org.uk/switched_on/index.htm	Next round on 1/9/07	£5,000
Social Economy Fund	UK: For access to loan finance to support the increasing working capital of charities, voluntary organisations, social enterprises and other social purpose bodies.	www.unity.uk.com	Ongoing	Tailored to needs of the customer
Tesco Charity Trust Community Awards	Local organisations whose core work supports children's welfare, children and adults with disabilities and elderly people.	http://www.cvsfife.org/funding/tesco.htm	Children: 31 Jan Elderly & Disabilities: 30 June	£1,500 - £5,000
The Tudor Trust	Supports projects that increase people's capacity to cope, build their confidence and vision and give them greater control over their future.	http://www.tudortrust.org.uk	Ongoing	From £1,000 to over £100,000
Trans-European Energy Network (UK)	Reduce energy isolation of the less-favoured and island regions of the EU. Interconnections with third countries. Facilitating the connection of RE resources and promoting interconnected networks	http://ec.europa.eu/dgs/energy	31st Aug 2008	check website
Unltd/Guardian Green Living Awards	Support a broad range of environmental projects run by social entrepreneurs across the UK, including people of all ages and from all backgrounds – individuals only	http://unltd.org.uk	Contact office	Between £500 and £5000
Volunteering Scotland Grant	The Volunteering Scotland Grant Scheme (VSGS) can	http://www.voluntaryactionfund.org.u	Any time of year	Larger grants up to £35,000. Small grants up to £5,000.

Scheme (VSGS)	provide grant for up to three years for projects that attract harder to reach volunteers	k/grant-schemes/vsgs		
The Wider Role Fund	The wider role fund was launched in 2000 to encourage housing associations to develop projects to help make life better for people in their communities.	http://www.communitiesscotland.gov.uk	Any time of year	Budget of £8 million in 2007
The Woodroffe Benton Foundation	Priorities include promotion of education and the conservation, preservation and improvement of public amenities and natural resources	http://www.wcva.org.uk/all/dsp_link.cfm?subcat=64&cat=25	Every December	Check website
Your Heritage	Funding to support Community Based Heritage Projects (UK). Projects should conserve and enhance the UK's diverse heritage or encourage communities to identify, look after and celebrate and enhance the UK's heritage.	http://www.hlf.org.uk/English/HowToApply/OurGrantGivingProgrammes/YourHeritage/	Check website	£5,000 - £50,000

Community Renewable Energy Toolkit
Annex 2 - Case Studies

Case Study 1: Hilton Community Cafe, Inverness – *Solar hot water*

Case study provided by CES

Information points

Renewable device	solar thermal panels, flat plate collector
Rated output	3.28 kW
Manufacturer	Grant Sahara (collectors), CombiSOL (control system)
Total cost of project	*£9180*
Relevant sections in toolkit	*3.1*

Project Overview and Nature of Group

The former manse located next to Hilton Parish Church, Inverness was re-developed by the Church committee into an outreach centre and community cafe. The main aim was to create a space which could be used by both church and other community groups in a building with meeting rooms and available office space. The manse was in reasonably good condition before the renovation work but suffered from lack of insulation, a poor heating system and had single glazed windows. As a part of the renovation and development work on the building the group decided to incorporate a Solar Hot Water (SHW) heating system into the building.

How it works

General information on how solar water heating work can be found in section 3.1.

This particular system comprises 4.68m^2 of Grant Sahara flat plate collectors (tilt angle 30^o and orientation SW) mounted "in roof" and works in conjunction with a gas condensing boiler, using a Grant CombiSOL control system. The combiSOL control allows un-vented secondary hot water from the plate collectors to be utilised at hot water outlets or diverted through, in this case, a gas condensing boiler. Using a manifold arrangement this allows optimum control of supplied hot water.

In summary – when the stored water temperature reaches more than 42^{o}C, the control diverts the water directly to a hot water tap without passing it through the gas boiler. This reduces the need for heating and in turn fossil fuel consumption. Below 42^{o}C, the control supplies water pre heated by the plate collectors to the cold inlet of the gas boiler increasing boiler efficiency.

Development and Planning Stages

In the first instance the group approached Community Energy Scotland (CES) to ask for general advice on renewable technologies which could be incorporated into their building.

Following on from a site visit it was decided that the group should commission a consultant to conduct a detailed options appraisal on the building, concentrating on renewable system and giving guide costs and designs for those technologies thought applicable. The study also addressed the overall energy efficiency of the building and gave guidance on how it could be improved. Assistance was given by CES at this stage to help draw up a tender brief and appoint a consultant. The costs of this stage were met by a grant from CES. Following on from this stage the group decided that SWH was a good option for them and a tender was produced for the design and installation of a system.

Issues and Learning Points

- Reliable data on system performance was difficult to gather and only manufacturer's data was available.
- Although this was only a very small installation it did prove time consuming to co-ordinate and deliver for the group.

Costs / Sources of funding

Breakdown of Works – Hilton Community Centre	**Cost**
Initial consultant report	£4,280
Solar package and installation	£4,900
Total Cost	£9,180

Funding Sources – Hilton Community Centre	**Amount**
SCHRI (CES)	£8,180
Community Contribution	£1,000
Total cost	£9,180

Actual performance

Total annual global irradiation at this site	858.84 kWh
Energy produced by collectors	1,692.43 kWh
Energy produced by collector loop	1,402.93 kWh

Community Contact

Anne Thomas
Drumsmittal Park
Inverness
IV2 4VA
01463 731303

Case Study 2: Dunbog Hall, Fife – *Solar hot water*

Case study provided by EST

Information points

Renewable Device	Solar Water Heating
Rated Output	2000 Kwh per annum
Manufacturer	Viessmann, Germany
Installers	Latent heat (Edinburgh)
Project Cost	£3,805.20
Relevant section in toolkit	*3.1*

Project Overview and Nature of Group

In 2003 the Dunbog Parish Hall Trust was set up to renovate their village hall in Fife. Use of the hall has since expanded and now accommodates an After School Club and also provides school lunches. The increased use of the hall by children created the need for improved hygiene which included keeping water continually heated to a suitable temperature. To further improve the hall, the Trust wanted to install a solar hot water system. Certain members of the Trust committee were aware of the existence of economical solar hot water systems and the relevant grants as a result of having domestic systems installed. The main aim of the project was to reduce the cost of heating hot water.

Development and Planning Stages

The SCHRI development officer was contacted to see if a grant might be available for the hall. The officer visited the hall and gave encouragement to investigate further. A simple flat plate/duel coil system was chosen, as this system was within the Trust's financial capacity. As the Trust has no permanent or employed staff, the system was also ideal in that it is simple to maintain. Tenders were invited from six installers, five of whom provided tenders. The Trust selected a system that combined high quality components with reasonable cost.

Issues and Learning Points

The application and installation went reasonably smoothly. As the system has only just been installed, the Trust will monitor its performance to see if it delivers the expected savings.

Cost / sources of funding

Total Cost of Project	£3,805
SCHRI funding	£2,155
Fife Council	£900

Project Contact

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Case Study 3: Sgoil na Coillie wood school, Salen, Argyll – *Photovoltaic*

Case study provided by CES

Information points

Renewable device	Solar - photovoltaic panels
Rated output	175W
Manufacturer	Solargen
Installer	A.A. Grant Electrical
Project Cost	£7,130
Relevant section in Toolkit	*3.2 & 5.3*

Project description and nature of group.

Acharacle Community Company is a non profit distributing organisation; who run a small wood school near Salen, Argyll. The wood school is used for local woodcraft activities for local schools and the wider community with weekend woodcraft courses also being run. The nature of these activities requires an ample amount of light. The wood school is situated in a rural forest setting and is off the mains grid. During the winter months the lack of sufficient lighting was impacting on and limiting the usage of the wood school. In both its construction and usage the emphasis is on sustainability within its environs. The building fabric is derived from locally felled and milled timber and was built by local tradesmen, using only hand tools. The group has a strong sustainable ethos and were unwilling to compromise this by using fossil fuel generators to supply energy.

Sgoil na Coillie wood school, Salen, Argyll

How it works

In this case, the two 175W solar PV panels are mounted on timber frame at an angle of around 75% to maximise available seasonal sunlight. Energy is trickle fed and stored in a battery which feeds eight 12V low-energy bulbs when required.

Development and planning stages

Familiarisation
Currently there are relatively few PV installations in Scotland, because of the high capital costs, fairly low energy outputs, and lack of funding sources for grid-connected installations. However, in special circumstances SCHRI funding can be granted for small (<500w only) off-grid applications such as the wood school. The maintenance and operational considerations for the wood school are low and when coupled with the other considerations solar PV seemed like the best energy solution.

Design
Initially a more complex design was proposed, involving a greater number of panels feeding into a battery, and then through an inverter to power a 240V AC lighting system. However on advice from the installers, a DC system was chosen, as it required less wiring and fewer panels, and was safer in this location. Also, considering the open semi-external nature of the wood school potential for contact with moisture all electrical equipment is IP rated and has RCD protection.

Planning
On consultation with the local planning authority, it was decided that the relatively small installation was considered '*de minimis',* and therefore did not require planning permission. The Forestry Commission requested that the frame for the panels, and cladding for the battery and control unit, should be made from timber to fit with the aesthetics of the area, and offered to provide wood for this purpose.

Tendering
Several solar installers were approached to design and install, however, only one positive response was secured. Primarily the lack of interest was due to distance. The Welsh company Solargen were appointed as designers.

Issues and learning points

- Location of manufacturers/installers - Although in this case a local electrician was employed to conduct some of the electrical work on the system, the solar panels were supplied by a company based in Wales. While there were few problems with the creation of the system, it is useful to bear in mind local companies are often more able and willing to quickly resolve any issues or aftercare requirements. In the case of solar PV, because there are relatively few suppliers of the technology, this may not always be possible.

- Changing aspect of projects - Initially, the wood school was completely surrounded by dense forestry and renewable generation was not feasible. However, when CEU (Community Energy Unit, predecessor to HICEC and now CES) were requested to re-appraise the site a large southerly facing corridor of newly felled timber meant that there was now solar resource available. It is worth periodically re-appraising resources and advancement of technologies.

Cost / sources of funding

Breakdown of work – Sgoil na Coillie	**Costs**
Electrical work	£1,999
PV equipment	£2,421
Ground works	£1,880
Commissioning	£630
Contingency	£200
Total	**£7,130**

Funding source – Scoil na Coillie	**Amount**
SCHRI	£5,251
Wood school contribution 'in kind' excavation, ground works and construction of the PV panel frame	£1,879
Total	**£7,130**

Project contact

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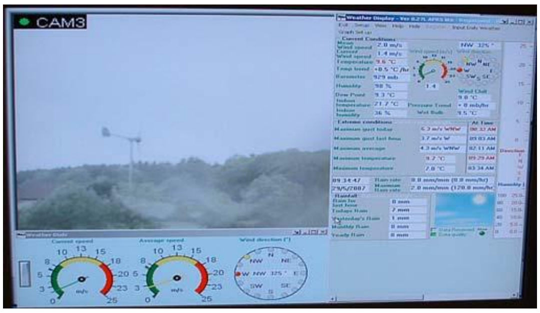
Case Study 4: Cults Primary School, Aberdeen – *Wind turbine*

Case Study provided by EST

Information points

Renewable Technology	Wind
Rated Output	6kW
Manufacturer	Iskra
SCHRI Contribution	£13,326
Relevant sections in toolkit	*3.3*



Project Overview and Nature of Group

Cults Primary is a school situated in a suburb of Aberdeen. The school through its hard work and commitment to green issues has already achieved green flag status with Eco-schools, as well as being a pilot school for WWF.

The project aimed to reduce reliance on fossil fuels, reduce CO2 production, raise awareness of renewable energy, and use the turbine as a valuable educational tool for the pupils of Cults and other schools and community groups within Aberdeen.

Development and Planning Stages

Cults Primary instigated the project and approached the Energy Management Unit of Aberdeen City Council to give them technical advice, apply for grant funding and manage the works. At this stage the school had no money to move the project forward. The Chief Executive of Aberdeen City Council, Douglas Paterson was impressed by the schools forward thinking and gave both financial and officer time to the project. In addition, the local community council and Parent Teacher Association both gave financial help.

Through the schools Eco Committee it was decided that the school wanted to install a renewable energy source. They decided on a wind turbine, as it was a clear and visible sign of the schools commitment to reducing CO2 emissions. Initial discussions with the local SCHRI officer were favourable and so the project began in earnest. After receiving quotes it was decide to go for the 5kW Iskra wind turbine. Although no formal public consultation was required, a letter was sent to the residents surrounding the proposed site to let them know exactly what was going on and invite them to comment.

