RENEWABLE ENERGY

Turning water into electricity

FACT SHEET

BIOMASS

GEOTHERMAL

HYDROPOWER

SOLAR

WIND

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Wisconsin streams are both beautiful and powerful.

Waterpower has long been used for mechanical processes such as milling flour or sawing logs. The power of streams and rivers was initially harnessed to generate electricity in 1882, when the first hydroelectric water wheel was built on the Fox River in Wisconsin, shortly after the invention of the light bulb. However the use of small hydroelectric systems is rare among Wisconsin's homeowners and small businesses. This is primarily because suitable sites are relatively scarce.

THE BENEFITS OF HYDROPOWER

Environment. Well-designed, small hydroelectric systems have very little impact on a river's ecosystem. They produce pollution-free electricity, reducing the use of coal and other fossil fuels.

Cost. Small hydro systems can offer a low-cost source of renewable energy. In fact, for remote locations where a utility grid connection may cost $3 to $4 per foot to extend the power line, small hydroelectric facilities may provide an economical option.

Independence. Small-scale electrical generation systems, such as hydropower, promote self-sufficiency. These systems can also serve as a back-up power source when connected to the grid, and possibly offer the advantages of net metering. A small-scale hydropower system can even help to provide an uninterruptible power supply (UPS) to protect sensitive electronic equipment.

Predictability. Unlike wind and solar energy, hydroelectric systems can be designed to provide a source of energy that is continuous and predictable from hour to hour. Hydro systems have proven to be robust over years of use.

However, during dry times, the hydro system may need a back-up generation source and, during flooding, the system may need to be shut down. Some users combine hydro with another renewable technology such as wind or solar generation. This allows them to maintain reliable power in most weather conditions and reduce the necessary size of each system.

DESIGNING YOUR SYSTEM

Small systems can be designed to supply all electricity needs of a household, small business or industry. Small-scale hydroelectric systems range from 50 watts to 1 megawatt. Less than 20 feet is generally considered low

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With the help of a low-head microturbine even small streams or rivers can have hydropower potential.

head (see illustration, page 3). A low flow is about 30 gallons per minute. A mini-hydro system with a 20-foot head and 30 gallons of flow per minute would produce about 50 watts of continuous electricity (with 50 percent efficiency), or 1.2 kWh per day.

At larger sites, the river, stream or creek is partially blocked by a weir, which controls the water's flow and diverts it into a canal. The canal guides the water to a tube called a penstock. The penstock directs the water down a vertical drop where the water turns a turbine, which spins a generator to produce electricity. The water then returns to the river at its new elevation. At a small site where volume is abundant and steady, a tube can be placed into a stream or creek to collect water and direct it to a generator. In these cases, there is no need for weirs or canals. Some of the latest technologies do not even require a drop in water elevation. Generators are now being sold in Wisconsin that can be placed directly into a stream and are powered solely by the water's flow.

CONSIDERATIONS

Maintenance. Hydro systems generally require less time for operation and maintenance than other renewable energy

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HYDROPOWER

Early hydropower technology was more reliable and efficient than emerging fossil fuel technology, and for that reason, many hydropower plants were built on appropriate rivers and streams, usually to serve their immediate areas. But as fossil fuel technologies became fully developed, the trend toward large, centralized power stations began to become established. The hydropower plants that survived tend to duplicate this model. Most people know about Hoover Dam and other large dams that were built to generate enormous amounts of electricity. Unfortunately, although they can be very economical to operate, these gigantic dams are now seen as causing environmental damage.

Small hydroelectric systems are another story. They can be an environmentally benign source of electricity for rural homeowners and businesses. As more people become interested in small-scale, independent electricity generation, hydropower is regaining popularity. For locations on a river, stream or creek where there is a decline in elevation, a hydropower system can produce electricity or mechanical energy.

