



E³A: Micro-hydropower for the Home, Farm or Ranch

Steps in the Micro-hydro Series

Understanding Micro-Hydro

Site Assessment

Equipment and Installer Selection and Costs

Regulations

Selecting equipment and installers

Selecting the right equipment for your location is crucial to the success of a hydropower system. Although waterwheels are still available today, most micro-hydropower systems use turbines. Turbines turn when moving water comes in contact with turbine blades, which in turn spin a shaft connected to a generator. Two main types of turbines are used for micro-hydro systems: impulse and reaction. Each turbine has a different design that makes it better suited for high- or low-head applications.



Impulse turbines

Impulse turbines are the most commonly used design for high-head systems. This relatively simple design uses the velocity of flowing water to turn a wheel called a runner. The Pelton and Turgo wheels are the most common types of impulse turbines.

The Turgo is an upgraded version of the Pelton wheel that operates more efficiently under certain conditions, particularly with medium heads of 50 to 150 feet. The Turgo wheel is often less expensive to manufacture than a Pelton wheel. Impulse turbines can generally operate under low-flow conditions but require a high head.

Reaction turbines

Reaction turbines use pressure rather than velocity to produce energy, and they are often highly efficient. Most large-scale hydroelectric projects use reaction turbines, but they can be used in low-head micro-hydro applications. Reaction turbines are more expensive, so they are less common than impulse turbines for micro-hydro installations.

Micro-hydro costs and incentives

In the right location, micro-hydro can be a low-cost source of renewable energy. Hydroelectric resources vary from location to location, so it is difficult to provide a cost estimate for a hydropower system. For example, low-head systems are generally more expensive than high-head systems. Also, some landowners may already have civil works, such as a diversion or penstock, already installed for other purposes. Table 1 provides a rough estimate of costs.



Micro-hydro system costs

Table 1. AC-Direct system installed by a contractor

System size		100 watts (flow rate of 63 gpm; head of 16 feet)	400 watts (flow rate of 63 gpm; head of 80 feet)	3.5 kW (flow rate of 222 gpm; head of 163 feet)
Component	Intake	\$1,200	\$1,200	\$1,500
	Penstock	\$2,000	\$2,000	\$4,000
	Turbine-generator	\$2,300	\$1,500	\$2,500
	Controller	\$350	\$350	\$650
	Transmission line	\$300	\$400	\$1,500
	Powerhouse	\$1,500	\$1,500	\$2,500
	Miscellaneous	\$4,400	\$4,500	\$4,800
	Total cost of equipment	\$12,050	\$11,450	\$17,450
	Installation cost	\$3,000	\$3,000	\$4,000
Total cost		\$15,050	\$14,450	\$21,450
Cost per watt		\$150.50	\$36.13	\$6.13

Estimates provided by Ken Gardner, Gardner Engineering from Kindberg, Leif. *Micro-Hydro Power: A Beginners Guide to Design and Installation*. National Sustainable Agriculture Information Service. February 2011. http://attra.ncat.org/attra-pub/farm_energy/hydropower.html.

Incentives

Unfortunately, micro-hydroelectric systems are not eligible for many of the financial incentives available to other renewable energy systems. The federal government provides relatively few incentives for micro-hydro, but local utilities may have some incentives. The Database of State Incentives for Renewables & Efficiency lists some incentives at <http://www.dsireusa.org>.

As of 2011, federal incentives include the following:

- Renewable Electricity Production Tax Credit: Available to qualified hydroelectric facilities that offer electricity for sale. Under current law, systems need to be in service by Dec. 31, 2013, to receive a \$0.011/kWh tax credit for the first 10 years of production. This is generally most practical for larger micro-hydro or small hydro installations.
- USDA Rural Development Rural Energy for America Program (REAP): Offers 25 percent grants up to \$500,000 and options for guaranteed loans for hydroelectric projects. The program is only available to agricultural producers and small businesses when electricity is not supplied to a residence.

References

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