

## Hydro Power

### How does it work?

Hydro power is one of the oldest, most reliable and most efficient renewable technologies. It converts the energy in falling water from rivers or burns into electrical energy. Some use a dam to store water in reservoirs at the top of the system for periods of low rainfall, but most small schemes are now 'run of river', and divert some of the flow of the river using an intake weir. The weir usually incorporates a trash guard to filter out leaves, twigs and other debris, and may include a fish pass for migratory fish in the river. The weir feeds the diverted water into a 'penstock' which is the pipeline which carries the water downhill. Some schemes on old weirs may use an open channel to divert the water, with the main drop directly over the turbine. The water is directed by the pipeline or channel into the turbine where it strikes a wheel, which turns a generator and produces electricity. The water then returns to the river through a 'tailrace', and the electricity is sent through cables to the national grid or to the building it powers.

### Most common uses

Community hydro schemes fall into three broad categories;

- Off-grid applications to provide power for remote communities not connected to the national grid, such as the hydro schemes on Eigg and Knoydart
- Off-grid or grid-connected schemes providing electricity and/or heat to a community building, such as the one being developed by the Abernethy Trust at Ardgour
- Income-generating projects developed by a community group to feed into the national grid to provide them with long term community revenue, like the scheme being developed by the Catrine Community Trust in Ayrshire

### Site and area suitability

There is almost no minimum or maximum theoretical size of hydro system, but the key requirements are for:

- 'Head' – a drop in height over the length of the river or burn, which might be a waterfall, old weir, or a more gradual incline over some distance, and/or;
- Flow – the greater the volume of water flowing downstream, the greater the potential energy of the system

Both low head/high flow and high head/low flow schemes are common, although a combination of both will generate the greatest amount of energy. The potential power available from a site can be calculated from the following formula:

$P = H \times Q \times g \times e$  where:

P is the power measured in Watts

H is the head over the site measured in metres

Q is the flow rate measured in cubic litres per second

G is the gravitational constant (9.8 metres/second<sup>2</sup>)

e is the efficiency factor (for small schemes usually around 0.5 i.e. 50% - up to 90% for large systems)



*A 500W hydro for battery charging showing tailrace*

Other requirements are likely to be good road access, or possible routes to build a new track for construction of the weir or dam, penstock and powerhouse. The powerhouse would ideally be located close to power lines or to the building it will be providing energy to, in order to cut down on energy losses or the cost of laying cables long distances. The river or burn should have a good flow all year round to maximise the power output and payback of the scheme; most will be designed based on the summer (minimum) flow of the river. Sizing it to peak flows is not advised as the turbine will not work as efficiently when the flows are lower for much of the year.



Intake weir showing trash screen (centre) and intake to pipeline (right)

A 500kW turbine (blue) and generator (red)

### Questions and Answers

*Is it expensive?* – Capital costs of the installation vary hugely depending on the size and site of the scheme, but can be expensive per kilowatt installed compared to wind power. However, they tend to operate much more efficiently, more often and more reliably than wind turbines, and last much longer – many hydro schemes in Scotland are still working 50 or 70 years after being built.

*What are the environmental impacts?* – Hydro schemes create some noise and visual impact, but these can be reduced through careful siting and construction. Maintaining the ecology of the river is very important, and normally a licence will be required from the Scottish Environmental Protection Agency (SEPA), who will advise you on this.

*Where can I find more information and advice?* – Visit the British Hydropower Association's website on [www.british-hydro.org](http://www.british-hydro.org) for a comprehensive micro-hydro development guide; read more about developing a community hydro project in the Scottish Government's Community Renewable Energy Toolkit, available at <http://www.scotland.gov.uk/Publications/2009/03/20155542/8>, or contact your local CES Development Officer who will be able to advise you on the possibilities and support available - <http://www.communityenergyscotland.org.uk/team.asp>

### See for yourself

Cruachan Power Station is a large scheme open to visitors - <http://www.visitcruachan.co.uk/>

The Isle of Eigg has two small 6kw hydro schemes and a medium size 100kW hydro system, all community owned and developed - <http://www.isleofeigg.org/>