

## Encyclopedic Entry

# hydroelectric energy

hydroelectric power, hydroelectricity

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[Hydroelectric energy](#) is made by moving water. Hydro comes from the Greek word for water.

Hydroelectric energy has been in use for thousands of years. [Ancient](#) Romans built [turbines](#), which are wheels turned by flowing water. Roman turbines were not used for [electricity](#), but for grinding [grains](#) to make [flour](#) and breads.

[Water mills](#) provide another source of hydroelectric energy. Water mills, which were common until the [Industrial Revolution](#), are large wheels usually located on the banks of moderately flowing [rivers](#). Water mills [generate](#) energy that powers such [diverse](#) activities as grinding grain, cutting [lumber](#), or creating hot fires to create [steel](#).

The first U.S. hydroelectric power plant was built on the Fox River in 1882 in Appleton, Wisconsin. This plant powered two paper mills and one home.

## Harnessing Hydroelectricity

To harness energy from flowing water, the water must be controlled. A large reservoir is created, usually by damming a river to create an artificial lake, or [reservoir](#). Water is channeled through tunnels in the [dam](#).

The energy of water flowing through the dam's tunnels causes turbines to turn. The turbines make generators move. [Generator](#)s are machines that produce electricity.

[Engineers](#) control the amount of water let through the dam. The process used to control this flow of water is called the [intake system](#). When a lot of energy is needed, most of the tunnels to the turbines are open, and millions of gallons of water flow through them. When less energy is needed, engineers slow down the intake system by closing some of the tunnels.

During [floods](#), the intake system is helped by a [spillway](#). A spillway is a structure that allows water to flow directly into the river or other body of water below the dam, bypassing all tunnels, turbines, and generators. Spillways prevent the dam and the community from being damaged. Spillways, which look like long ramps, are empty and dry most of the time.

## From Water Currents to Electrical Currents

Large, fast-flowing rivers produce the most [hydroelectricity](#). The Columbia River, which forms part of the border between the U.S. states of Washington and Oregon, is a big river that produces massive amounts of hydroelectric energy.

The [Bonneville Dam](#), one of many dams on the Columbia River, has 20 turbines and generates more than a million [watts](#) of power every year. That's enough energy to power hundreds of thousands of homes and businesses.

Hydroelectric power plants near [waterfalls](#) can create huge amounts of energy, too. Water crashing over the fall line is full of energy. A famous example of this is the hydroelectric plant at Niagara Falls, which spans the border between the United States and Canada.

Hydroelectric energy generated by Niagara Falls is split between the U.S. state of New York and the Canadian [province](#) of Ontario. Engineers at Niagara Falls cannot turn the falls off, but they can [severely](#) limit the intake and control the amount of water rushing over the waterfall.

The largest hydroelectric power plant in the world is the enormous [Three Gorges Dam](#), which spans the Yangtze River in China. It is 185 meters (607 feet) tall and 115 meters (377 feet) thick at its base. It has 26 turbines and will be able to generate more than a billion watts of power. The Three Gorges Dam is operating, but engineers are still working on the system. They are adding even more turbines and generators to the project.

## Hydroelectric Energy and the Environment

Hydroelectricity relies on water, which is a clean, [renewable energy](#) source. A renewable source of energy is one that will not run out. Renewable energy comes from natural sources, like [wind](#), [sunlight](#), [rain](#), [tides](#), and [geothermal energy](#) (the heat produced inside the Earth). [Non-renewable energy](#) sources include [coal](#), [oil](#), and [natural gas](#).

Water is renewable because the [water cycle](#) is continually recycling itself. Water [evaporates](#), forms clouds, and then rains down on the Earth, starting the cycle again.

Reservoirs created by dams can provide large, safe [recreational](#) space for a community. Boaters and water skiers can enjoy the lake. Many reservoirs are also [stocked](#) with fish. The area around a reservoir is often a protected natural space, allowing campers and hikers to enjoy the natural environment.

Using water as a source of energy is generally a safe environmental choice. It's not perfect, though. Hydroelectric power plants require a dam and a reservoir. These man-made structures may be [obstacles](#) for fish trying to swim [upstream](#). Some dams, including the Bonneville Dam, have installed [fish ladders](#) to help fish migrate. Fish ladders are a series of wide steps built on the side of the river and dam. The ladder allows fish to slowly swim upstream instead of being totally [blocked](#) by the dam.

Dams flood river [banks](#), destroying [wetland habitat](#) for thousands of [organisms](#). [Aquatic](#) birds such as [cranes](#) and [ducks](#) are often at risk, as well as plants that depend on the [marshy](#) habitat of a river bank. Operating the power plant may also raise the [temperature](#) of the water in the reservoir. Plants and animals near the dam have to adjust to this change or [migrate](#) elsewhere.