A number of historic hydropower plants in Wisconsin continue to produce electricity. (top) **The Noshonoc Hydropower Plant in West Salem, Wisconsin generates 450 kW.** (bottom) **This refurbished horizontal turbine was built in the 1920s but remains in use today, generating 800 kW of electricity.**

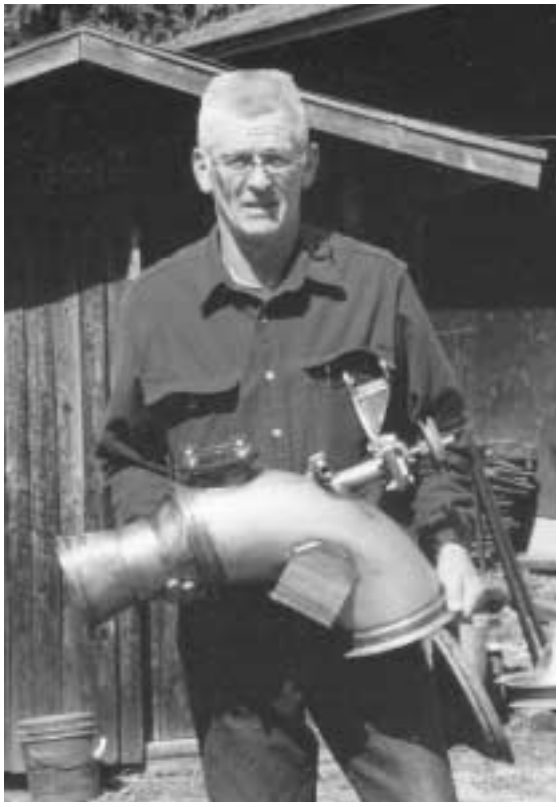
systems. However, users must be willing and able to perform maintenance to keep their systems running optimally and safely.

Fish. Well-designed hydro systems are environmentally benign. However, poor design can disrupt an ecosystem, especially for spawning fish.

Batteries. Batteries are not environmentally benign. Although quality recycling programs help mitigate their effects, the trade-off between connecting to the grid and using batteries off the grid should be made carefully. Hydroelectric systems can be used in both cases.

Permits. Installing dams, weirs or other water diversions in rivers and streams requires a permit or approval from the Wisconsin Department of Natural Resources (WDNR), even if the water is non-navigable. Consult with the WDNR office in your region before purchasing any equipment or making improvements to the riverbed. The telephone numbers of WDNR regional offices are listed on the department's web site (shown on back page).

Quality design and construction. To ensure a safe and reliable hydroelectric system, consult an experienced designer. Refer to Wisconsin's Renewable Energy Yellow Pages for a listing of Wisconsin's hydroelectric professionals.