Only two comments were received both regarding possible noise intrusion from the turbine. After supplying those concerned with the noise assessments from the manufacturer there were no further enquiries.

Tendering was by quotation to companies who supply and install small wind turbines. BRUMAC of Laurencekirk were successful and could supply and install the Iskra turbine. It is anticipated that the turbine will produce up to 13,100kWh of electricity per year reducing CO2 emissions by 5.5 tonnes. It was also important to have a display in school so the children can see at any moment what energy the turbine is producing both instantly and cumulatively. An additional feature of the display unit is to have a camera pointing at the turbine 24hrs a day.

Issues and Learning Points

The grant application was a straightforward affair, entailing nothing more than giving simple, readily available information that Aberdeen City Council and the turbine supplier could provide. The only problem encountered was that the application was processed in the winter months. The Christmas period is never a good time to carry out engineering and construction activities. As a result there was very little time before the end of the financial year to get works completed and grants claimed. Communication with the surrounding property owners that may be affected is paramount in order to manage expectations and answer any queries effectively.

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Case Study 5: Eriskay Hall, Eriskay – *Wind turbine*

Case study provided by CES

Information Points

Renewable device	Turbine, Wind2Heat, Grid connected
Rated output	6kW
Manufacturer	Proven Energy Ltd
Installer	West Coast Energi
Total cost of project	£55,272
Relevant sections in Toolkit	*3.3; 6.3 & 6.4*

Project Description and nature of group.

Eriskay Hall is a community facility which is used on a regular basis for social events, sports, meetings and the local nursery group. However, the activities facilitated by the hall were being hampered due lack of sufficient heating and the high costs of trying to maintain a comfortable environment. In order to tackle these issues the group decided to improve the insulation in the roof of the hall, ensuring that any heat generated was stored in the building, and also to install a 6kW turbine behind the hall to help power the storage heaters within the hall. Without the insulation the building would have remained hugely inefficient. The 6kW turbine was installed by a local Proven installer.

How it works

General information on how wind turbines work can be found in section 3.3.

This 6kW Proven turbine is grid connected which means that it works in conjunction with electricity drawn from the local electricity distribution network to provide power to the building. The system installed ensures that the building's electricity needs are met by electricity drawn from the turbine first, with any additional electrical demands drawing electricity from the grid. It was important to the group that as much of the energy as possible went into the building first before the excess was sold to the grid.

When the wind isn't blowing the community building just draws all electricity from the grid as normal.

Development and Planning stages

This project started with the group trying to pinpoint what they could do in order to lower their bills, make the building more sustainable and ensure the comfort of the community. The stages of carrying this project out included:

- Gaining consensus in the community to pursue a renewable/energy efficiency project
- Examining energy bills, usage, existing insulation

- Targeting different funding streams to get advice and support in carrying out a renewable project
- Securing funding
- Getting quotes for the different aspects of the work
- Choosing the quote with the best value for money for both insulation and turbine works
- Removing the existing roof and inserting insulation
- Replacing the roof with a new one which makes the building more efficient
- Ensuring the turbine installation was done by an accredited installer
- Ensuring the community knew what works have been done and how the systems work
- Monitoring the system regularly

Issues and learning points

One of the main learning points which the group took from this project was the difference which insulation can make to a building. The other issue they found was that accessing funding can take a long time in some instances and this is something the group needed to keep striving for. This is more often the case for funding which does not have any officers locally to provide assistance.

It is also advised that groups ask for a maintenance package from installers at the time of obtaining quotes which can then be included in the funding and ensure the system is managed for the first few years before the community take it on fully. The system should be maintained annually so as to get the most out of the technology.

Cost / sources of funding

Breakdown of Works – Eriskay Hall	**Cost**
Insulation materials & labour	£21,411
6kW turbine & installation costs	£31,061
Project management fees	£ 2,800
Total Cost	£55,272

Funding Sources – Eriskay Hall	**Amount**
SCHRI (CES)	£17,136
Comhairle nan Eilean Siar (CnES)	£17,136
Energy Saving Trust (EST)	£18,000
Community Contribution	£3,000
Total cost	£55,272

Community contact

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Case Study 6: Berneray Hall, North Uist – *Wind turbine*

Case study provided by CES

<u>Information Points</u>

Renewable device:	Turbine, Wind2Heat, Standalone
Rated output:	6kW
Manufacturer:	Proven Energy Ltd
Total cost of project:	£56,533
Cost of renewable elements:	£36,690
Relevant sections in Toolkit	*3.3; 6.3 & 6.4*

Berneray Community Hall and 6kW turbine

<u>Project Description and nature of group.</u>

Berneray Community Association is a constituted community group which runs Berneray Hall. The hall provides a much needed community facility for the residents of Berneray and is used on a regular basis for social functions, weddings, sports events, local meetings, ceilidhs, community dinners and parties.

Berneray Hall was built in 1985 and little insulation was installed initially. The Hall was originally heated by domestic sized storage heaters with a collective heat load of 5kW permanently (minimum demand) and a maximum demand of 23kW. The total electricity consumption of the hall was estimated at 15,000kWh/year. Many repairs to the hall were undertaken as a direct result of the cold and damp nature of the building.

Berneray Community Association felt that the hall would benefit from a direct heating system as it would protect the fabric of the building, help sustain a comfortable level of heating which would encourage use of the hall and increase the sustainability of the hall by reducing the energy costs. A 6kW Proven turbine was installed at the hall to provide heat to the building and the roof was insulated to reduce heat loss.

<u>How it works</u>

The turbine provides power to a storage heater system which ducts warm air into the toilets, hall and snooker room. When installed initially, the storage heater was not able to cope with all the power the turbine produced in high winds which caused the wind turbine to run off load. The storage heater was also dependent on a mains operated fan and therefore during power cuts the core quickly overheated. When the system was installed the thermostat failed to switch the fan on and all the elements burnt out. The total load was therefore increased by installing more storage heaters to the turbine to cope with extended periods of high winds.

This direct heating system stores the energy produced by the turbine for use when there is no wind and it is estimated that the system can store the energy for up to three days. The turbine and insulation have provided the community of Berneray with a more sustainable and comfortable venue for community events.

The Dimplex Industrial Storage heater has been fully configured to meet the requirements of the turbine using two thermostats. One acts as a failsafe and cut incoming power from the wind turbine should the absolute maximum temperature be reached within the core. The second switches the distribution fan on when 90% of the maximum temperature is reached. In addition, a programmer/timer has been set to distribute heat three times a day totalling seven hours operation in order that the hall is warmed during low wind periods.

A boost switch allows hall users to activate the fan for half an hour or more depending on their needs. Two 0.85kW storage heaters totalling 1.7kW and two 3kW ceramic heaters totalling 6kW have been installed to provide a back-up loading of 7.7kW should the main storage heater reach maximum core temperature. In the event of a power cut the turbine can supply energy to these storage heaters for twenty four hours or until power is restored. This protects the system in the event of a power cut when the fan would not be able to operate.

The system is now fully automatic with a manual boost available to distribute heat from the core out-with the timer settings or thermostatic fan operation at high wind velocity.

<u>Development stages</u>

Berneray Hall committee enlisted two enthusiastic members of their community to help them take forward the project as part of their renewables sub-group. The sub-group took the project through the following stages:

Planning

Berneray Hall committee estimated the energy usage in their hall and worked out what appliances used the most energy. They found that most of their energy use is for heating the hall and therefore the sub-group looked at how to reduce heat loss in the building by improving energy efficiency. It was decided that a turbine would be most appropriate renewable device to provide the hall with heat and that they would get the most value for money by insulating the roof of the hall.

The sub-group put in a planning application for a 6kW Proven turbine which they calculated would be an appropriate size to heat the building. At the same time they sought competitive quotes from installers in order to cost the project. Once full project costs were known, the group applied for funding for both the energy efficiency and renewables elements of the project.

While the turbine and insulation were being installed the group planned the cash flow for the project to ensure they could pay the invoices and claim the funding. The sub-group took a keen interest in the installation of the turbine in order to learn as much as they could about how the system worked. For the community's own contribution towards the project they dug the foundations and trench for the cable.

Monitoring and Evaluation

Once the turbine was running and producing heat the group monitored the system closely by taking readings of the total kilowatt-hours produced every week.

Issues and learning points

- Cash flow can be an issue for small community groups when installing expensive equipment. Deposits on turbines can often be for more than a group has in their bank and some funders will only pay out on claims with a receipt or receipted invoice. Think about the cash flow of the project early on, ask for staged payments to avoid one large invoice and make sure you understand the of process of claiming for each of the funding bodies of your project.
- Your voluntary time has a value towards your project. Keep a record of time spent on planning applications and paper work and get involved with the preparatory work if possible such as digging the foundations. This will all count towards your contribution to funding the project and your efforts will make the project more attractive to funders.
- If your project concerns an old building it is important to consider what you can do to improve energy efficiency before you look into renewables. Berneray Community

Association realised that if they did not improve the insulation in the hall a lot of the energy from the turbine would be lost and they would not get as much benefit from renewable energy.

- If installing a turbine you want to site the turbine in the best wind spot. When applying for planning permission the Berneray turbine had to be moved closer to the hall as when digging their preferred site they found it was of archaeological interest. To avoid delays to your project during the planning process choose the site carefully.
- The sub-group were very involved in design and installation of their turbine and the heating system. This ensured they got the most appropriate installation for their building needs and they are able to effectively manage the heating in the building. They regularly take a record of meter readings to ensure the system is running properly so any problems can be spotted and dealt with early.
- Ensure most of your group know how to use the system and that an appropriate manual which is easy to use is supplied by the installer. This is particularly important if the committee changes regularly.

Cost / sources of funding

Breakdown of Works – Berneray Hall	**Cost**
Insulation materials & labour	£19,843
6kW turbine & installation costs	£31,551
Contingency	£5,139
Total Cost	£56,533

Funding Sources – Berneray Hall	**Amount**
SCHRI (CES)	£21,462
Comhairle nan Eilean Siar (CnES)	£13,244
Energy Saving Trust (EST)	£9,827
Community Contribution	£2,000
Awards for All	£10,000
Total cost	£56,533

Actual performance

The turbine has been installed for around a year now and the electricity bill for the hall has reduced by almost £500 even though it has only been operating properly for about ¾ of the year. The hall is much warmer and more useable than before the installation of the turbine and insulation.

Project contact

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Case Study 7: Fountain Road Hall, Golspie – *Biomass: wood pellet*

Case study provided by CES

Fountain Road Hall

Wood pellet boiler

Information points

Renewable Device:	Biomass - wood pellet boiler
Rated Output	40kW
Manufacturer	Gilles
Installer	Highland Biomass Services
Total Cost of Project	£53,659
Relevant section in Toolkit	*3.4*

Project Description and nature of group

Fountain Road Hall is an old church building (c.1800s) in the middle of the East Sutherland coastal village of Golspie. It is now a focal point for many community activities in the village including Beavers, cubs, scouts, venture scouts, aerobic classes, badminton and other sporting activities as well as a meeting place. The large main hall has a suspended wooden floor, the walls are over 600mm thick stone with stained glass windows and the main hall has a high (c.8m) ceiling typical of old church buildings. There is a loft space running the entire length of the building which had no insulation in it with large vents (c.400mm diameter) from the main hall straight into the loft space. Space heating was provided solely by overhead electric heaters. Some of the ground surrounding the church is under different ownership.

Fountain Road Hall Development Group is a constituted voluntary group and is made up of volunteers who represent both the user groups and those involved in running the hall itself.

How it works

The Gilles 40kW pellet boiler burns wood pellets delivered via an automated auger from a pellet store located adjacent to the boiler room and underneath the body of the building in an old cellar/store area. The pellets are made of compressed sawdust from forest thinnings which are converted to pellets in a state of the art purpose built pellet mill in Aberdeenshire. Due to their low moisture content, between 8-10%, wood pellets have high useable energy content similar to high grade coal. This coupled with their small size and relatively high surface area means it is possible to transport large quantities long distances realising economies of scale. The pellets can either be blown into the fuel store via specialised blower lorries or due to the small amounts required at Fountain Road can be tipped in by hand from 15kg bags.

Programmable room thermostats are positioned in different zones in the building and can be programmed and controlled zone by zone on a weekly basis according to events and meetings planned. In addition the boiler has censors out-with the heating envelope and is able to cycle right the way through its range from 15kW up to its rated output of 40kW and still maintain over 90% efficiency. When a call for heat is made the control system determines whether for example 15kW or 35kW is required to bring that particular zone up to the desired temperature and only delivers the amount of heat necessary resulting in more efficient use of fuel.