The OShaughnessy Dam on the Tuolumne River in the U.S. state of California was one of the first hydroelectric energy projects to draw widespread criticism for its [impact](#) on the environment. The dam, constructed in 1913, flooded a region called Hetch Hetchy Valley, part of [Yosemite National Park](#). (The lake created by the OShaughnessy Dam is called the Hetch Hetchy Reservoir.) Environmental coalitions opposed the dam, citing the destruction of the environment and the habitats it provided. However, the power plant provided [affordable](#) hydroelectric energy to the booming [urban area](#) around San Francisco.

The Hetch Hetchy Reservoir is still a [controversial](#) project. Many people believe the OShaughnessy Dam should be destroyed and the valley returned to its native habitat. Others contend that destroying a source of energy for such a major urban area would reduce the [quality of life](#) for residents of the Bay Area.

There are limits to the amount of hydroelectric energy a dam can provide. The most limiting factor is [silt](#) that builds up on the reservoirs bed. This silt is carried by the flowing river, but prevented from reaching its normal [destination](#) in a [delta](#) or river [mouth](#) by the dam. Hundreds of meters of silt build up on the bottom of the reservoir, reducing the amount of water in the facility. Less water means less powerful energy to flow through the systems turbines. Most dams must spend a considerable amount of money to avoid silt build-up, a process called [siltation](#). Some power plants can only provide electricity for 20 or 30 years because of siltation.

## Hydroelectric Energy and People

Billions of people depend on hydroelectricity every day. It powers homes, offices, factories, hospitals, and schools. Hydroelectric energy is usually one of the first methods a developing country uses to bring affordable electricity to [rural areas](#).

Hydroelectricity helps improve the [hygiene](#), education, and [employment](#) opportunities available to a community. China and India, for instance, have built [dozens](#) of dams over the past decade, as their development has quickly grown.

The United States depended on hydroelectric energy to bring electricity to many rural or poor areas. Most of this construction took place during the 1930s. Dams were a huge part of the [New Deal](#), a series of government programs that put people to work and brought electricity to millions of Americans during the [Great Depression](#). The Bonneville Dam on the Columbia River, the Shasta Dam on the Sacramento River, and the Hoover Dam on the Colorado River are some dams constructed as part of the New Deal.

The most famous hydroelectric power project of the New Deal is probably the [Tennessee Valley Authority \(TVA\)](#). The TVA constructed a series of dams along the Tennessee River and its tributaries. Today, the TVA is the largest [public](#) power company in the U.S., providing affordable electricity for residents in the states of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia.

However, hydroelectricity often comes at a human cost. The huge dams required for hydroelectric energy projects create reservoirs that flood entire valleys. Homes, communities, and towns may be relocated as dam construction begins.

Egypt began construction of the Aswan Dam complex on the Nile River in 1960. Engineers realized that ancient [temples](#) of Abu Simbel were going to be flooded by the reservoir, called Lake Nasser. These monuments were built directly into [cliffs](#) several stories tall. The Abu Simbel temples are a part of Egypt's [cultural heritage](#) and a major [tourist](#) destination. Rather than have the monuments flooded, the government of Egypt [relocated](#) the entire mountainside to an artificial hill nearby. Today, Abu Simbel sits above the Aswan Dam.

Chinas massive Three Gorges Dam project will bring safe, affordable electricity to millions of people. It will allow hospitals, schools, and factories to work longer, more reliable hours. It will also allow people to maintain healthier lifestyles by providing clean water. Construction of the dam directly benefited workers, too. More than a quarter of a million people have found work with the project.

However, the project has forced more than a million people to relocate. Lifestyles were disrupted. Many families were relocated from rural towns on the banks of the Yangtze River to Chongqing, a major urban area with 31 million residents. Other people were relocated out of the province entirely.

