Trawsnewid Calon Teifi

SMALL SCALE HYDRO

What is Small Scale Hydro Power?

Harnessing the power of water represents one of the oldest renewable energies in the history of mankind; firstly to irrigate land and then to power mills such as the woollen mills in the Calon Teifi area. Therefore it is a mature and proven technology to apply to electricity generation. Small scale hydro power, often called micro hydro, is a system that converts the energy of flowing water into electricity, usually having an output of 100 kW or less. Micro hydro systems differ from larger scale hydro power in that they utilise much lower quantities of flowing water during operation, generating less electricity as a consequence. Although the tides and waves are both forms of hydro (water) power, only land based schemes will be presented in this page, i.e. those that use streams or rivers.

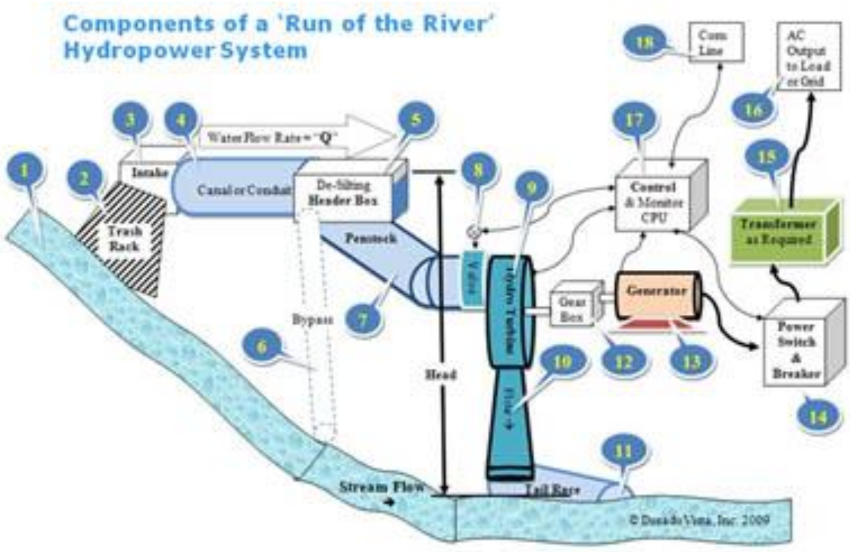
Common types of Small Scale Hydro

Small scale hydro systems are often defined in two general ways; **storage schemes** or **run-of-river schemes**. The former includes damming a whole stream or river to hold back a large volume of water, which is then released through a turbine, while the latter uses a weir to modify the flow of a stream or river and divert some of the flowing water to a turbine. They can be stand-alone systems in which a load is powered directly or via a battery bank, or be grid connected. Either way you can get paid by the **Feed In Tariffs at the rate of 19.9 p/kWh** for all electricity generated and **3p extra** for all power exported to the grid. They can also be defined as low-, medium- or high-head depending on the height from which the water falls. The head and flow rate of the stream define the turbine type necessary: low head need propeller or Kaplan turbines; medium head crossflow or Francis; and high head Pelton (impulse) turbines. **Waterwheels** are an important part of the low/medium head scenario. They are more easily fabricated by local labour, can be made fairly efficient, extremely long lasting, are less invasive to wildlife and the only renewable technology which everyone agrees is good looking.

How does Small Scale Hydro Work?

In order for hydro power to work, water flowing from a high point to a lower point must be diverted through a turbine.
Water from a river, stream or weir/dam enters the intake and is diverted to the penstock. This then channels the water to a turbine located in the powerhouse. The pressure and flow of water cause the turbine to rotate and hence drive the generator. The water then exits through an outflow pipe, or tailrace, to recombine with the water course.

What Components Comprise a Small Scale Hydro Scheme?



