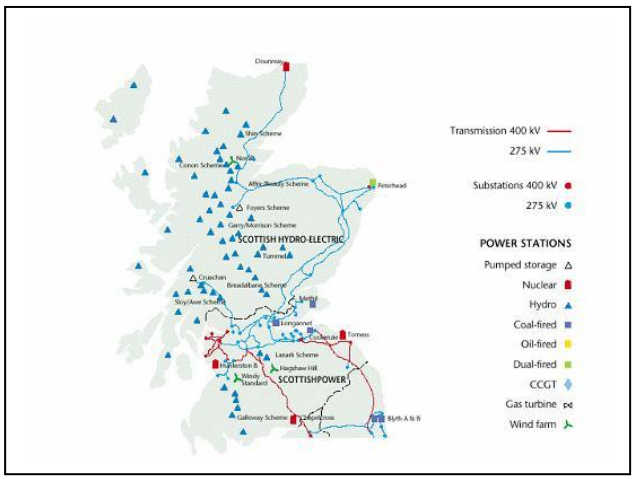
Section 5: Off - Grid Solutions

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.

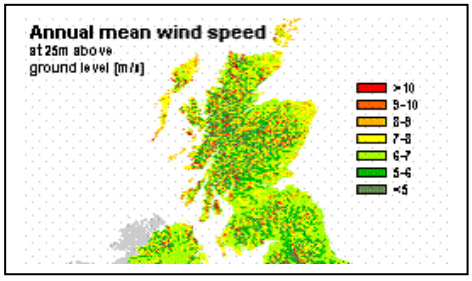
5.3 Building or small scale off-grid solutions

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 on 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.