

# Renewable energy

## Factsheet

### Small scale hydroelectricity

#### Introduction

Hydro power is a mature and proven technology; it is perhaps the oldest method of harnessing renewable energy. The first water wheels were used for irrigation over 2000 years ago. Later they were applied to milling and by the Industrial Revolution their use was extensive. Towards the middle of the 19th century the first water turbines were developed. They were smaller, more compact and more efficient than the wheel and were particularly suitable for electricity generation.

#### Technology

Hydro power systems convert potential energy stored in water held at height to kinetic energy (or the energy used in movement) to turn a turbine to produce electricity.

A micro hydro plant is below 100kW. Improvements in small turbine and generator technology mean that micro hydro schemes are an attractive means of producing electricity. Useful power may be produced from even a small stream. The likely range is from a few hundred watts (possibly for use with batteries) for domestic schemes, to a minimum 25kW for commercial schemes.

#### Applications

Hydro power requires the water source to be relatively close to the site of power usage, or to a suitable connection to the national grid.

Hydro systems can be connected to the national grid, or be part of a stand-alone power system that's not connected to the national grid (off-grid). In a system connected to the national grid, any electricity generated in excess of consumption on site can be sold to electricity companies.

In an off-grid hydro system, electricity can be supplied directly to the devices powered, or via a battery bank and inverter set up. Allowances should be made for any seasonal variations in water flow, which can affect the amount of electricity delivered to the system i.e. have a back up power system.

It is possible for single households with a mains connection located near a hydro source to install a micro hydro system. They can go 'off the grid' entirely, or stay connected and sell



excess electricity to the national grid. The capital cost is high, but the prospect of zero electricity bills, or even being paid for excess electricity you generate by selling it back to the national grid may tempt you.

Provided the resource is there, community hydro projects can also be a viable proposition. Potentially, there are great benefits in clubbing together to increase buying power or sharing expertise - although the work involved should not be underestimated.

#### System sizing

Energy available in a body of water depends on the amount of water flowing per second, and the height (or head) that the water falls. The scheme's actual output will depend on how efficiently it converts the power of the water into electrical power (maximum efficiencies of over 90 per cent are possible, but for small systems 50 per cent is more realistic). Hydro electric systems are generally divided into 2 categories, low and high head.

The former could include old mill sites with a weir and sluice, whilst the latter includes fast flowing upland streams.

A small turbine on a hill stream with a flow of say, 15 litres/second, and a head of 15m will generate about 1kW, enough to meet the basic needs of a house.

It should be stressed that resource assessment is a specialised subject, best left to micro-hydro consultants who can do a site survey and feasibility study. It is critical that you obtain high quality advice from the outset. Reliable, efficient equipment and sound advice is available from a number of experienced UK suppliers and consultants.

## Components of a typical hydro system

- An intake, often incorporated into a weir, to divert the flow from the water course and likely to incorporate trash and fish screens.
- A penstock pipe to convey the water from the intake to the turbine - this pipe must be of sufficient diameter to minimise 'head-loss'.
- A powerhouse, in which the turbine and generator-set convert the power of the water into electricity.
- An outflow through which the water is released back to the river or stream.
- Underground cables, or overhead lines to transmit electricity to its point of use - these must be of a sufficient size to minimise efficiency losses in the cable.



Fig 1: A small scale intake

## Will it meet my energy needs?

This will depend on the water resource available and your energy needs. For houses with no mains connection, but with access to a micro-hydro site, a good hydro system can generate a steady, more reliable electricity supply than other renewable technologies at a lower cost. Total system costs can still be high, but often less than the cost of connecting to the national grid, and with no electricity bills to follow. Note that in off-grid applications the power is used for lighting and electrical appliances, however space and water heating can be supplied when available power exceeds demand.

## Costs

Hydro costs are very site specific and are related to energy output.

- For low head systems (not including the civil works - so assuming there is an existing pond or weir), costs may be in the region of £4,000 per kW installed up to about 10kW, and would drop per kW for larger schemes.
- For medium heads, a fixed cost of about £10,000, and then about £2,500 per kW up to around 10kW - so a typical 5kW domestic scheme might cost £20-£25,000. Unit costs drop for larger schemes.

## Environmental impacts

Turbines can have visual impact and produce some noise, but these can be mitigated relatively easily. The main issue is to maintain the river's ecology by restricting the proportion of the total flow diverted through the turbine. The Environment Agency will be able to advise on this and should be your first port of call for advice on planning issues.

## Where can I get more information?

Your nearest Energy Saving Trust Advice Centre can provide free, impartial, expert advice on renewable energy measures. Based in your region, we can help you choose the most suitable renewable energy technology for your home, as well as put you in contact with local suppliers and installers in your area. To find out more, call 0800 512 012 or visit [www.est.org.uk/myhome](http://www.est.org.uk/myhome).

## Useful links

- For advice and information about renewable energy technologies and other energy saving measures for your home: [www.est.org.uk/myhome](http://www.est.org.uk/myhome)
- British Hydro Power Association: [www.british-hydro.org](http://www.british-hydro.org)
- Environment Agency: [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

Title picture courtesy of Hydrogeneration Ltd  
Fig 1 courtesy of ERDA

