

# Small Hydropower



MANNVIT



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In principal, all hydropower schemes operate using a turbine to extract energy from water that is flowing from a high level to a lower one. Suitable sites include streams in hilly areas to rivers with higher flow in lowland areas.

There is significant potential for small hydropower projects in the UK making use of old mill sites and weirs. It has been estimated that there are 2,600 locations where a hydropower turbine could produce electricity.

Hydropower provides a good correlation with demand with maximum output during the winter months.

The Environment Agency supports the deployment of hydropower and is committed to make it quicker and easier to get approval for a scheme.

Small hydropower fall into 2 categories:

- **Micro** with installed capacity of between **10kW – 100 kW** (equiv. to supplying about 10-100 homes)
- **Mini** with installed capacity of between **100kW- 1MW** (equiv. to supplying about 100-1000 homes)

## Power and Energy

The two principal parameters in hydropower are:

- Flow: the volume of water per second
- Head: the vertical fall of water available

Hydro-turbines convert water pressure into mechanical shaft power, which can be used to drive an electrically generator.

## Preliminary Hydro Assessment

Essential information to be ascertained about a new site before commencing a hydro project is:

- An estimate of annual energy generation from available flow and head
- Initial estimate of the viability of a project, i.e. costs and revenue
- Permissions likely to be required to develop the project
- The location of a grid connection

## Environmental design considerations

Key environmental features of a small hydropower scheme need to include:

- A fish-friendly turbine or upstream screen
- Safe routes for fish
- Sufficient flow to maintain the ecology and amenity value of the downstream watercourse.

## Feed in Tariff (FIT) (table 1)

Payments to anyone who owns a renewable electricity system (up to 5MW in size), for every kilowatt hour they generate. The tariff applies for 20 years and is index linked.

The "generation" tariff is paid on the total output of the renewable generation system whether you feed it into the grid or use it yourself. The "export" tariff is a bonus payment for every kilowatt-hour (kWh) your system exports to the electricity grid.

Hydropower	Generation Tariff p/kWh	Export Tariff (p/kWh)
0-15kW	19.9	3.0 – 5.0
15-100kW	17.8	3.0-5.0
100-2000kW	11	3.0 – 5.0
2000-5000kW	4.5	3.0 – 5.0

Table 1: FIT: Hydro Generation / Export Tariff over 20 year

## Steps in Small Hydro Development:

- Preliminary Site Assessment: Locating a suitable weir with sufficient flow and head. Considering flow diversion to a turbine, site access, demand for electricity, environmental considerations and land ownership. Carrying out initial calculations on power and energy output, costs and revenue.
- Feasibility: Hydrological survey, outline design, costing and energy and revenue
- Environmental Assessment: assessment of a projects likely environmental impacts and mitigation measures.
- Consultation with: Environment Agency, Planning Authority, Fisheries, Statutory environmental bodies, landowners, Regional Electricity Company.
- Letting a Contract for the engineering design and construction of the works.
- Commissioning and Handover including performance tests against specification.

## Planning Issues

- Visual appearance
- Noise
- Disruption during construction
- Structures of historic importance

## Environment Agency Licences

- Abstraction Licence
- Impounding Licence
- Land Drainage Consent



15kW example of scale: stream



100kW example of scale: river



## Grid Connections

It is likely that the electricity will be exported to the 11kV distribution system which is extensive in rural areas. It is financially advantageous to use electricity generated locally than to export.

## 4 key components of a small hydro project

1. An intake, incorporated into a weir, including trash and fish screens
2. A penstock pipe to deliver the flow to the turbine, sized to minimise head loss
3. A powerhouse for the turbine and generator
4. An outflow to release water back to the river

## Hydro technologies

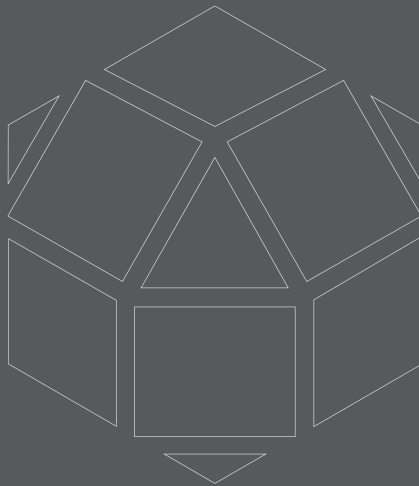
There are 4 main types of hydro technologies used to generate electricity in small hydropower projects:

- Waterwheels which are robust and can be used for low head sites.
- Archimedes screw which are popular for low head sites, high efficiency and fish friendly.
- Impulse turbines, such as the Pelton, Turgo and Crossflow in which a high velocity jet strikes the plane of the runner at an angle.
- Reaction turbines; such as Propeller, Kaplan and Francis which use the oncoming flow to generate a lift force to propel the runner blades.



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# Mannvit Engineering

Mannvit UK are an independent renewable energy consultant, dedicated to the development of renewable energy, energy efficiency and other efforts to reduce the effect of climate change. We design and manage the development of renewable energy solutions for our clients to capitalise on financial incentives, reduce carbon emissions and fuel costs. We are proud of our heritage and draw on 40 years of renewable energy experience from our operation in Iceland where 72% of electricity and almost 100% of heat is generated from renewable sources. Since the 1970's Mannvit has been actively designing and project managing Hydroelectric Power plants, Geothermal Power Plants and Bio Energy projects. We offer a broad range of services in renewable and alternative energy consulting from our UK offices and offer a multi-disciplinary approach to ensure the success of every project we run for our clients.

#### The Mannvit **website**

Mannvit's corporate web site, [www.mannvit.com](http://www.mannvit.com) contains further information and project examples for hydroelectric and geothermal power plants as well as contact information.



## MANNVIT

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