Development and Planning stages

Familiarisation
The group requested advice and assistance on energy matters from CES. They viewed a number of local installations of under floor ground source heating and wood fuel. Energy analysts provided the group with heat loss calculations and a small grant was provided for the group to insulate the loft space in the church with 200mm of glass wool.

Decision
Through a process of elimination the group decided to install a wood pellet system with under floor heating. The heat pump had been discounted predominantly on the basis that there were ownership issues with the surrounding land and they also wanted a higher grade heat on demand sporadically rather than a lower temperature all the time. Woodchip was discounted on the basis of perceived higher amounts of maintenance required. Wind turbines and solar panels were ruled out due to sheltered location of the building.

Planning
The group employed a local architect who was familiar with sustainable building design practices to oversee the design and installation of the system. From three quotes obtained, Highland Biomass Services were chosen as they had experience in wood fuel systems and had impressed the group with their approach. No significant changes were to be made to the exterior of the building so planning permission was not required. However, due to the conversion of the cellar to a fuel store, the new concrete floor in the boiler room, a new heating system and a new steel flue penetrating the roof, a building warrant was required.

Because there was sufficient crawl space under the building, the floor did not need to be lifted and as the vast majority of the work was undertaken in what was the old cellar at one end of the building there was negligible disruption to the use of the building.

Issues and learning points

- Ensure the community group is actively engaged in the process - this group were very proactive in seeking assistance and asking questions regarding how heat is retained and lost, running costs and installation considerations.
- Building fabric – care is needed with old buildings and their internal fabric especially ones that haven't been heated before. Measures should be put in place such as moisture meters and slow heating to guard against damage to previously unheated fabric.
- Installer/community group liaison - The installer in this project was keen to involve a small number of the hall committee and "mentor" them through the development, installation and commissioning process. The result is that the group can effectively troubleshoot with relative ease. Wherever possible ensure that "mentoring" and demonstration to the user group is built into any final tender documents and that time is put aside and costed for this.

Comment from representative of the project group

Marion Sutherland a committee member who was a key figure in taking the project forwards said, *"We are absolutely delighted with our new wood pellet heating system. Everything from funding to commissioning has gone very smoothly and the hall has gone from being a fridge to a warm welcoming place to visit and undertake activities. We are delighted with the support from our advisors, installers and funders and especially the help we received from CED and Highlands and Islands Community energy Company, now operating as Community Energy Scotland. They offer an invaluable service to community groups like ours."*

Costs / Sources of Funding

Breakdown of work – Fountain Road Hall	**Costs**
Biomass boiler plant, Burner and automatic ignition system, Worm screws, Controls Flue, Internal heating system pipe work	£31,492
Internal fabric alterations including , fuel store and boiler room conversion	£11,742
Under floor heating system including all new pipe work, floor coverings, insulation, pressure testing, general heating and plumbing work	£7,864
VAT	£2,561
Total	**£53,659**

Funding Sources – Fountain Road Hall	**Amount**
HICEC/SCHRI	£27,163
Community Economic Development Programme	£19,541
Own resources	£6,956
Total	**£53,659**

The overall cost of the system including the under floor heating was £53,659.13 which equates to a cost of £1400 per kW installed. However if the cost of the under floor heating system (£7364) was removed i.e. there were already wet heat emitters in place the installed cost of the pellet boiler, controls and fuel store would be £1200 per kW installed. This reflects favourably with other renewable energy installations and shows that biomass systems especially need not be overly expensive.

Actual Performance

Performance has met in and in some cases exceeded expectations. Although a heat meter has been fitted to the system and now data loggers are installed there is insufficient data (in terms of a time series) to demonstrate exactly how the system is performing.

To date, 1 ton of wood pellets have been used in 5 months when the system was running continuously to dry out the building fabric. The cost of 1 ton of wood pellets is £160. At this stage it has been estimated the hall is unlikely to use more than 2 tons of wood pellets per year now the fabric has settled and therefore at present fuel costs, the group are expecting an annual maximum fuel bill of around £320.

The ash from 1 ton of pellets has proved to be minimal and filled a conventional dustbin to a depth of 2cm in the period June to beginning of November. The stated efficiency of the system is just over 90% and early indications from the amount of ash and the amount of fuel used would tend to validate that.

Project Contacts

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Case Study 8: Lochaber College, Fort William – *Biomass: wood chip*

Case study provided by CES

<u>Information points</u>

Renewable Device	Biomass – woodchip boiler
Rated Output	110kW
Manufacturer	Fröling
Installers	Highland Wood Energy
Total cost of project	£150,779
Relevant section in Toolkit	*3.4.2*

<u>Project description and nature of the group</u>

Lochaber College has charitable status and is also a company limited by guarantee. It was built in 1996 and is a modern, extremely well used building. Both centrally located and highly visible in the An Aird area of Fort William, it is an outreach campus for Inverness College and an integral part of the UHI network. It has a high user base with vocational and non-vocational students attending throughout the day and evening. In addition, it provides rented office accommodation for local businesses and agencies. The building also hosts frequent courses and meetings for local businesses, organisations and agencies.

When the building was extended in 2006, the College carried out a feasibility study into the viability and appropriateness of a wood chip heating system for the existing building and new extension. Following this, Lochaber College decided to install wood fuel boiler system to contribute towards the heating and hot water requirement for the whole campus.

The project entailed the installation of an 110kW Fröling boiler complete with a 1800litre buffer tank, a $25m^3$ fuel storage area and a Mus-max fuel blower. To accommodate this equipment a bespoke energy centre building was also constructed.

<u>How it works</u>

The system is a 'bolt on' system which is accommodated in a three chambered energy centre building adjacent to the main college building. There are existing oil boilers linked to the system which work to backup the biomass boiler when heat demand is high.

Fuel delivery & storage

Wood chip can be delivered from a tipping vehicle or trailer into a Mus-max fuel blower (this is a high speed auger and powerful blower fan). Chip blown through a delivery tube is centrally deposited over the swept area of the spring agitators. As the spring agitators revolve, chip is swept into the auger (which looks very like an Archimedes screw). When the boiler is required to produce heat, the auger turns and delivers chip to the burning head of the boiler. The quantity of chip delivered into the combustion chamber directly relates to the amount of heat being called for by the college building.

System interface and distribution

Space heating is via radiators in the existing building and under floor heating pipe work in the newer extension. Primary heated water from the wood fuel system is delivered to the college's existing system through insulated underground flow and return pipes. Operational sequencing gives priority to the biomass boiler and hence is the first stage of heating to the building. The oil fired boilers are only activated at times when the biomass boiler cannot meet the total heating demand of the college. Sequence controls monitor the main system flow & return temperature and determine the number of boilers, i.e. wood fuel and/or oil required to keep the system operating at the desired water temperature of 80^{o}C flow and 70^{o}C return.

Development and Planning stages

Familiarisation

The first stage in the project development involved appointing team of stakeholders who examined the pros and cons of wood fuel systems. Familiarisation and capacity was increased when Lochaber College staff and project managers visited two operating wood fuel systems in Lochgilphead, Argyll. Early conversations were also held with a local wood fuel supplier, Woodtherm Fuels.

In order that budget costs and early designs could be determined, the project team requested a feasibility study from Harley Haddow, the appointed engineers for the mechanical service design of the new college extension. The study cost £8450.00 and an SCHRI grant to finance this was secured.

Design considerations

Both the mechanical and architectural designs for the system and energy centre building were appraised for costs, wood fuel reception/delivery and system component suitability.

One of the primary considerations was wood fuel delivery. The normal practice locally was to deliver fuel by mechanically lifting m^3 bags of fuel above a hopper and dropping fuel in through an aperture on the bottom of the bag. This was deemed to be unsafe and a barrier to other suppliers supplying wood fuel due to the expensive specialised lifting equipment required. The potential to build an underground storage silo was examined but ruled out because of the high water table. Therefore a Mus-max trough and blower delivery system was chosen, see below. This allowed tipped delivery for potential future/new suppliers, whilst allowing the existing supplier to supply using his existing bag delivery system.

Mus-max trough and blower unit

Tendering

Following the feasibility and design stages, Lochaber College decided to progress with the project. A tendering process was undertaken and the on-site builders (Uist Builders) quoted for the construction of the energy centre. Three installers were invited to tender for the wood fuel installation. Highland Wood Energy, a local company were chosen as the preferred installers of the wood fuel system and Uist builders were chosen to build the energy centre.

Issues and Learning points

- Client fully understands the operational issues and specialised fuel and delivery requirements associated with wood fuel. This mitigates the risk of system failure and ensures the system is suited to its environment and fit for purpose.

Comment from representative of project group

The system operator and college campus steward operates the system has said: "*It works really, really well and I would recommend this system for any other buildings of this type, and its saving us lots of money"* (Phillip Clift Nov 08).

Costs/sources of funding

Breakdown of work – Lochaber college	Costs
Biomass boiler costs	£29,083
MUS-MAX woodchip blower unit	£10,250
Installation and commission -	£5,429
Extended warranty (3 years) -	£6,000
Biomass fuel store, heating pipe work, pumps and pressurisation equipment, electrical wiring and controls, ventilation	£18,738
Fuel and equipment store	£22,800
Biomass plant room	£22,800
Contractors fees (boiler specialist cost)	£16,975
Contractors fees (Heating sub contractor cost)	£3,720
Contractors fees (Builders work cost)	£14,985
Total costs for biomass installation	**£150,779**

Funding sources – Lochaber college	Amount
Lochaber Enterprise	£30,155
Lochaber College original heating allocation	£10,000
Lochaber College bank finance	£20,177
SCHRI	£90,467
Total costs	**£150,779**

It is not unusual for projects of this scale to incur increases in cost; however this project came in on budget with no contingency fees or increased costs.

Actual Performance

The system has been operational since November 2006 and in that time has had only two days down time due to wet fuel. To avoid as much oil use as possible, the system operates at full capacity.

Ultimately, the Mus-max was chosen as the preferred delivery mechanism and although it is a noisy, slow delivery, it is effective. In the two years since commissioning of the system, delivery is now made by blown chip delivery. Again this is specialised, however, the Mus-max remains in situ to enable other potential suppliers to deliver.

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Case Study 9: Coach House Trust, Balmore – *Biomass: wood chip*

Case Study Supplied by EST

Information points

Renewable Device	Biomass boiler – Wood chip
Rated Output	60kW
Manufacturer	VETO
Installer	Highland Wood Energy
Project Cost	£18,612
Relevant section in toolkit	*3.4.2*

Project Overview and Nature of Group

The Coach House Trust (CHT) is a registered Scottish charity and was set up in 1998. The Trust has become a recognised major innovative organization in the field of mental health and environmental and social justice. CHT provides occupational, educational and employment opportunities and seeks to help individuals discover their talents through offering a wide range of workshops.

Balmore industrial estate houses three of workshops, CHT wanted to install a biomass heating system to heat these three units. The three main aims were:

- generate energy in the form of heat from a renewable source
- to reduce our energy/heating costs
- to reduce environmental impacts by using carbon neutral materials
- to promote the use of renewable energy through education and demonstrations

CHT has also taken on the management of a short rotation coppice site planted twelve years ago, products from which will be used for fuelling the boiler.

Development and Planning Stages

CHT decided to look at its energy use in order to reduce its environmental impact and at the same time reduce their energy bills. After looking into various options it was decided that a biomass heating system would be the most suitable. The Trust contacted their local SCHRI development officer through the Energy Efficiency Advice Centre. After consulting with the development officer, CHT got three competitive quotes from accredited biomass installers. The Trust decided to go with Highland Wood Energy who proved to be most competitive and helpful company contacted. After consultation with Highland Wood Energy, it was decide to go with a 60kW Veto stoker boiler. In addition to the SCHRI grant, CHT used £8406 of Waste Management Innovation Fund (WMIF) monies along with £1800 of CHT's monies as match funding

Issues and Learning Points

The Trust would recommend that any group wishing to install a biomass heating system looks into the availability of wood chip. CHT has learned there are sources of wood chip available but have been informed that this can be unreliable. The Trust is in a fortunate position to be able to supply its own chips and is now looking into becoming a supplier to other installed systems to improve the reliability of using biomass heating systems.

The installation went well and was carried out in two days with a further day for commissioning. The installation will provide approximately 123557 kwh/yr of heat which will achieve carbon reductions per year of approximately 23475.83kg CO_2 based on current use of natural gas fired warm air blowers.

