

Micro-Hydro

Practical Guide



Our Practical Guides cover five useful topics:

1. Use energy and fuels efficiently
2. Renewable energy
3. Lock carbon into soils and vegetation
4. Making the best use of nutrients
5. Optimise livestock management

For more Practical Guides, Case Studies, information on our Focus Farms and ideas to benefit your farm, visit www.farmingforabetterclimate.org

Find us on Facebook and follow us on Twitter @SACFarm4Climate



Energy produced from natural renewable resources such as wind, water and sunlight can reduce the demand on electricity generated from fossil fuels, meaning less harmful greenhouse gases (GHG) are emitted to the atmosphere.

Micro or mini-hydro is the term used for installations generating power from harnessing the energy in flowing or falling water, usually referring to schemes with a generating capacity of below 100 kW - many of the schemes considered at farm scale are in this category. Smaller schemes, generating below 5 kW are often referred to as pico-hydro.

Micro-hydro can be a predictable source of energy to supplement the farm. Selling the electricity to homes or businesses, or back to the grid

can all provide possible income. The Feed-in Tariff (FIT) scheme closed to new applicants from 1st April 2019. The government are consulting on future support and payment mechanisms for small-scale low-carbon generation, including Smart Export Guarantee (SEG), with more details to be announced in 2019.

Micro-hydro schemes may provide all power needs, or may supplement energy requirements, reducing spend on mains electricity and could be particularly helpful for off-grid situations.

Due to the nature of hydro power, output from a given size of micro-hydro scheme is likely to be greater than for other comparable renewable technologies. Schemes can also be engineered to last for over 50 years.

This Practical Guide concentrates on micro-hydro opportunities.

Installing micro-hydro could reduce electricity bills, supplement income, and reduce GHG emissions from the farm.

Is your site suitable?

If you are thinking about a micro-hydro scheme, you will need to consider the following points:

- Is there enough head and flow? **Head** is the vertical fall in the water from upstream to downstream level. Less than 10 m would be classed as low, 10 to 50 m medium and above 50 m would be described as high head. **Flow** is the volume of water passing per second, measured in m³/second. For smaller schemes, this may be easier to measure in litres per second, where 1000l/sec is equal to 1m³/sec. A basic calculation to assess the power in your watercourses is **Power (kW) = 7 (efficiency loss) x flow (m³/sec) x head (m)**
- What is the mean flow in your watercourse, i.e. what variation in flow can you expect over the year?
- How near are you to a load or grid connection? How easy will it be to transfer the power from point of generation to point of use?
- Are there any environmental impacts?
- Do you own all the land or will you need to seek permission from others?
- What are the planning and environmental licensing requirements?

Websites

- www.farmingforabetterclimate.org
- www.gov.scot
- www.ofgem.gov.uk
- www.ipcc.ch
- www.carbontrust.com
- www.energysavingstrust.org.uk
- www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy
- www.microgenerationcertification.org
- www.sepa.org.uk
- www.snh.gov.uk/docs/A301202.pdf
- www.british-hydro.org
- www.agrecalc.com



Micro-Hydro

Payment mechanisms

The Feed-in Tariff (FIT) scheme was often the main source of income for micro-hydro developments, however this is no longer available to new applicants as of 1st April 2019. Therefore, the financial aspects of any micro-hydro scheme need to be carefully considered before beginning a project.

To be financially viable a use for the generated electricity needs to be found, such as offsetting a high demand on site and saving on energy bills.

The opening up of energy markets, smart metering and other incentives may improve the economics of some schemes in the future. The government are consulting on future support and payment mechanisms for small-scale low-carbon generation including Smart Export Guarantee (SEG) which would remunerate small-scale low-carbon generators for the electricity they export to the grid. However, maximising onsite use of the generated electricity is still optimal.

Micro-hydro schemes have a long lifetime, making construction and installation costs per kWh of output low when compared to other renewable technologies.

Environmental and planning considerations

Micro-hydro schemes are generally deemed to have a low environmental impact when installed on a suitable site. Allowing fish migration and making sure there is enough water remaining in the watercourse all year round are key aspects when considering micro-hydro.

A CAR (Controlled Activities Regulations) licence will be required from SEPA. Guidance published by SEPA and SNH provides information on what sites are likely to be acceptable in respect of these regulations and can be accessed from the SEPA website.

It would be advisable to contact SEPA and the local Planning Authority at the planning stages to discuss your application before work commences. See the links overleaf for useful documents and publications.

Micro-hydro systems

Micro-hydro systems convert the potential energy stored in water within a stream, river or pond, into kinetic energy used to turn a turbine and produce electricity. Key factors affecting viability are the head or vertical distance over which the water falls and the flow rate of the watercourse.

On the farm, it is likely that the hydro system will be either one that requires storage of water in a reservoir or millpond or the more common 'run of river' type, taking a flow of water from the watercourse, diverting it through the turbine and then returning it back to the watercourse further downstream.

Because run of river systems depend on river flow, generation of electricity will vary throughout the year and so a back-up power source may be needed to compensate for these seasonal variations.

Hydro schemes must be designed and sized accurately to ensure maximum efficiency. Different types of turbine are available to suit head and flow conditions at the individual site. Some systems could be up to 90% efficient, although a more realistic figure for small scale installations is perhaps 50%.

Installation and maintenance

The costs for micro-hydro schemes will vary, as it will depend on your individual site and the works required. For a low head system, which uses for example, an existing pond, the costs may be in the region of £4,000 per kW installed.

For installations with medium head costs are typically £20-25,000 for a 5 kW unit. Once installed, micro-hydro units are deemed to be very reliable, so on-going maintenance costs should be low.

Although farmers can reduce costs by carrying out a lot of the groundwork, pipeline installation and concrete / metalwork themselves, it is vital to ensure the scheme is constructed to an acceptable standard.



Site Leasing

For larger scale hydro schemes (i.e. 100 kW upwards) the required capital outlay can be considerable.

There are a number of developers who specialise in this type of installation, who may pay an annual rental for a suitable site. Long term contracts are necessary to justify the outlay. In some cases joint ventures can be established between the landowner and the developer so that the risk and rewards are shared between the two parties.