## VOCABULARY

<b>Term</b>	<b>Part of Speech</b>	<b>Definition</b>
<b>adjust</b>	<i>verb</i>	to change or modify something to fit with something else.
<b>affordable</b>	<i>adjective</i>	reasonably priced, not expensive.
<b>ancient</b>	<i>adjective</i>	very old.
<b>ancient Rome</b>	<i>noun</i>	civilization founded on the Mediterranean Sea, lasting from the 8th century BCE to about 476 CE.
<b>aquatic</b>	<i>adjective</i>	having to do with water.
<b>bank</b>	<i>noun</i>	a slope of land adjoining a body of water, or a large elevated area of the sea floor.
<b>Bay Area</b>	<i>noun</i>	region surrounding San Francisco Bay in the U.S. state of California.
<b>block</b>	<i>verb</i>	to prevent something from happening.
<b>Bonneville Dam</b>	<i>noun</i>	series of hydroelectric dams and locks across the Columbia River in the U.S. states of Oregon and Washington.
<b>bypass</b>	<i>verb</i>	to go around or skip.
<b>cite</b>	<i>verb</i>	to give as an example.
<b>cliff</b>	<i>noun</i>	steep wall of rock, earth, or ice.
<b>cloud</b>	<i>noun</i>	visible mass of tiny water droplets or ice crystals in Earth's atmosphere.
<b>coal</b>	<i>noun</i>	dark, solid fossil fuel mined from the earth.
<b>continual</b>	<i>adjective</i>	ongoing or repeating frequently.
<b>controversial</b>	<i>noun</i>	questionable or leading to argument.
<b>crane</b>	<i>noun</i>	large wading bird.
<b>cultural heritage</b>	<i>noun</i>	traditions and customs of a specific population.
<b>dam</b>	<i>noun</i>	structure built across a river or other waterway to control the flow of water.
<b>delta</b>	<i>noun</i>	the flat, low-lying plain that sometimes forms at the mouth of a river from deposits of sediments.
<b>destination</b>	<i>noun</i>	place where a person or thing is going.
<b>developing world</b>	<i>noun</i>	nations with low per-capita income, little infrastructure, and a small middle class.
<b>diverse</b>	<i>adjective</i>	varied or having many different types.
<b>dozen</b>	<i>noun</i>	a group of 12.
<b>duck</b>	<i>noun</i>	aquatic bird.
<b>electricity</b>	<i>noun</i>	set of physical phenomena associated with the presence and flow of electric charge.
<b>employment</b>	<i>noun</i>	job or work.
<b>engineer</b>	<i>noun</i>	person who plans the building of things, such as structures (construction engineer) or substances (chemical engineer).
<b>environmental coalition</b>	<i>noun</i>	group of people or organizations who are united in defense of the environment or an environmental issue.

**evaporate**      *verb*      to change from a liquid to a gas or vapor.

<b>factory</b>	<i>noun</i>	one or more buildings used for the manufacture of a product.
<b>fall line</b>	<i>noun</i>	imaginary line along which parallel rivers plunge, or fall.
<b>fish ladder</b>	<i>noun</i>	series of steps overflowing with water, where fish can migrate upstream around a barrier such as a dam.
<b>flood</b>	<i>noun</i>	overflow of a body of water onto land.
<b>flour</b>	<i>noun</i>	ground grain, usually of wheat.
<b>gallon</b>	<i>noun</i>	unit of volume equal to four quarts (3.79 liters).
<b>generate</b>	<i>verb</i>	to create or begin.
<b>generator</b>	<i>noun</i>	machine that converts one type of energy to another, such as mechanical energy to electricity.
<b>geothermal energy</b>	<i>noun</i>	heat energy generated within the Earth.
<b>grain</b>	<i>noun</i>	harvested seed of such grasses as wheat, oats, and rice.
<b>Great Depression</b>	<i>noun</i>	(1929-1941) period of very low economic activity in the U.S. and throughout the world.
<b>habitat</b>	<i>noun</i>	environment where an organism lives throughout the year or for shorter periods of time.
<b>Herbert Hoover</b>	<i>noun</i>	(1874-1964) 31st president of the United States.
<b>hydroelectric energy</b>	<i>noun</i>	energy generated by moving water converted to electricity. Also known as hydroelectricity.
<b>hydroelectricity</b>	<i>noun</i>	power generated by moving water converted to electricity. Also called hydroelectric energy or hydroelectric power.
<b>hygiene</b>	<i>noun</i>	science and methods of keeping clean and healthy.
<b>impact</b>	<i>noun</i>	meaning or effect.
<b>Industrial Revolution</b>	<i>noun</i>	change in economic and social activities, beginning in the 18th century, brought by the replacement of hand tools with machinery and mass production.
<b>intake system</b>	<i>noun</i>	process engineers use to control the flow of water through a dam.
<b>lumber</b>	<i>noun</i>	precisely cut pieces of wood such as boards or planks.
<b>marsh</b>	<i>noun</i>	wetland area usually covered by a shallow layer of seawater or freshwater.
<b>migrate</b>	<i>verb</i>	to move from one place or activity to another.
<b>mouth</b>	<i>noun</i>	place where a river empties its water. Usually rivers enter another body of water at their mouths.
<b>natural gas</b>	<i>noun</i>	type of fossil fuel made up mostly of the gas methane.
<b>New Deal</b>	<i>noun</i>	(1933-1938) series of U.S. government programs intended to provide economic "relief, recovery, and reform" to Americans during the Great Depression.
<b>non-renewable energy</b>	<i>noun</i>	energy resources that are exhaustible relative to the human life span, such as gas, coal, or petroleum.