Cost / sources of funding

The total cost of the project was £18,612

Funding Sources –	**Amount**
Waste Management Innovation Fund	£8,406
Coach House Trust	£1,800
SCHRI	£8,406
Total	**£18,612**

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Case Study 10: Castlehill Heritage Centre, Castletown – *Biomass: logs*

Case study provided by CES

Information points

Renewable device	Biomass log boiler
Rated Output	48kW
Manufacturer	Baxi
Project Cost	£16,687
Relevant section in Toolkit	*3.4.3*

Log boiler, Castlehill Heritage centre, Castletown

Project Description and nature of group

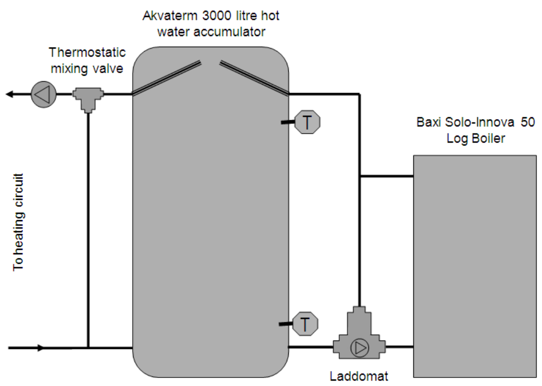
The Castlehill Heritage Centre is located within renovated farm buildings immediately adjacent to the cutting yard and quarry of the old Caithness flagstone workings in the parish of Olrig, Caithness on the very north Coast of Scotland. The building now serves as an operational centre for the Castletown Heritage Society, Dunnet Forest Trust and North Highland Wood Turners Association.

Castlehill Heritage Society is a community heritage group in Caithness specialising in local heritage, archaeology and archive material from the North Coast. They are an open membership group who secured a long term lease for an old byre at Castlehill for which they have raised significant funding to renovate and provide a modern and well equipped archive and visitor centre. The group is made up of volunteers. Legally it is a constituted voluntary group with charitable objects dedicated to preserve the character, history and traditions of the village of Castletown and the Parish of Olrig.

How it works

The Baxi 48kW Solo-Innova 50 Log Boiler, burns wood fuel in the form of logs providing heat to a 3000 litre Akvaterm accumulator tank. The accumulator tank is a large body of water which acts as a heat store for the heating system. Once the accumulator tank reaches the required temperature the boiler can be shut down and the heat stored inside the accumulator is then used to provide domestic hot water and heating for the buildings under floor heating system.

The system is controlled by a Laddomat 21 tank charging unit which enables the boiler to rapidly achieve its operating temperature. When the temperature in the accumulator tank drops below a critical level, logs are loaded into the boiler to have another 'burn' to charge up the accumulator. The flexibility of this accumulator system allows the group to fire the boiler only once every few days depending on the weather conditions and usage of the building.



General layout of Log boiler

The under floor heating system uses the heat capacity in the floor as another heat store. Pipes circulating hot water are laid in a sand screed on top of insulation to prevent heat loss to the sub floor foundations. Caithness Flagstones are laid on top of this for the floor surface. The under floor heating system is zoned into four areas allowing independent control of heat requirements in different areas of the building.

The fuel logs are sourced from Dunnet Forest, a local community run woodland. They must not exceed 500mm in length. The Dunnet Forest Trust, which manages the woodland, operates a wood fuel enterprise providing seasoned fire wood from their plantation forest. Due to the local nature of the fuel source, the group are able to minimise transport costs and carbon fuel miles while actively supporting another local community group enterprise.

Development and planning stages

Familiarisation

Castletown Heritage Society secured the bare shell of the old farm buildings in 2004. The group made a very early decision that every effort should be made to adopt a sustainable approach to the development and operation of Castlehill Heritage Centre. In doing so they wanted to maximise use of renewable energy sources available to them. They were keen to ensure that their heating system had a low carbon footprint and low running costs. They commissioned a local consultant who researched different renewable heating technologies including ground source heating, photovoltaic cells, wind generation and solar thermal systems. The group decided that an accumulator tank, under floor heating and good insulation were essential baseline features for their system.

Decision

The group first explored the option of using a ground source heat pump for their primary heating source. However the installation of horizontal sub-surface heat collection loops was not possible due to minimal soil cover and a rocky layer in the land surrounding the building. The alternative vertical bore holes for heat collection was discounted due to higher installation costs.

The group then looked at wind energy but decided that this would be unreliable as a sole source of heat. This lead the group to consider biomass which they felt could be implemented quickly and seemed to be more suited to their budget. After looking at both wood chip and wood pellet options the group settled for a log burning system which they felt was a well proven technology and offered them the degree of automation they wanted. It also gave them the opportunity to enter into a symbiotic and socio-economic supply arrangement for fuel with the local community forest trust.

Planning

The group were keen to base the design for the system on a proven configuration with tried and tested components. They set about sourcing an experienced wood fuel system supplier/designer using the internet as a research tool and speaking to other groups including those that had been assisted by CES/HICEC about their experiences. The group were keen to find someone who would work with them to develop their requirements, design the system, supply the components and support the group to undertake the installation themselves. After extensive research the group chose Peter De La Haye Engineering who they felt had a good reputation in the industry.

<u>Issues and learning points</u>

This system has become the sole heating system in Castlehill inspirational community run and managed Heritage Centre in Castletown, Caithness.

- Decision making process - The group were keen to take control of the project from the very start and make use of the skills and resources locally available to them.
- Community Contribution and Capacity Building - The group used the skills of the members of the group and surrounding community for this project. This enabled the project to be locally managed and controlled whilst saving costs on the installation element by using local volunteers with engineering and other relative skills.

- Fit for purpose - The group gave due consideration to the heating requirements for the building, what type of heat they would need, most suitable distribution system for their usage, how often the building would be used and what controls they needed.
- Using tried and tested technology - The group steered away from novel ideas and wanted something that was reliable and proven to provide a consistent heat source. They comprehensively researched the suitability of those suitable technologies along with any likely running costs.
- Looking to the future - The group specified that the accumulator tank was fitted with a solar heating coil to enable the future addition of a solar thermal system to contribute to domestic hot water.

Comment from representative of a project group

Neil Buchan of CHC said, "*The system was ordered by the group in March 2008. 11 weeks later the log boiler system and associated components were installed and commissioned, 1 week under the estimated time. The actual installation took the group only 7 weeks. The help and support offered by HICEC, now Community Energy Scotland, was invaluable and knowing we had their backing we could just get on with the nuts and bolts of making the system work*."

Cost / sources of funding

Breakdown of work – Castlehill Heritage Centre	**Costs**
Design and Commissioning , delivery, installation.	£4,867.50
Baxi Log Boiler , Accumulator Tank, Plumbing items, energy meter and other associated components	£10,302.65
Contingency	£1,517.02
Total	**£16,687.17**

Funding sources – Castlehill Heritage Centre	**Amount**
SCHRI	£7,459.28
Highland Council Landward Caithness Discretionary Fund	£5,835.87
Lochaber College bank finance	£20,177
Castletown Heritage Centre own contribution	£3,392.02
Total costs	**£16,687.17**

Actual performance

The boiler system has been 100 % reliable since installation. In the first 27 weeks of use the system used 8.5m^3 timber (approx £250) and produced 8443kWh of heat energy to the building. Over the same time period the system consumed 306kWh of electricity to power the boiler control system, three circulating pumps and under floor control panel at a cost of £40. The system requires firing every 2-3 days in the summer/autumn and once per day during winter.

The group plan to enhance data logging capacity of the system to actively monitor performance through the introduction of an interactive, monitoring and display system (IDMS). The group hope to include environmental monitoring of external conditions such as wind, temperature and solar incidence along with the addition of heat meters on the domestic hot water and heating circuits.

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Case Study 11: Shawbost Old School, Lewis – *Ground source heat pumps & Wind turbine*

Case study provided by CES

Information points

Renewable device	Ground Source Heat Pump & Wind Turbines
Rated output	heat pump 58kW, each turbine 6kW
Manufacturer	Thermia (heat pump), Proven (turbines)
Project costs	£123,004 (heat pump only)
Relevant sections in Toolkit	*3.3, 3.5, 6.3 & 6.4*

Project Description and nature of group.

Shawbost Old School on the west coast of Lewis was converted from an old primary school into a multi-purpose community centre incorporating a range of community and commercial benefits to the resident population. A professional design team was commissioned to carry out a feasibility study for the project and this was taken on by a local architect. Incorporated into the plan were renewable energy options, including a heat pump and two 6kW turbines.

The borehole ground source heat pump was installed first with under floor heating being powered by the heat pump. Two Thermia Robust 28 heat pumps were chosen and 12 x 125mm x 75m boreholes were drilled. The heat pump was designed to provide 100% of the space heating and the domestic hot water requirements. Although there are two heat pumps, one is more or less a back up to the first one. Two 6kW wind turbines were installed at a later date to offset the electricity used by the heat pump.

How it works

An explanation of how heat pumps operate is in the main body of this document, section 3.5.

Development and planning stages

This project, due to its complication and size, took a number of years in the development stages. The steps taken included:

- Hiring an architect to look at getting the best design, utilising sustainable energy design and renewable energy
- Comparing other systems to ensure the best one for the group
- Looking into the funding available for each aspect of the project
- Getting contractors on board to give costs and facilitate the build
- Looking forward to the idea that the two turbines would be installed in the future to offset the electricity used for the heat pump
- Ensuring the building was up to building standards
- Getting the boreholes drilled, the job being contracted to Raeburn drilling

- Ensuring that, where possible, any follow up maintenance would be done by local contractors.
- Connecting the borehole pipes to the heat pump
- Guaranteeing a designated space for the heat pumps was designed into the build and this was kept safely in a locked storage room.
- Gaining information regarding the workings of the pumps.

Issues and learning points

- Understanding/specifying requirements - With hindsight, the group feel that installing only one heat pump would have met most of their needs and resulted in an easier and cheaper system. It is essential to try and get a number of quotes and to compare the sizes which are stated in the quotes.
- Energy Efficiency - The group insulated the building to current building standards prior to installation resulting in the heat pump working efficiently and reducing running costs.
- Installer/community group liaison - With any new technology it can take a while to get used to the system, it is important that the heat pump supplier and installer conducts a training handover with the community groups and leaves a user-friendly manual.

Cost / sources of funding

Breakdown of Work – Shawbost old school	**Cost**
Drilling boreholes and associated works	£45,363
Installation of under floor and associated works	£27,380
Provision of heat pump, 7001 hot water tank and associated works	£33,390
Additional fees for architects and consultants	£8,775
Contingency	£8,096
Total Cost – Renewable element only	£123,004

Funding Sources – Shawbost old school	**Amount**
ERDF	£200,494
Comhairle nan Eilean Siar (CnES)	£97,266
Community Fund	£350,000
SCHRI	£66,798
Western Isles Enterprise	£70,973
Community contribution	£28,736
Total cost of entire build (renewables included)	£814,267

Project Contact

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Case study 12: Barra learning centre, Barra – *Air source heat pump*

Case study provided by CES

Information points

Renewable Device	Air Source Heat Pump
Rated output	8.1kW
Manufacturer	Thermia Diplomat 8 heat pump with Thermia Aer 3 handling unit
Project Costs	£22,621
Relevant section in Toolkit	*3.5*

Air source heat pump, Barra learning centre

Project Description and nature of group.

Lews Castle College's (LCC) Learning Centre in Barra provides further and higher education to the communities of Barra and Vatersay. It is a valuable asset to the population in Barra and enables people to study on the island. This brand new building was erected in 2005 and incorporated into the build was an air source heat pump to provide heating for the under floor system. This Air Source Heat Pump system (ASHP) was the first of its kind to be installed by a community in the Western Isles.

How it works

As described in section 3.5, a heat pump works to move heat from an outside source through a heat exchange system and provides heat to a building. In the Barra Learning centre the heat pump is attached to one of the external walls. Air source heat pumps work best in locations that do not have very low temperatures and Barra with its maritime climate has a relatively low annual temperature range with very few below freezing days.

Further info on air source heat pumps is available;
http://www.energysavingtrust.org.uk/Generate-your-own-energy/Types-of-renewables/Air-source-heat-pumps

The Coefficient of Performance (COP) was calculated by the manufacturer to be around 3.8 with an outside temperature of +7^{o}C. The heat pump provides all of the space heating (16,000kWh) and the domestic hot water requirements of the centre. With a COP of 3.8, the annual input required to power the heat pump will be an average of 4,450kWh electricity which is provided by the mains grid through a green tariff. It is important for groups to remember that electricity is needed to power this system.

