CONSTRUCTING MICRO HYDROELECTRIC POWER PLANTS

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Abstract

In this article we are going touch on some of the topics about the way micro hydroelectric generators and power plants function , and what components they are actually consist of. Also we are going do discuss what are the advantages and disadvantages of building constructing a power plant like hydroelectric power plants. In addition to that the overall cost and prices are going to be discussed as well as in what conditions it's best to build them

Key words: MHP, AC, DC , Reaction Turbines, Wiring, Regulator, efficiency, monobloc, thermos, solar cells, solar radiation

Introduction

Microhydropower can be one of the most simple and consistent forms or renewable energy on your property.

If you have water flowing through your property, you might consider building a small hydropower system to generate electricity. Microhydropower systems usually generate up to 100 kilowatts of electricity. Most of the hydropower systems used by homeowners and small business owners, including farmers and ranchers, would qualify as microhydropower systems. But a 10-kilowatt microhydropower system generally can provide enough power for a large home, a small resort, or a hobby farm.

A microhydropower system needs a turbine, pump, or waterwheel to transform the energy of flowing water into rotational energy, which is converted into electricity.

How a Microhydropower System Works

Microhydropower System Components

Run-of-the-river microhydropower systems consist of these basic components:

Water conveyance -- channel, pipeline, or pressurized pipeline (penstock) that delivers the water

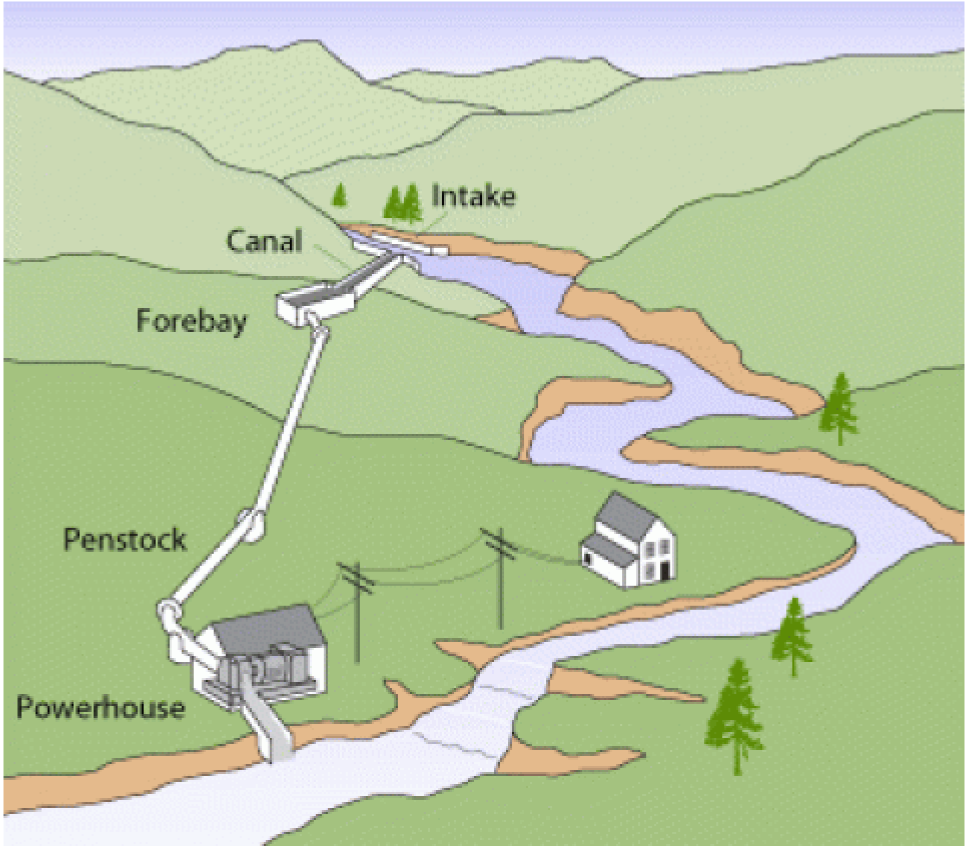
Turbine, pump, or waterwheel -- transforms the energy of flowing water into rotational energy

Alternator or generator -- transforms the rotational energy into electricity

Regulator -- controls the generator

Wiring -- delivers the electricity.

Image



Commercially available turbines and generators are usually sold as a package. Do-it-yourself systems require careful matching of a generator with the turbine horsepower and speed.

Many systems also use an inverter to convert the low-voltage direct current (DC) electricity produced by the system into 120 or 240 volts of alternating current (AC) electricity. (Alternatively, you can buy household appliances that run on DC electricity.)

Whether a microhydropower system will be grid-connected or stand-alone will determine many of its balance of system components.

For example, some stand-alone systems use batteries to store the electricity generated by the system. However, because hydropower resources tend to be more seasonal in nature than wind or solar resources, batteries may not always be practical for microhydropower systems. If you do use batteries, they should be located as close to the turbine as possible because it is difficult to transmit low-voltage power over long distances.