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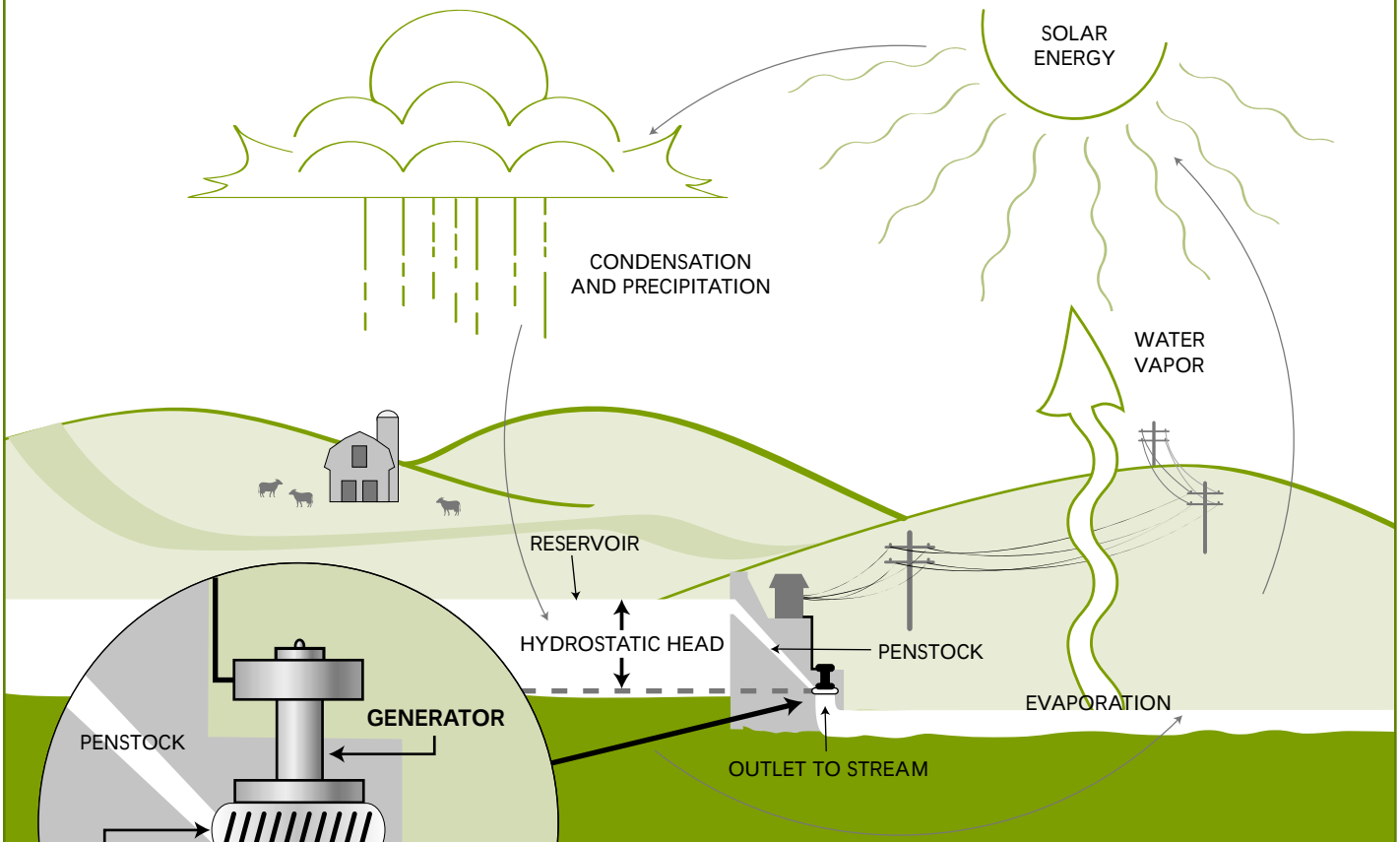
A Wisconsin manufacturer of low-head microturbines illustrates how small these systems can be.

LOW-HEAD HYDROPOWER



The cycle of rain, rivers and power: Hydropower is essentially solar power. The sun's rays contribute heat to the cycle of evaporation, condensation and precipitation that creates the earth's watersheds. Hydropower generation systems make use of the kinetic energy present in the movement of water after it falls to the earth and begins to seek sea level. The amount of electricity that can be produced depends on the vertical distance downward the water must travel (the hydrostatic head) and the volume of water running through the system (the flow).

A small, vertical-type microturbine before installation.

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This 20-kW hydropower plant in the Village of Oxford, Wisconsin, sells its power to Alliant Energy.

FOR MORE INFORMATION

focusonenergy.com
Contact Focus on Energy to learn more about renewable energy choices.

dnr.state.wi.us
For information about permitting, locate the appropriate WDNR regional office here.

Wisconsin's Renewable Energy Yellow Pages
Visit focusonenergy.com to access this directory of Wisconsin renewable energy providers.

europa.eu.int/comm/energy/library/hydro/layman2.pdf
"LAYMAN'S GUIDEBOOK ON HOW TO DEVELOP A SMALL HYDRO SITE." This detailed publication also explains how to assess site feasibility.

WISCONSIN HYDROELECTRIC FACTS
Hydroelectric power currently ranks second as a renewable energy source in Wisconsin; wood burning for space and process heat ranks first.
Electric utility hydropower sites in Wisconsin: 72
Electric utility hydropower capacity: 455,500 kW
Electric utility hydropower generation (annual): 1,734,000 MWh
Wisconsin non-utility hydropower sites (estimated): 50
Wisconsin non-utility hydropower generation (estimated annual): 595,700 MWh

WISCONSIN ENERGY STATISTICS 2001 FOR YEAR 2000
SOURCE: WISCONSIN DIVISION OF ENERGY

Focus on Energy is a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. The goals of this program are to encourage energy efficiency and use of renewable energy, enhance the environment, and ensure the future supply of energy for Wisconsin. For information about the Focus on Energy services and programs, call 800.762.7077 or visit www.focusonenergy.com.

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