

# Small Scale Hydroelectricity



## Introduction

Presently about 6% of Ireland's electricity generating capacity is in the form of hydropower. The Ardnacrusha hydroelectric station built in the 1920's is still the country's largest renewable energy generating unit.

Hydroelectricity is derived from the power harnessed from the flow of falling water, typically from fast-flowing streams and rivers. There is no international agreement on the definition of small hydropower. In Ireland 'small' refers to an upper limit capacity of 10MW. Small-scale schemes (under 10MW) are usually operated by private developers and small companies.

Hydro power requires the source to be fairly close to the site of power usage or to the national grid. The turbine converts potential energy stored in the flow of water to produce electricity. The lack of a default purchaser of all renewable energy supplied to the network is the main deterrent to developing small-scale hydro generation. ESB fulfilled this function until 1994. Start-up costs are high, but, after the initial pay-back period, the developer is rewarded with power production from a "free fuel" at relatively low operating costs.

## The Market

Small-scale hydro is a useful way of providing power to houses, workshops or villages that need an independent supply. Considerable unexploited hydropower potential exists in Ireland at the small to micro-scale level. The electricity generated can potentially be supplied to the local community. Surplus electricity can be sold to the national grid.

By investing in a small hydropower system, it is possible to reduce exposure to future fuel shortages and price increases, and help reduce air pollution.

Improvements in small turbines and generator technology mean that "micro" technology (under 100 kW) hydro schemes are an attractive means of producing electricity. As a result much focus nowadays is on small developments. The likely range is from a few hundred watts (possible for use with batteries) for domestic schemes, to a minimum 250 kW for commercial schemes. Another option is to refurbish old buildings (for example saw mills) to generate electricity.

## Steps in Building a Small Scale HEP

### 1. Identify Sites with potentially good water resources

A sufficient quantity of falling water must be available. Determine the amount of power that you can obtain from the flowing water on your site. The power available at any instant is the product of what is called *flow* volume and what is called *head*. The best sites have a reliable water supply year-round and a large vertical drop in a short distance.

A rough estimate of the power available at a specific micro-scale site can be calculated from the equation:

$$\text{Power (kW)} = 6 \times \text{Head (m)} \times \text{Flow (m}^3\text{/sec)}$$

*Head* = the vertical flow of the water, essential for hydropower generation

*Flow* = volume of water passing per second

**Note:** Heads less than 2m are liable to be uneconomic.



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*This is one of a series of fact sheets on potential income generating activities.*

*All fact sheets are available in the Advisory Section of the Teagasc Website  
[www.teagasc.ie](http://www.teagasc.ie)*

**Edited by:**  
**John Whiriskey**  
**Paul McCarthy**  
Teagasc  
Mellows Development  
Centre  
Athenry, Co. Galway.  
**+ 353 (0) 91 845200**

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## 2. Research Planning and Licence requirements

If the potential output of a scheme is attractive, then one needs to be certain that permission will be granted. It is wise to commence informal discussions with planning and fishery board authorities early on in the assessment to get a better feeling for their attitude towards the project. The relevant local authority will decide if an Environmental Impact Assessment (EIA) is required. An EIA is carried out at the project proposal stage to determine if an Environmental Impact Statement (EIS) is required. Most proposed small-scale hydro schemes would have an output well below 20 megawatts and may not impound any water. A change in 30% of mean river channel flow is likely to occur and it is in this context that an EIA is required.

## 3. Consider the Environmental Impacts

Environmental effects must be considered (the effect of the dam on fish, flooding and so on). Turbines can have a 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.

## 4. Determine Proximity to Electricity Grid

The distance from potential sites to the nearest suitable connection point on the grid should be estimated and the cost of same. It is important to determine to whom the power will be sold. The electricity generated by a scheme may be used at the point of generation, in place of electricity supplied by the ESB. Alternatively it may be exported via the national grid. Presently, any new generator into the network must secure their own customers and buy any surplus at unpredictable prices. Therefore it is financially advantageous to consume as much power as possible on site and only export the surplus into the network.

## 5. Establish Access to Capital

Economics dictates the feasibility of a hydro plant. The economic viability of hydropower development is highly site specific. Generally, a hydro system requires substantial initial capital investments and relatively low operating costs. It is considered that the location and site conditions determine a significant amount of the development cost. The final point is to calculate the cost per kWh produced by the hydro plant. In this order, an estimate cost of building the plant at the site, the annual cost of the plant and all other costs must be done.

## 6. Build the Plant

The next step is to design and to effectively build the plant.

The major steps involved include:

- The preparation of the budget and facilities
- The turbine, generator, batteries, pipe for penstock, the inverter and any other items must be ordered.
- The delivery of the mechanical and electrical components can take some time. Meanwhile the dam, powerhouse, headrace, tailrace and other civil works can be built. The next step is to install the penstock and valves.

## Costs

Most of the development cost is determined by the location and site conditions the rest being the cost of manufacturing the electromechanical equipment. Initial costs may be high due to strict environmental regulations. To generalise, though, is estimated that production of electricity from small-scale hydro would range from 0.07 – 0.15 cents per kWh depending on closeness to the gridline. A large proportion of the capital costs are associated with the civil engineering works and, for plants in remote locations, the grid connection charges can also be significant.

## Links

Darrell Nightingale, Irish Hydro Power Association Glengarriff, Co. Cork Tel (027) 63212

E-mail: [darrelln@eircom.net](mailto:darrelln@eircom.net) Website: [www.irish-hydro.org](http://www.irish-hydro.org)

**Co-ordinated by: Paul Mc Carthy, Teagasc , Mellows Development Centre, Athenry, Co. Galway**  
**Email: [paul.mccarthy@teagasc.ie](mailto:paul.mccarthy@teagasc.ie) ☎ +353 (0)91 845200**