Development and planning stages

The ASHP was designed as part of the building, making it easier to fit than if it was being included retrospectively. The project development stages included:

- Contacting funding bodies for advise on developing a renewable energy project
- Estimating the projected energy loading of the building
- Deciding on the ASHP unit, taking into account the type of heating, and the needs of the building and its users.
- Obtaining three quotes from installers to install the ASHP
- Ensuring that the funding package was in place and approved for the system before the quote was accepted
- Approval date – 30/08/04
- Contacting the installer to enable them to install the unit, while working with the other contractors doing the remainder of the build
- Installing monitoring equipment
- Claiming grant for the different stages of the project by showing invoices and bank statements which prove that the work has been paid and the grant can then be released.
- Project completed – 16/03/05

Issues and learning points

- The COP quoted above by the manufacturer is deemed very high with ASHP's usually quoted at having a COP of between 2 and 3. Groups should always enquire as to the accuracy of these claims to ensure they are getting an accurate representation of the system.
- Connectivity to existing equipment – in this project there was no actuators fitted on the manifolds and so there was nothing to connect the room thermostats to the heat pump. This is something that must be put in to allow the group to have control of the system. The group needed an electrician in to ensure a connection from the thermostats to the zones the heat pump controls.
- Record keeping - Groups should keep copies of the under floor zones in a safe place where people can access it easily.

Quote from the community

"The heat pumps have proved to be the right choice for our Community Centre despite some initial teething problems. They provide a steady heat at all times so the building doesn't have to put up with temperature variations throughout the day. Although adjustments do not take effect as quickly as you would want this is rarely a problem. We have not had the huge increase in fuel bills faced by those using oil to provide their heating. Through support from Community Energy Scotland we have recently had our heating system settings reviewed and been provided with more user friendly operating instructions. One of the issues faced when we installed the system was the lack of local expertise however this is now changing. The most important factor regarding hea tpumps is that they are set up correctly to provide the most efficient heat distribution within your building as incorrect settings can greatly increase your electricity use. If your community group is considering installing heat pumps it is worth visiting other centres to see what they have done. Community Energy Scotland will be able to signpost you in the right direction for the expert advice you need."
Irene Donnelly

Cost / sources of funding

Breakdown of Works – Barra learning centre	**Cost**
Electrical	£1,310
Installation of underfloor and associated works	£6,555
Provision of heat pump, 1051 hot water tank, air handling unit and associated works	£12,156
Additional plumbing for heat pump	£2,600
Total Cost	£22,621

Funding Sources – Barra learning centre	**Amount**
ERDF	£119,000
Comhairle nan Eilean Siar (CnES)	£70,000
LCC's own funding (Further Education Funding Council	£111,000
Scottish Communities and Householders Renewable Initiative	£15,621
Total cost of entire build (renewables included)	£315,621

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Case Study 13: Glenshellach District Heating System, Oban – District heating scheme – *Biomass: wood chip*

Case study provided by CES

Information points

Renewable device	District heating scheme, biomass woodchip boiler
Rated output	650kW
Manufacturer	Danstoker
Main Installer	Vital Energi
Project Cost	£635,000
Relevant section in Toolkit	*3.4 & all section 4*

Glenshellach district heating scheme

Project Description and Nature of group

Glenshellach District Heating Scheme serves a new social housing development (Glenshellach Housing Phases 2 and 3) which comprises 89 domestic properties. These are villas, semi-detached two-storey houses and flats (four-in-a-block type). All the homes include energy efficiency measures and sustainable features such as local timber and sun porches. Properties are placed within the site to maximise solar gain. They are heated by a single 650kW woodchip boiler.

Oban is a west coast ferry port and tourist centre with a population of 8,500. The town has a high rainfall (over 1,400mm per annum), restricted hours of sunshine and an average temperature range of between 1-17^{o}C. Argyll has a high level of forest cover and wood production. Oban has a history of housing pressure and suffered from a shortage of land for housing and industrial development due to topographic planning and ownership issues. Highlands and Islands Enterprise opened up a new area close to the town by the provision of a spine road through a previously undeveloped glen. Glenshellach (the glen of the willows) is now the site for a district general hospital, industrial units and parcels of land have been sold for social and speculative private housing developments.

Glenshellach has challenging ground condition issues including rock, peat and drainage. The valley sides are steep. Temperature inversion and long periods of shadow affect ambient temperatures, especially in winter.

Home styles and areas of shadow, with sun porches for solar gain in Glenshellach

West Highland Housing Association is a registered Scottish charity. The Association has an enviable record as a local responsive social housing provider. It now has a total of 759 letting properties. The Association's main aim is **" To provide high quality, well maintained, affordable housing, to meet local needs and to assist in supporting fragile communities within our area."** Glenshellach Housing Development (phases 2 and 3) provided WHHA with the opportunity to increase its stock of quality new-built homes on a completely undeveloped site. The Association wanted their new development to address fuel poverty - widespread amongst householders in older properties in Oban.

In deciding how these homes were to be heated, WHHA had to consider the options. Parts of Oban are served by an independent isolated town gas network supplied by road tankers delivering liquefied natural gas (LNG) to a gasification plant in the town. This network does not extend to Glenshellach.

Electric storage heating has been costly and problematic for some other properties and independent oil boilers for each property would require numerous tanks. Some tenants could have found budgeting for oil deliveries problematic. Solid fuel was inefficient and not ideal for prospective tenants of all abilities.

How it works

A district heating scheme like Glenshellach has three main characteristics.

- a single central boiler which heats water to a high temperature
- a district heating ring main pipe, which carries the hot water pumped from a central boiler house and runs round all the properties, then returns the cooler water to the boiler-house to be heated again
- individual properties which draw the heat they need from the ring main via small heat exchangers

Because of the nature of the Oban site where a substantial number of homes are clustered together, a district heating system was an option for this development.

At Glenshellach, a hopper of woodchips feeds a woodchip boiler in a boiler-house close to the homes. Pumps circulate the water into two separate ring main loops (east and west). Each property has a heat exchanger, which takes heat from the ring main and transfers it for use in the home. Hot water from the system heats under floor pipes in the ground floor and radiators in the upper floor of each property and also domestic hot water tanks.

Tenants buy heat by using a smart card and a heat meter. The card can be topped-up by a payment at the local petrol station (like a mobile phone card or electricity card). The card is inserted in the domestic meter which allows heat to flow to the limit of the credit purchased. A motorised valve closes down the heat supply when credit is exhausted.

Development and planning

Familiarisation
This was West Highland Housing Association's first district heating scheme. The Board and officers of the association had to be confident that the technology proposed would meet their requirements of an effective heating system which provided their tenants with affordable warmth. Officers visited other wood fuel installations including the Whitegates District Heating Scheme and other wood boilers including simple VETO boilers and the Talbott wood boiler at IKEA's furniture store in Braehead, Glasgow.

Decision
The difficulties of other fuels and the overall ethos of the development drove the desire to use locally available wood fuel. Other elements within the new build (such as maximising solar gain, local timber cladding and high levels of insulation) would be mirrored by a heating system using renewable energy. The availability of grant funding and support was important. In addition, the increasing competition for Communities Scotland funds based on innovation and sustainability were important factors.

Planning

The various building professionals involved in design, project management and construction needed to gain suitable knowledge for this innovative scheme. New suppliers for the elements therein were also required. As a new build scheme on an area released and zoned for housing, there were no major issues as regards planning consents. Low emissions from the boiler had to be guaranteed because the boiler house and low chimney is located within the cluster of homes.

Glenshellach DHS, Boiler House
Note blue fuel store and oil tank for back-up boiler (to right of boiler house)
The wood fuel boiler is in operation in this photograph, without visible emissions.

Phase 3 Homes are visible, above the level of the boiler house

Funding

The overall unit cost of the homes was high. This was due to many factors, such as site and location and the district heating system. This reflected the quality of the homes and their high environmental credentials. Housing Associations were require to raise funds for capital projects from government and non-government sources. Whilst the 'cost per unit' exceeded norms set by Communities Scotland, additional support was forthcoming.

Issues and learning points

The implementation of this district heating scheme met a number of set-backs.

- Boiler Manufacturer / Installer / Operator - The initial choice of these service providers was frustrated by insolvency and business problems. These were overcome and there are now great advantages due to the fact that a single business is responsible for design, build and operation, including remote surveillance. This avoids issues of argument or blame as regards performance. Open-book accounting now operates between the operator of the system and the housing association.
- Boiler size - A large boiler (650kW), suitable for the planned load from 90 (actually 89) homes (phase 2 and 3) had to be purchased and installed to serve phase 2 alone, even although funding to build the houses in phase 3 was not yet secured. The operation of the boiler for the lower load was problematic. Even with all 89 homes

connected, the energy efficiency of the properties means that heat sales are low. This is a benefit to tenants, however, the system would work better, and earn more, if more heat was sold. Spare capacity in the boiler remains, and a hot water feed to the hospital is now being investigated (500 metres distant).

- Woodfuel Supply Chain - The initial suppliers of woodfuel provided an inferior product and had reliability of supply issues. The variability of quality was a problem for the boiler technology. Wet fuel increased smoke, oiling and steam production, which was inefficient and required expensive remedial work. The boiler is now supplied by quality drier woodchip from the Isle of Mull, which is delivered as a return load from the island by a building materials lorry. The woodfuel store is not ideal for this type of delivery.
- Tenants' Top-Up Cards, Systems and Education - Card and card readers and a shop trading for long hours each day close-by where payment cards can be topped up are all essential if tenants are to buy heat easily and use the system. This system avoids tenants running up debt as small amounts of heat can be bought. Tenants also require a visit to show how the system works. Whilst not complex, the Domestic Control Module and conventional water and heating time-clocks must be operated correctly to maximise tenant benefit.

Glenshellach DHS, Individual house Set-up
Note Domestic Credit Module (DCM) with Smart card inserted
A conventional time clock controls space heating and water

<u>Quote from the Community</u>

Work commenced in June 2004 and was completed in February 2007. Throughout the project, West Highland Housing Association has been chaired by Kenneth MacColl. Mr MacColl comments that Glenshellach homes have been a great success with tenants, and meet the Association's requirements to provide quality accommodation and affordable warmth. In the WHHA 2007/8 annual report a home is pictured with a tenant and the quote *"I am absolutely thrilled with my new home, it is fantastic and I couldn't wish for more for myself and my family." Happy New Tenant - Rhuvaal Road, Oban.* This comment relates to the whole package – the design of the house as well as its heating system. The low cost of heat is an attractive element of this. In November 2008, the cost of heat pre-purchased by top up card by the tenant was increased from 4.4p per kWh of heat to 6.5p per kWh. There are no standing charges or peak-rate tariff.

Costs / Sources of Funding

This project was a new-build housing development on a Greenfield site. West Highland Housing Association needed to acquire the land and propose a project which addressed housing needs. It also needed to attract funding from private sector and government sources (Communities Scotland). Communities Scotland concerns included the high cost per home, due to the site and the additional cost of a District heating System – over the cost of individual boilers or electric heating was a factor which required justification.

Establishing the overall cost of the system, or the marginal cost of a gas or oil district heating system over a more ‘conventional’ system, or a biomass district heating system is problematic. A cost - benefit analysis model is helpful.

Fuel / System	Installation Costs	Negative Attributes	Positive attributes
Electric Storage in homes	A - Lowest -	Highest running costs, poorer sustainability. More fuel poverty exposure	Traditional technology
LPG / oil boilers in homes	B - Slightly Higher	Lots of tanks, high tenant costs, inflexible charging regimes, poor sustainability	Traditional Technology
LPG / oil District Heating	C - Higher (ring main)	High cost fuel, volatile price, poor sustainability, innovation risk	
Woodfuel District Heating	D - Higher (wood boiler and backup)	Innovation risk	Local fuel and jobs Sustainable affordable warmth

For West Highland Housing Association, this model was applied to other elements within the new build. For example, aluminium gutters and downpipes were fitted at extra cost, however, these do not require to be painted, do not rust like steel or iron pipes, and unlike plastic pipes are not susceptible to recreational damage or deterioration by sunlight. The higher capital cost for this fully recyclable material is outweighed by the whole life-cycle cost benefit analysis. The availability of capital grants – where additional investment has the effect of reducing future revenue expenditure is also an attraction for some registered social landlords.

In saying this, the contract value for the installation of the heating system at Glenshellach paid to the main installer, Vital Energi, was £635,000. This equates to £7,140 per dwelling. WHHA had additional management costs and professional fees costs relating to the overall design. Additional costs relating to the underfloor pipe systems in the ground floor properties could also be added, although this method of heat emission could equally have been required by other heating solutions.

The overall costs of the build, including site purchase, site preparation and the erection of the dwellings was funded from Communities Scotland, West Highland Housing Association's own resources and commercial bank lending, the Dunfermline Building Society and grant from Fresh Futures (Lottery) and the Scottish Community and Householders Initiative.