**obstacle**                      *noun*                      something that slows or stops progress.

<b>oil</b>	<i>noun</i>	fossil fuel formed from the remains of marine plants and animals. Also known as petroleum or crude oil.
<b>organism</b>	<i>noun</i>	living or once-living thing.
<b>power</b>	<i>noun</i>	ability to do work.
<b>province</b>	<i>noun</i>	division of a country larger than a town or county.
<b>public</b>	<i>adjective</i>	available to an entire community, not limited to paying members.
<b>quality of life</b>	<i>noun</i>	satisfaction with the material, cultural, and technological conditions of a region or population.
<b>rain</b>	<i>noun</i>	liquid precipitation.
<b>recreational</b>	<i>adjective</i>	having to do with activities done for enjoyment.
<b>recycle</b>	<i>verb</i>	to clean or process in order to make suitable for reuse.
<b>reduce</b>	<i>verb</i>	to lower or lessen.
<b>relocate</b>	<i>verb</i>	to move a residence or business from one place to another.
<b>rely</b>	<i>verb</i>	to depend on.
<b>renewable energy</b>	<i>noun</i>	energy obtained from sources that are virtually inexhaustible and replenish naturally over small time scales relative to the human life span.
<b>reservoir</b>	<i>noun</i>	natural or man-made lake.
<b>reuse</b>	<i>verb</i>	to use again.
<b>river</b>	<i>noun</i>	large stream of flowing fresh water.
<b>rural area</b>	<i>noun</i>	regions with low population density and large amounts of undeveloped land. Also called "the country."
<b>severe</b>	<i>adjective</i>	harsh.
<b>silt</b>	<i>noun</i>	small sediment particles.
<b>siltation</b>	<i>noun</i>	process where sediment and silt build up on the bottom of a reservoir, reducing the amount of water it can hold.
<b>spillway</b>	<i>noun</i>	dam structure that allows excess water to flow directly into the river or other body of water below the dam.
<b>steel</b>	<i>noun</i>	metal made of the elements iron and carbon.
<b>stock</b>	<i>verb</i>	to supply.
<b>sunlight</b>	<i>noun</i>	visible radiation from the sun.
<b>temperature</b>	<i>noun</i>	degree of hotness or coldness measured by a thermometer with a numerical scale.
<b>temple</b>	<i>noun</i>	building used for worship.
<b>Tennessee Valley Authority (TVA)</b>	<i>noun</i>	largest public utility in the U.S.

**Three Gorges Dam**

*noun*

electrical power plant along the Yangtze River in China.

<b>tide</b>	<i>noun</i>	rise and fall of the ocean's waters, caused by the gravitational pull of the moon and sun.
<b>tourist</b>	<i>noun</i>	person who travels for pleasure.
<b>tributary</b>	<i>noun</i>	stream that feeds, or flows, into a larger stream.
<b>turbine</b>	<i>noun</i>	machine that captures the energy of a moving fluid, such as air or water.
<b>upstream</b>	<i>adjective</i>	toward an elevated part of a flow of fluid, or place where the fluid passed earlier.
<b>urban area</b>	<i>noun</i>	developed, densely populated area where most inhabitants have nonagricultural jobs.
<b>water cycle</b>	<i>noun</i>	movement of water between atmosphere, land, and ocean.
<b>waterfall</b>	<i>noun</i>	flow of water descending steeply over a cliff. Also called a cascade.
<b>water mill</b>	<i>noun</i>	large mechanism powered by flowing water.
<b>watt</b>	<i>noun</i>	unit of power. Abbreviated w.
<b>wetland</b>	<i>noun</i>	area of land covered by shallow water or saturated by water.
<b>widespread</b>	<i>adjective</i>	affecting a large area or community.
<b>wind</b>	<i>noun</i>	movement of air (from a high pressure zone to a low pressure zone) caused by the uneven heating of the Earth by the sun.

## For Further Exploration

### Articles & Profiles

- U.S. Energy Information Administration: Today in Energy—Hydroelectric

### Websites

- National Geographic Environment: Freshwater
- U.S. Department of Energy: Hydrothermal Power Systems
- USGS: Hydroelectric Power: How It Works
- EPA: Hydroelectricity



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