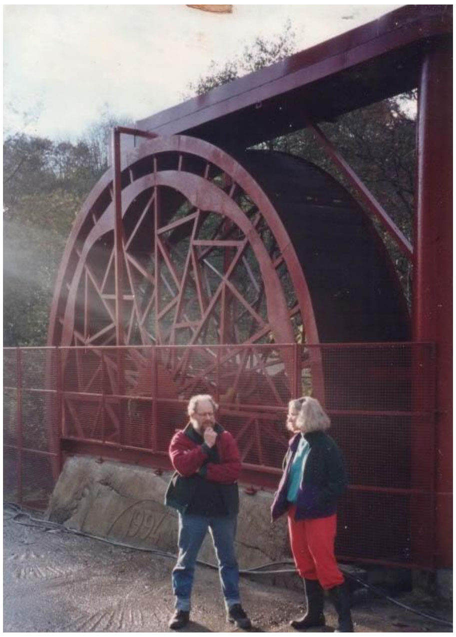
Hydro schemes vary in size but the following components comprise a typical system:

- **Intake**: often part of a weir the intake diverts the flow of water from a water course towards a forebay tank and penstock. The intake would usually contain some sort of fish/debris filter
- **Forebay tank**: this is optional, basically providing a small reservoir to buffer the flow through the turbine during extremes in stream flow rate. This may be suited to larger micro hydro schemes
- **Penstock**: transfers and delivers the water from the intake/forebay tank to the turbine unit located in the powerhouse
- **Powerhouse**: this accommodates the turbine and generating equipment

•**Tailrace**: also commonly called an outflow, to deliver water back the water course once it has given up its energy to the turbine and exited the powerhouse
•**Transmission line** (overhead) or cable (underground) to transmit the power produced to its point of use or grid connection

How much energy can I expect Small Scale Hydro to produce?

The energy available in flowing water depends on the volume of water flowing per second and the height (head) that the water falls. The conversion of this energy into electricity will depend upon the combined efficiency of the components listed above; the efficiency of a small hydro scheme can be between 50-85%.
The power contained by a body of water can be calculated by the following equation:
P = H x Q x g x e Where:
•P = power (kW)
•H = head height (metres)
•Q = flow rate (cubic metres per second)
•g = gravitational constant (9.81 metres per second)
•e = efficiency (0.5 ? 0.9, i.e. 50% - 85%)
Therefore a steady flow rate of 30 litres per second dropping through a head of 5 metres will have a power of 1.47 kW. If this passes through a hydro system with overall efficiency of 60%, then 0.883 kW could be produced, or an annual electricity production of 7,734 kWh.



Brain Faux with his Waterwheel installation at Dolbantau Mill Llanfihangel-ar-arth generating 5.5 KW and approx 40MWH pa

What are the benefits of Small Scale Hydro?

Many benefits may be obtained from small scale hydro power including:
•emissions-free electricity production
•unlike wind turbines and PV, hydro power can potentially generate electricity consistently
•long-proven and reliable technology

Suitability

In order to minimise the ecological impacts of hydro power, it may be necessary to allow a proportion of the stream/river to continue to flow along its natural water course. Criteria for this will be detailed in an **Abstraction License**, which must be obtained from the Environment Agency before any work begins on a hydro power scheme of any size, or at any location

Generator installed to a gearbox turned by the wheel above rotating at 5 rotations per minute

Maintenance

Hydro equipment is relatively uncomplicated and needs simple routine maintenance. With a small effort on a regular basis this machinery can last, literally, for a lifetime.

Installation costs

A number of factors affect the installed cost of a hydro power scheme, and can vary substantially from one site to another. This includes the extent of civil works needed, accessibility to the site and other environmental factors needing to be addressed.
For a low head system (less than 20 metres), where a pond or weir already exists, installed costs could be between £3,000 and £4,000 per kW up to 10kW. Larger schemes tend to cost less per kW.
A medium head system (20 - 100 metres) will require a different and possibly smaller turbine for a given output reducing costs per kW to around £2,500. However, civil works could be more involved, increasing its associated cost.

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