Actual Performance

Initial performance was problematic, due to the issues above, principally, the supply of wet and inconsistent fuel and the low load on the boiler caused by the phased development. The system is fitted with a back-up oil boiler which was used extensively and during a repair period when the wood boiler tubes were attended to.

Since a reliable supply of drier woodchips has been sourced, operation has improved, however, the boiler would work better with a greater constant load, and the suggested extension to serve the hospital would improve efficiency, increase output and revenue.

Case Study 14: The Creed Waste Management Facility, Isle of Lewis – *Anaerobic digestion*

Information points

Renewable device	Anaerobic Digestion
Relevant section in Toolkit	*4.4.2*

Project Description and nature of group.

The Creed Anaerobic Digestor Plant on the Isle of Lewis is owned and run by Comhairle nan Eilean Siar (Western Isles Council), providing a integrated waste management facility for the islands chain. Work was awarded in early July 05 for the integrated facility based in the Creed Business Park on the outskirts of Stornoway. A further development in Uist at Market Stance was also advanced to provide Waste Transfer facilities for the Uists and Barra.

The two integrated waste management facilities act as the hub for the Council's municipal waste management service delivery, allowing it to not only to meet but exceed the challenging targets for recycling and landfill diversion that have been set by the Scottish Executive. It also ensures that the Western Isles is able to play its part in helping Scotland meet the requirements of the European Landfill Directive.

At present the Integrated Waste Management Facility processes waste from the northern isles (Lewis & Harris) and the southern isles (the Uists, Benbecula & Barra) as follows:

- Organic waste from both the northern isles and the southern isles;
- Residual (or black bag) waste from the northern isles only. Residual waste from the southern isles is sent to landfill directly because of the limitations imposed by the in-vessel composter issues.

How it works

Residual waste is mechanically screened, firstly to separate out metals for recycling, but primarily to produce an organic-rich fraction. This is then treated in a series of HotRot composting vessels to produce a low-grade soil conditioner for use in landfill restoration. Both the AD and the In-Vessel composting system are fully compliant with the animal by-products regulations.

The main waste treatment facility was the first plant in the UK to incorporate anaerobic digestion of source-separated biowaste (food, paper and garden waste) on a commercial scale. The Linde dry-digestion technology lies at the heart of the process. The biogas produced is used to generate up to substantial electrical power annually for export to the local network, whilst the solid digestate is matured to produce high-quality compost for local use. The facility also houses the recycling of glass and baling of plastics and crushing of cans.

Additionally, there is an in-vessel aerobic composting process on site which reduces and stabilises some of the residual waste prior to being used as a lower grade soil improver product in landfill restoration. The plant currently employs twelve people directly and a number indirectly. It also hosts the CNES Waste Aware team.

The biogas powered CHP unit will provide electrical power and heat for the whole facility yielding a net surplus of electricity. A complementary Hydrogen Project, H2SEED, will sit alongside this utilising the space capacity and provide the initial infrastructure for the Hydrogen developments. There are also possibly three wind turbines to be co-located at Creed, the power from which could also be utilised to generate Hydrogen. The biogas engine has been recently commissioned and the electrical energy produced is metered to benefit not only from unit sale of electricity but also the Renewable Obligation Certificates (ROCs) value of the energy produced.

Performance data indicated that electrical energy produced by the bio-gas engine over the period November 07 to April 08 was 23,909kWh and the heat energy was 35,863kWh. Of this electrical energy 11,240kWh was exported to the grid and the remaining 12,669kWh was consumed internally. Over the same six month period the energy imported from the grid was 258,420kWh making the total energy consumed 271,089kWh.

Development stages

In March 2005, following competitive tender, Earth Tech were awarded the contract by Comhairle nan Eilean Siar (CnES) to design and build two integrated waste management facilities.

The commissioning of the Integrated Waste Management Facility began in October 2006 (approximately). As part of this process the biogas engine was commissioned on May 23rd 2007. There is an ongoing programme of public education to promote source segregation of organic material and to maximise organic material recovery. As a consequence the anaerobic digester is not operating at its potential and certainly not at full (design) capacity as yet.

Issues and learning points

Since the facility opened, significant technical difficulties with the in-vessel composters have prevented their effective use. Indeed, since December 2007 this equipment has been taken out of commission pending resolution of the technical issues. During periods when the in-vessel composters have not been operational the residual waste stream has been diverted to landfill directly without undergoing processing.

Actual performance

The total quantity of waste handled at the Integrated Waste Management Facility is:

- Organic stream – 3281 tonnes between Jan-Dec 2007. 740 tonnes for quarter 1 of 2008.
- Residual stream – 6675 tonnes between Jan-Dec 2007. 1636 tonnes for quarter 1 of 2008. [Note: this does not include the southern isle residual waste.]

Organic Stream
January - December 2007 - 1501 tonnes of the organic stream was rejected as oversize and sent to landfill. The remaining 1780 tonnes (a calculated quantity rather than a measured quantity) was input to the anaerobic digester.
January - March 2008 - 398 tonnes was rejected and landfilled. The remaining 342 tonnes was input to the anaerobic digester.

The anaerobic digester produced 616 tonnes of dry digestate between March and December 2007 - the amount of dry solids was too low for input to the dewatering plant in January & February 2007. In the first quarter of 2008, 221 tonnes were produced. The amount of liquid digestate is not recorded. At present, liquid digestate is sent to drain although small quantities are diverted, occasionally, as input to the anaerobic digester to improve the liquid content.

Residual Stream
January - December 2007 - 2248 tonnes of processed material was rejected as oversize and sent to landfill together with 2693 tonnes of unprocessed material sent directly to landfill. Thus a total of 4941 tonnes of residual waste was landfilled. 1767 tonnes of processed material was input to the in-vessel composters.

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Case Study 15: Nunton Steadings, Benbecula – *Wind turbine*

Case study provided by CES

Information points

Renewable device:	Turbine
Rated output:	6kW
Manufacturer:	Proven Energy Ltd
Installer	Element Engineering
Total cost of project:	£32,353
Cost of renewable elements:	£26,942
Relevant sections in Toolkit	*3.3, 5.3, & 6.4*

Nunton Steadings, Benbecula

Project Description and nature of group.

Uist Building Preservation Trust (UBPT) was set up in order to purchase and restore Nunton Steadings, a listed 18^{th} Century farm Steadings in Benbecula. During the renovation as much of the original materials as possible were used in the restoration. Electric storage heaters with a total of capacity 35kW were installed as they were thought to be the most appropriate method of heating whilst maintaining integrity. The building is difficult to heat due to lack of insulation and therefore UBPT decided to install a wind turbine to provide more heat without increasing the energy costs.

An energy audit of the building was carried out and recommendations of basic energy efficiency measures such as extra insulation and draft proofing were implemented. The wind turbine/heating configuration was assessed and priced by Element Engineering. It was realised that the turbine would not fully cover the heating demand but could provide a significant saving and a degree of background heat.

How it works

The 6kW system is an off-grid direct heating system which connects the turbine to three heaters on a separate circuit. The original storage heaters are still connected to the mains. A separate inverter/battery bank (UPS) was installed to act as backup in case of grid outage.

Development and planning stages

Uist Building Preservation Trust rented Nunton Steadings to another community group, the Southern Isles Amenity Trust (SIAT), which started the project on their behalf.

Planning
SIAT calculated the energy use of the building from previous bills in order to make their case for funding a turbine. They then contacted the crofter that has the lease of the land behind the building to ask for the use of the site for the turbine and started the process to get a servitude for that piece of land.

SIAT wanted to ensure that the local community were happy with the project before proceeding and visited all the houses in the township to provide them with details on the turbine before submitting the planning application. The feedback from the township was favourable and the funding and planning applications were submitted.

Delivery
By the time Element Engineering installed the turbine Nunton Steadings had a new tenant who watched over the installation to ensure they understood the system and learnt as much as possible about it. The tenants were then able to give feedback to the installer on its performance.

Issues and learning points

- Consultation - It is very important to take neighbours into consideration when planning the project. Ensure they have the correct information on the project such as the manufacturer's details on height and noise and that they are kept up to date with the project. This can help you find the most appropriate location for the turbine for all parties and gain community support for the project.
- Energy efficiency - If your project concerns an old building it is important to consider what you can do to improve energy efficiency before you look into renewables. Berneray Community Association realised that if they did not improve the insulation in the hall a lot of the energy from the turbine would be lost and they would not get as much benefit from renewable energy.
- Changing needs - As Nunton Steadings is rented out by UBPT the use of the building can vary as can the needs of the tenants. The turbine system at Nunton Steadings was designed to provide power during power-cuts to fit the needs of tenants at that time. The inverters and batteries installed to provide this service, reduce the efficiency of the system and therefore less heat is produced. The building is still very

cold and therefore the system is going to be redesigned to improve the efficiency and improve the heating. When working with the installer on the design of the system ensure that the long-term use of the building is taken into account.
- Listed buildings - Nunton Steadings required special planning consent in order to make alterations to the building. This can prohibit energy efficiency works such as installing insulation. Nunton Steadings was built as a farm Steadings to house animals and it is therefore the building is not as fitting to its modern day use as offices and a community hall. Ensure any insulation installed is appropriate to the building and still allows airflow through the building.

Quote from community

'UBPT is looking forward to getting the turbine back up and running and changing the system to better address the energy needs of the building.'
Alasdair MacEachen, Director of Uist Building Preservation Trust. Nunton Steadings, Benbecula

Cost / sources of funding

Breakdown of Work – Nunton Steadings	**Cost**
Insulation materials & labour	£1,870
6kW turbine & installation costs	£26,942
Legal fees (servitude)	£600
Contingency	£2,941
Total Cost	**£32,353**

Funding Cource – Nunton Steadings	**Amount**
SCHRI (CES)	£8,625
Comhairle nan Eilean Siar (CnES)	£8,625
European Rural Development Fund (ERDF)	£8,633
Community Contribution	£6,470
Total Costs	**£32,353**

Actual performance

The turbine has not reduced the energy bills for the building as hoped due to the increase in use of the building and therefore the increased requirement for heat. The batteries and inverter have also reduced the efficiency of the system and has been providing less heat to the building as hoped. The batteries did provide electricity to the building during power-cuts which allowed the occupants to keep the building running off-grid for short periods of time.

Community contact
George MacDonald, Nunton Steadings, Nunton, Benbecula, Western Isles, HS7 5LU

Case Study 16: Pier Hydro Scheme, Eigg - *Hydro*

Case study provided by CES

Information points

Renewable device	Micro hydro
Rated output	6kW
Manufacturer	Pelton style Platypus turbine
Cost of Project	£21,720
Relevant sections in Toolkit	*5.3 & 6.4*

The turbine for Eigg pier hydro

Water source for Eigg pier hydro

Project Description and nature of group.

In 2003, the Isle of Eigg Heritage Trust installed a new 6kW hydro turbine to power An Laimhrig, their new Pier centre building. Since then, the system has been integrated into the new 'Green Grid', as part of the 2008 electrification of Eigg. The IEHT is a registered company (not for profit distributing) and a registered charity, and is made up of three members; the Eigg Residents' Association, the Highland Council, and the Scottish Wildlife Trust. Each of these members appoints directors to the board of the trust. The Trust operates to promote sustainable development, poverty alleviation, conservation and improved infrastructure on the island.

How it works

The Pier hydro utilised some existing hydro infrastructure from a redundant scheme, and incorporates a small dam and reservoir, feeding into a 250m-long pipeline (penstock). This water then flows downhill over a drop of some 30m through the penstock into the powerhouse, where it turns a Pelton style Platypus 6kW turbine. This feeds electricity directly into the new Eigg grid. The system uses two different nozzles to increase velocity of flow into the turbine (one for summer and one for winter) to make the most efficient use of the seasonal flows.

Development stages

Original Development
The first scheme was designed and installed by Hugh Piggott, and had a 2kW output. This was connected solely to the Pier Centre and adjacent buildings.

Redesign and Upgrade
In 2003 the system was upgraded to a 6kW turbine with assistance from HICEC, the predecessor to CES. This was a relatively simple upgrade, involving changes to only the turbine and generator.

Renovation and Connection
In 2007/2008 the system was serviced and connected to the new island grid, as part of the Eigg Electrification scheme, also support by HICEC.

Issues and learning points

- Manufacturer location - Although the new turbine has worked fairly reliably, sourcing replacement parts from the Australian manufacturer has been more time-consuming than with the previous system manufactured in Scotland. This is worth bearing in mind for future projects.
- Seasonal flow - Changing the nozzles for the different seasonal flows is also complex, so it is worth making this as simple as possible during the design of the system if it is likely that there will be seasonal variances in flow.