Turbine Types

Impulse Turbines

Impulse turbines, which have the least complex design, are most commonly used for high-head microhydro systems. They rely on the velocity of water to move the turbine wheel, which is called the runner. The most common types of impulse turbines include the Pelton wheel and the Turgo wheel.

Pelton wheel -- uses the concept of jet force to create energy. Water is funneled into a pressurized pipeline with a narrow nozzle at one end. The water sprays out of the nozzle in a jet, striking the double-cupped buckets attached to the wheel. The impact of the jet spray on the curved buckets creates a force that rotates the wheel at high efficiency rates of 70–90%. Pelton wheel turbines are available in various sizes and operate best under low-flow and high-head conditions.

Turgo impulse wheel -- an upgraded version of the Pelton. It uses the same jet spray concept, but the Turgo jet, which is half the size of the Pelton, is angled so that the spray hits three buckets at once. As a result, the Turgo wheel moves twice as fast. It's also less bulky, needs few or no gears, and has a good reputation for trouble-free operations. The Turgo can operate under low-flow conditions but requires a medium or high head.

Jack Rabbit turbine -- a drop-in-the-creek turbine that can generate power from a stream with as little as 13 inches of water and no head. Output from the Jack Rabbit is a maximum of 100 Watts, so daily output averages 1.5–2.4 kilowatt-hours, depending on your site. Sometimes referred to as the Aquair UW Submersible Hydro Generator.

Reaction Turbines

Reaction turbines, which are highly efficient, depend on pressure rather than velocity to produce energy. All blades of the reaction turbine maintain constant contact with the water. These turbines are often used in large-scale hydropower sites.

Because of their complexity and high cost, reaction turbines aren't usually used for microhydropower projects. An exception is the propeller turbine, which comes in many different designs and works much like a boat's propeller.

Propeller turbines have three to six usually fixed blades set at different angles aligned on the runner. The bulb, tubular, and Kaplan tubular are variations of the propeller turbine. The Kaplan turbine, which is a highly adaptable propeller system, can be used for microhydro sites.

Pumps and Waterwheels

Conventional pumps can be used as substitutes for hydraulic turbines. When the action of a pump is reversed, it operates like a turbine. Since pumps are mass produced, you'll find them more readily than turbines. Pumps are also less expensive. For adequate pump performance, however, your microhydropower site must have fairly constant head and flow. Pumps are also less efficient and more prone to damage.

The waterwheel is the oldest hydropower system component. Waterwheels are still available, but they aren't very practical for generating electricity because of their slow speed and bulky structure.

Micro Hydro Pros – Advantages

MHP is decentalised, renewable, robust, and simple technology.

It only takes a small amount of flow (as little as few litres per minute) or a drop as low as 1 m to generate electricity with micro hydro. Electricity can be delivered as far as 1 km away to the location where it is being used. If planned carefully and well adapted to the environmental conditions, micro hydropower schemes produce a continuous and predictable supply of electrical energy in comparison to other small-scale renewable technologies. The peak energy season is during the winter months when large quantities of electricity are required. MHP is considered to function as a 'run-of-river' system, meaning that the water passing through the generator is directed back into the stream with relatively little impact on the surrounding ecology. In comparison to large hydropower, MHP thus only has a little negative environmental impact. Negative socio-economic impacts are even insignificant in comparison. Further advantages include low distribution and running costs (requires no fuel and only low maintenance) as well as local implemenation and management. Moreover, hydropower is a durable and robust technology; systems typically last for 50 years or more without major new investments

Micro Hydro Cons – Disadvantages

There are, however, a number of disadvantages that need to be taken into account. MHP plants require certain site conditions and are thus not suitable for any location. In order to take full advantage of the electrical potential of small streams, a suitable site is needed. Factors to consider are: distance from the power source to the location where energy is required, stream size (including flow rate, output and drop), and a balance of system components — inverter, batteries, controller, transmission line and pipelines. Limited technical know-how especially in resource-rich locations might impede hydropower development.[2] Furthermore, the size and flow of small streams may restrict future site expansion as the power demand increases. As MHP plants require no reservoir, electricity generation is highly dependant on an constantly sufficient river discharge. In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output. Advanced planning and research will be needed to ensure adequate energy requirements are met. Finally, environmental impacts need to be taken into account. The ecological impact of small-scale hydro is minimal; however the low-level environmental effects must be taken into consideration before construction begins. Stream water will be diverted away from a portion of the stream, and proper caution must be exercised to ensure there will be no damaging impact on the local ecology or civil infrastructure.

Conclusion

Micro-hydro power systems typically cost between $1,500 and $4,000 per kilowatt of installed capacity. However, the cost can vary depending on several factors, such as: The manufacturer, The quality of the components, Installation costs, Location, The site.

A 1 kW micro hydro generator can cost anywhere from a few thousand dollars to over ten thousand dollars. A 5 kW micro hydro turbine system for residential or commercial sites typically costs between $15,000 to $55,000 including equipment, installation, and auxiliary components.

Hydro power plants are classified as micro (100 kW and below), mini (101 kW and 2000 kW) and small (2001 kW and 25000 kW) according to their power.

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