Quote from the project group

"The turbine worked very well over the period before the island grid – it helped us a lot with the situation we were in. It is currently undergoing some maintenance before it can be connected to the island grid, but we are very happy with its performance overall."

Cost / sources of funding

Breakdown of work – Eigg pier hydro	**Cost**
7kW Hydro turbine and load control governor	£4,882
7kW dump load heaters for turbine shed	£100
Fittings for manifold and hoses	£200
1000W Battery chargers (unity power factor, switch mode type)x 3	£1,101
2x 4.5kW 48 volt SW inverters	£6,042
50kWh battery (500 ah at 48V/1240Ah at 48V)	£3,660

300metres cable from turbine to generator shed (35mm2)	£1,500
Miscellaneous controls and wiring accessories	£1,000
SUB TOTAL	£18,485
VAT	£3,235
Scoraig Wind labour design & install	£800
Island labour	£280
Contingency 10%	£2,280
Total Project Cost	**£25,080**

Funding source – Eigg pier hydro	**Amount**
Lochaber Enterprise	£6,270
SCHRI	£13,810
Highland Council	£5,000
Total	**£25,080**

Actual performance

No performance data is available for the system, however, it has been reported that it has worked well and fairly consistently. The biggest limitation to the system is water flow; while the reservoir provides some storage, it has been found that it is best to run the system at a lower flow and lower power output than to run it at a higher output and quickly exhaust the water supplies. Consistency of power supply in this case is more important than level of output.

Project Contact

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Case study 17: Electrification of Eigg, Isle of Eigg – *PV, Hydro & Wind turbines*

Case study provided by CES

Information points

Renewable device	Various – PV array, micro hydro and wind turbines
Designers/Installers	E connect Consulting and Scottish Hydro Contracting
Relevant sections in Toolkit	*5*

Note… This case study is presented differently due to its unique nature. The explanation of the technologies involved has been covered in both the technologies section and various other case studies. The planning and development stages are very much tied up with the issues and learning points. A breakdown of work costs is not possible without compromising confidentiality.

Project Description and nature of group

The composition of the Electrification Scheme makes it exceptional in both Scottish and UK terms. It is the first island electrical grid network in the British Islands that is being powered by an integrated mix of micro-scale renewable energy technologies.

Initially, several options to provide power for the island were examined. These included a proposal to connect Eigg to the mainland. However, estimated costs of c. £4-5 million were deemed too expensive and the proposal was dismissed. In 2004 the design for the current scheme was chosen as the best option for Eigg.

The island harnesses solar and kinetic energy by generating electricity using a mix of renewable technologies:

- a new 10kW solar photovoltaic array
- a new 100kW run-of-river hydro
- wind power from four new 6kW wind turbines
- inclusion of two existing 6kW Hydro's.

The new scheme also includes control system and a battery system that can yield 24 hours of stored renewable electricity. For back-up there are also two 80kW diesel generators. Estimates are that the scheme shall be 98% renewably powered.

10kW P.V array, Eigg electrification

Hydro Dam, Eigg electrification

Four 6kW Proven turbines, Eigg electrification

Eigg Electrical Limited, a subsidiary of the Isle of Eigg Heritage Trust, operates the scheme. It is vital for its long-term operation that it is able to sustain itself financially. Before any funding was secured a business plan was formed to demonstrate that the financials of the scheme were sound. (See section on actual performance for further information on the business plan.)

Maintenance of an island system is a significant issue and because of its isolated nature, it has been essential to employ and train Eigg residents as part-time operatives to cover day-to-day (or when otherwise required) maintenance cover.

Overall, benefits this scheme will include:

- A reduction in the importation of polluting hydrocarbon fuels and resultant leakage of energy costs to the mainland. Much of the energy pound now stays on Eigg and is playing an important part in feeding back into the island and increasing sustainability and self-sufficiency;
- A reduction in the Carbon/Ecological footprint of Eigg and its inhabitants;
- An increase in living standards and quality of life for the Islanders;
- Increased self-sufficiency;
- Increased economic opportunity;
- Increased skills and capacity of the Eigg workforce;
- Increased capacity and expertise in project development;
- Electrical energy security;
- Potential to capitalise on and export expertise;

Development and planning / Issues and learning points

It was inevitable that a project of this scale would provide a substantial number of challenges for all the project stakeholders. A strong Eigg based project team backed by other committed stakeholders ensured that there was a determination to overcome obstacles and address challenges. These included:

- Timing of design - A significant challenge for Eigg was to accurately establish capital costs early in the project. The only way to do this was to produce a costed design. At £100k the design costs were expensive, but without this, there was a risk that capital costs could return too expensive; thereby rendering the project unrealistic and unaffordable. This would have resulted in the loss of £100k of SCHRI funding. Although there was a risk, HICEC recognised that this was an important first step for the project and deemed that the need for timely project assistance outweighed the risk of loss.
- Keeping within budgets - Following the design and early indications of funding it was imperative that the project costs were not allowed to escalate out with acceptable funding limits. The project team on Eigg took a strong hand with this challenge and worked very closely with the contractors to ensure cost overruns were avoided.

- Funding - As can be seen from the later funding table and project costs there was a considerable challenge to raise the finance required. The Eigg project team, assisted by HICEC and HIE Lochaber worked hard making applications and lobbying other stakeholders for funding. This was no easy feat and demanded a great deal of time and effort.
- Permissions - As with all projects, gaining permissions can be a problematic and difficult area to overcome. Consents were necessary from: SNH, SEPA, Historic Scotland, Highland Council planning, Highland Council roads dept, way leaves from local land holders and organisations. The Eigg project team took a practical and pragmatic approach to gaining these permissions. They engaged personally with agencies, inviting them to visit the various sites, to spend time exploring and discussing difficult areas of contention and showing a willingness to find practical and mutually acceptable solutions. This approach was successful and personal engagement and a willingness to co-operate and find solutions enabled all permissions to be gained without stalemate and lost time.
- Energy Efficiency - In terms of achieving overall energy self-sufficiency, Eigg has made giant leaps and is more advanced than most of the rural communities in Scotland. However, the demand for heat energy still remains a challenge for Eigg and other similar communities. That said, this model for development and the type of scheme now operating successfully on Eigg offers great scope for replication in other off-grid communities worldwide. The Highlands and Islands Community Energy Company has worked closely with the community of Eigg on this project from the early stages and is now planning how to ensure that other communities can benefit from Eigg's experience.

The above examples illustrate a sample of some of the many challenges that the Electrification Project encountered. These were overcome through a diplomatic, prudent and pragmatic approach to project development, with skills and experience that can be transferred to other community renewable developments.

Costs / sources of funding

The final cost (including design & capital) for the project was c. £1,664 million. Funding was secured from a variety of sources as can be seen below.

Funding source – Eigg electrification	**Amount**
SCHRI	£196,127
ERDF	£764,000
Big Lottery Fund	£250,000
HIE Lochaber	£313,000
Energy Savings Trust	£33,940
IEHT & residents	£92,761
Highland Council	£15,000
Total project cost	**£1,664,828**

Actual Performance

The Island of Eigg Electrification scheme is now commissioned and operational, with 100% take-up. All 37 households and 5 commercial properties on the island are connected and now have their very own supply of renewable electricity. The effect of the Electrification project on the Eigg community has been significant and in a number of ways is leading to greater self-sufficiency.

The business plan for the scheme is based on income from electricity sales, ROC income, and a standing charge for metering equipment. At the moment electricity tariffs and standing charges (15p per kWh and 12p per day standing charge) are both higher than their mainland equivalents. These have been set to cover the costs of operation and maintenance of the system, with an amount accumulating over time to form a sinking fund for replacement components. The financial and cost regime structure should ensure that the system is now financially self-sufficient.

Although the island has a continuous 24 hour electricity supply for the first time, it has still been necessary to adopt a cautious approach to the allocation of electricity supply. The potential threat of inappropriate use/abuse of supply by some customers could de-stabilise the balance and smooth operation of the system. To mitigate this threat, supplies have been capped at 5kW for domestic properties and 10kW for larger properties i.e. commercial and local authority. If these limits are exceeded then meters shall “lock-out” and require to be reset, with customers incurring a penalty of £25.00.

Every property on Eigg has been supplied with smart energy meters. These meters give constantly updated digital displays of current energy consumption. The use of smart meters and the capping of supply have engendered a culture of energy prudence amongst the islanders. They realise that electricity usage in their properties must be sensible and such that they do not risk a “lock-out” and penalty charge. Thus far, there have been no “lock-outs” or penalties! In many ways, therefore, the people of Eigg are piloting an approach to energy consumption that has, potentially, much wider application.

Case Study 18: Knoydart - *Hydro*

Case study provided by CES

Information points

Renewable device	Hydro
Rated output	280kW
Manufacturer	Gilkes & Gordon
Cost of project	£23,216 (monitoring equipment)
Relevant sections in Toolkit	*5.4, 6.3 & 6.4*

Project description and nature of the group

The Knoydart Foundation was created through a community buyout in 1999. It is a non-profit distributing charity and Company limited by guarantee.

Knoydart, although on the mainland, is accessible only by sea and to all intents and purposes is an island community. It is not connected to the mainland grid. Electricity on Knoydart is supplied from their own 280kW hydro-electric scheme and diesel back-up generator and fed through a small local grid to most of the households and businesses on Knoydart. Operation of the hydro-scheme and electricity scheme is the responsibility of Knoydart Renewables who are a trading subsidiary of the Foundation.

The hydro generator is a Gilkes & Gordon turbine, with a Pelton wheel and rated at 280kW. It is supplying power from Loch Bhromasaig which has a head of 274m with a maximum flow rate of 129 l/s. The distribution system is an 11kv 3-phase distribution system consisting of 82 poles, 11 transformers and over 5km of power line.

Development and planning stages

First installed in late 1970s by the then landlord Major MacDonald, the scheme and supply of electricity was erratic and one of the first projects for the Foundation was the upgrade of the hydro-electric scheme. This was seen as a key project with strong socio/economic benefits for the community. This work took place and the system was upgraded in 2001. In the years since the refurbishment there has been a great deal of improvement activity. Another 23 properties were connected bringing the total amount of customers to 67 properties.

With the increase in customer base and the potential of further expansion, the hydro company recognised that there was a greater need for them to understand the supply and demand pressures on their hydro system. It was also important that they were fully able to understand and measure other important factors such as increased draw on the supply, reservoir re-fill times, water levels at the reservoir and penstock flow rates in relation to consumer demand.

This was addressed in 2006 with the installation of comprehensive monitoring equipment. This equipment measured reservoir levels, overflow amounts, rainfall, and remote data-logger located in the Foundation offices. The installation of this equipment has given the hydro company the ability to know at any time what the status of the hydro scheme is. It also has given the hydro company accurate data as to what extra untapped capacity the scheme has.

It would be fair to say that the hydro electric scheme has (in common with its mainland counterparts) suffered mechanical failures, technical difficulties and external damage by others. In the period since the Foundation has taken over there have been many power outages. However, as time has passed the steady upgrade and improved community capacity has seen the performance of the system vastly improve. Breakdowns are now a lot less frequent and the quality of customer supply has improved significantly.

Ownership and operation of this scheme has obviously challenged the capacity of the Foundation and the hydro company. However, in the time that has elapsed between the Foundation taking over the scheme to the present day has seen an increased efficiency for the scheme coupled with a growing capacity, knowledge and understanding of not only the hydro system, but also as providers of electricity.

This is not the end of the story. Knoydart renewables intend to develop its spare capacity from the hydro scheme by utilising it for either new connections or for community hydrogen development.

Loch Bhraomsaig

Knoydart hydro dam

Knoydart hydro pipeline

Gilkes & Gordon 350KVa pelton turbine

Pictures courtesy of Knoydart Foundation.

Issues and learning points

Angela Williams of the Knoydart Foundation & Knoydart Renewables has been very heavily involved with all aspects of developing and running the hydro scheme and electric supply. She has offered the following as issues to be aware off and learning points:

- *“Implementing a project is just the easy bit - the hard work really begins when you have to run it and manage it yourselves.*

- *Being an energy supplier is NOT a license to make money! (Sell to the grid if you can!) - but it does give you control*

- *Have good paperwork systems in place, keep good records of everything*

- *There will be lots of things you should know and don't realise you should know - talk to as many people as possible and look at the different way of doing things*

- *Good communication locally is imperative - don't assume that everyone will have heard about things, find a way that reaches to as many people as possible.*

- *Repairs will cost more than you expect - but pay for proper advise and expertise as it will be cheaper in the long run.*

- *Volunteer support is great but only if managed well".*

Quote from community member

"Knoydart is not grid connected, and the community owned and managed hydro scheme is the main source of electricity for a significant proportion of the community living on Knoydart. Running your own electricity company can be incredibly frustrating at times - but it can also be very satisfying knowing that you are in control and, despite the problems, is the ultimate in energy security" (Angela Williams Nov 08).

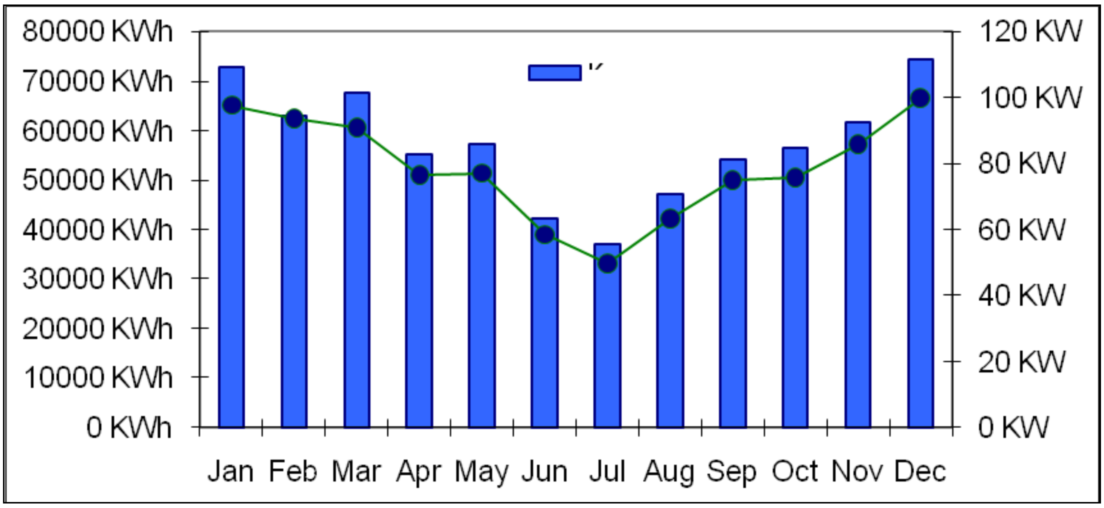
Costs and sources of funding

Breakdown of work – Knoydart hydro	**Costs**
Submerged level transducer, rainwater gauge, Ultra sonic flow meter, 7 core cable, and open channel flow-meter.	£16032
Modem, Laptop and appropriate software	£1724
Telephone line	£2460
Operative training	£3000
Total Project Costs	**£23,216**

Funding Source – Knoydart hydro	**Amount**
SCHRI	£10,108
Knoydart Hydro Company	£3,000
Fresh Futures	£10,108
Total Funding	**£23,216**

Actual performance

The graph below is for KWh and KW for each month of 2007:



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Case Study 19: Rousay, Egilsay and Wyre, Orkney Islands – *Community development plan*

Case study provided by CES

Information points

This case study follows the set up of a Community Development Plan for installing renewable devices rather than the devices themselves.

Relevant sections in Toolkit 8.3

Project Description and nature of group.

Rousay, Egilsay and Wyre are a group of three islands that form part of the Orkney Islands archipelago. The residents of these islands were inspired to get involved with community development planning due to real and perceived concerns about the present fragility and long-term sustainable viability of their community and opportunities to earn and invest revenues derived from renewable energy generation.

Although they are three separate islands which maintain post offices and community halls on each island, the island group generally behaves as a single community; sharing one school, shop, GP surgery, ambulance and fire service, restaurant, and hotel on the main island of Rousay. There is a regular internal ferry service linking the islands and a 25 minute crossing that links the group to the Orkney Mainland.

The present resident populations are approximately 210, 20 and 15 respectively for the three islands. Like a number of other outer isles within Orkney the three islands have experienced a sustained history of depopulation. Previous censuses show that Rousay, Egilsay and Wyre have experienced marked population decline over the last century; from a peak of 939, 205 and 93 respectively in the 19th Century, the total population is estimated to have halved in the years between the two world wars, and continued to decline to less than 350 by 1961 and its present all time low of less than 250. There is also a growing demographic gap within the populations as the communities collectively fail to retain and attract school leavers, young families and homemakers within the area whilst simultaneously being attractive to more mature/retired new residents.

This situation has been exacerbated by a recent rapid decline in three key industry sectors within the islands. Since the Second World War, agricultural employment has dramatically reduced through mechanisation and reduction in local demand. Simultaneously, over the last four decades the traditional local fishing fleet working from the islands has declined to nothing. Most dramatically, over the last decade, the fish farm sector which accounted for over 20 jobs within the community has shrunk to less than 4 full time equivalent jobs for residents.

Further to this, because of the location and very remote rural nature of the islands, the community is further burdened by disproportionately high energy and fuel costs and threats to their key lifeline services. Due to climatic conditions, low average incomes and a historically poor housing stock Orkney is recognised nationally as having the highest incidence of fuel poverty (where a household spends more than 10% of its total income on fuel for heating, electricity and transport etc.). All these fuel poverty factors apply to the Rousay, Egilsay and Wyre community and are further amplified by additional embedded fuel costs for any items imported into or exported out of the community (including fuel itself).

These major social trends in depopulation, loss of industry and lack of employment, and fuel poverty led to the interlinked island communities coming together to influence their own development through organising a community group that could help plan activities and projects that would attempt to redress the worst of the communities social needs and build a more sustainable future. Central to this was the formulation of a community development plan.

How it works

The community development plan for Rousay Egilsay and Wyre works by providing a concise document that defines key components of the community's circumstance and future wishes and creating a structure for discussion, publicising and co-ordination of the steps needing to be undertaken. Based wholly on information supplied from and supported by the community members, it tries to best identify the needs and aspirations of the community, sets out a clear future vision for the area, and defines the nature and principles of the community development group that has been set up to address these aspirations and vision. It identifies broad themes, each with their own aim, to help define areas of action and has a list of potential projects and activities that have been suggested to assist with these aims.

By including voted scoring of potential activities and projects, it allows the development trust to select and prioritise their current activities. As a written summary of aspirations and plans, it assists further recruitment within the community and provides useful documentation when attempting to get further resources and grant from outside bodies. By including the ability to review and update priorities, the plan can be kept relevant and activities of the trust can also then be modified and refocused to reflect changing needs and aspirations over time.

Development and planning stages

Familiarisation
Recognising the worrying trends in community viability, about 6 years ago, a number of members within the Rousay, Egilsay and Wyre community council had been keen to investigate the potential of revenue generating renewable energy projects to benefit the local community. As a result a community turbine working group was established by the community council. The subsequent research of the working group over the next few years

introduced the concepts of social enterprise, and the group became increasingly aware of activities being undertaken by other similar communities in and outside of Orkney.

Elsewhere non-profit distributing community groups were being formed as development trusts and partnerships to address concerns about viability and sustainability in the community by actively seeking development projects and activities that could be owned and managed by the community itself. Often (for example Gigha and Westray) these were other island communities and their activities included significant revenue derived from renewable energy projects. The results of the "North Isles Wind Energy Project" study (commissioned at the time by Scottish Community Renewables Initiative through HIE (Orkney) to investigate the potential for community ownership of renewable energy in the area) were sufficiently positive to result in a series of public meetings to discuss the opportunities they identified.

Planning

As with many communities at a similar stage, there was general agreement at this time that there were significant worries about the fragility and future viability of the community, and that the possibility of a community owned turbine should be pursued further, but little knowledge on how best to take this further. Rousay, Egilsay and Wyre were fortunate at this point that in addition to community council resources, they had access to support from the community team of the local HIE Orkney and the wider Scottish Community Renewables Initiative. These teams advised the working group and engaged Alan Caldwell as a consultant specialising in community development planning and community group formation.

Alan worked with the residents on a range of activities to publicise issues and engage with the community. This culminated in a series of workshops with the community, during which the key elements for a plan were defined, a draft development plan produced. The draft plan was then distributed to every household in the community for comment and additions. After this, there was a final meeting where the content of the plan was agreed and a voting exercise undertaken on the list of potential projects and activities so as to score them as priorities. The content of the draft plan and the prioritising information was then designed and formatted to produce the first finished Community Development Plan.

Updating

The plan has been in place since spring 2007. On completion, it was proposed that the list of activities and projects be reviewed annually and re-prioritised through a community vote and the whole plan be subject to major review after five years.

<u>Issues and learning points</u>

- Community Engagement - The main issue with this plan, as with many was trying to ensure community engagement and involvement. The relatively small size of the community aided this process but it was further complicated by having the community split across three islands with a restricted boat service. By the time the plan was finalised, 1 in 5 of the total community had been actively involved in workshops to formulate the plan and every household had directly received information and had 2 opportunities to input and comment on the proposals and plans.

- Review and Updating - Initially, it was the strong desire of founding members of the trust that prioritisation of activities be voted on and updated annually by all members and the wider community. After less than two years spent trying to implement the initial plan, it has already become clear that this aspiration is challenging practically and may not even be desirable.
- Sustaining interest - after the initial excitement of setting up the Trust had died down, without any subsequent topic to provide clear focus for the community and with very limited resources, the Trust have found it very difficult to stimulate sufficient numbers of trust and community members to actively vote on these priorities annually.
- Time scales - Given the time required to progress any activities using volunteer time alone, it has become apparent that a one year timescale is often not sufficient to substantially explore many priorities.

The Trust presently have a compromise in place to accommodate these experiences, but also attempt to keep the plan up to date, relevant and flexible to any rapid changes in community needs and aspirations. The Trust has modified its plan updating and review process so that the annually plan is circulated to all households for comment and all its content openly discussed at the Annual General Meeting of the Trust and every five years there will be new series of mail shot, meetings and community workshops in the same fashion as the initial meetings, whereby all aspects of the community plan will be assessed, updated and voted on again.

<u>Comment from representative of a project group (quote)</u>

Anne Grieve, founding member and secretary of the Trust, found the development planning process invaluable, "*The open workshops we held not only helped us draft our development plan, but also allowed us to engage the community early on, which meant that the interim board had a strong mandate for action as soon as the Trust was formed.*"

<u>Cost / sources of funding</u>

The process for Rousay, Egilsay and Wyre was probably more expensive than is usual. Overall there were 7 public meetings/workshop sessions. There were the normal costs for hall hire of c.£15 per meeting and use of a consultant for the workshops and drafting the plan added a further £2500. However, as most the meetings had to be in the evening to allow workers to attend, they also required a special hire of the local ferry to put Egilsay and Wyre residents home. Though necessary to make sure everyone had the opportunity to be included, this was by far the most costly part of the process; with boat hires adding an average £600 extra cost per meeting.

The community were fortunate that little of this financial burden fell directly upon them, as the costs would have prohibited the process from happening. Key funding was supplied by the local Community Council, who covered the boat and venue hire costs and HIE Orkney who paid the consultant's fees. However, the level of commitment in voluntary time and effort by community members must also be remembered.

Breakdown - Rousay, Egilsay and Wyre	**Cost**
Hall Hire	£105
Boat hire	£4,000
Annual update of plan	£2,500
Total Costs	**£6,605**

Funding Source - Rousay, Egilsay and Wyre	**Amount**
Community Council	£4,105
HIE Orkney	£2,500
Community Members	c. 500 hours of voluntary time for ➢ Generating vision, aims and projects and activity suggestions ➢ Prioritisation of themes and potential projects and activities ➢ Plan design and Finalisation ➢ Annual update of plan
Total amount	**£5,605**

<u>Actual performance</u>

There is general agreement within the Trust that the plan has been a great aid when recruiting new members in the area. It is also agreed that it has been an invaluable tool for interacting with and securing funds from 3rd parties and agencies (instrumental in acquiring a total of c. £20 thousand in grant funding from Rousay, Egilsay and Wyre Community Council, Orkney Islands Council, Highland and Islands Enterprises (Orkney), Community Energy Scotland and the Co-operative Bank) to realise the aims of the plan.

It is worth noting to the contrary that, when the Trust reviewed its activities over 12 and 18 months after formulation of the plan, it found quite a poor correlation between progressed projects and activities and the top 3 and 10 priorities as set out in the plan. After discussion and analysis, this seemed to be best explained by the fact that over this initial period the progression of activities and projects relied heavily on voluntary work undertaken by board members and, naturally, the undertaking and selection of work was quite heavily influenced by the particular interest of the active board members. If this has been the case then the recent appointment of a part-time paid community development worker, whose post has the progression of the key priorities contained within the current community development plan as a core part of the job description, should help to redress any imbalances.

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