Hydropower

What Is Hydropower?

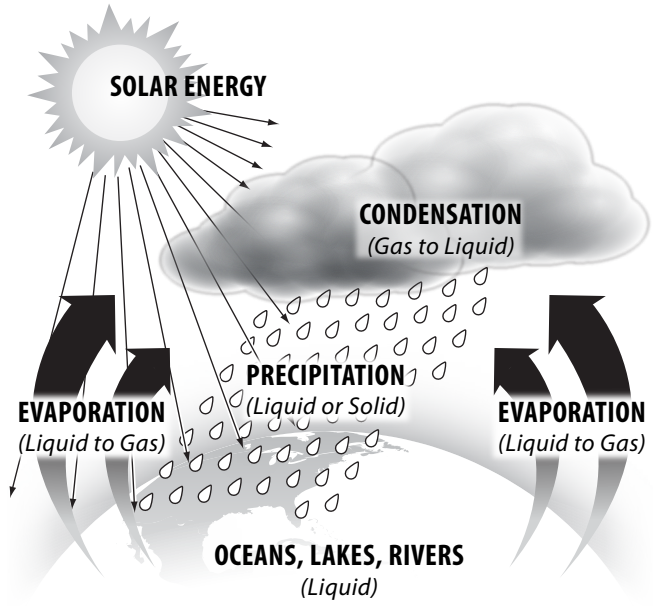
Hydropower (the prefix *hydro* means *water*) is energy that comes from the force of moving water.

The movement of water between the Earth and the atmosphere is part of a continuous cycle called the water cycle. The sun draws moisture up from the oceans and rivers, and this moisture condenses into clouds. The moisture is released from the clouds as rain or snow. The oceans and rivers are replenished with moisture, and the cycle starts again.

Gravity causes the water on the Earth to move from places of high ground to places of low ground. The force of moving water can be very powerful.

Hydropower is called a renewable energy source because it is replenished by snow and rainfall. As long as the sun shines and the rain falls, we won't run out of this energy source.

The Water Cycle



History of Hydropower

Water has been used as a source of energy for centuries. The Greeks used water wheels to grind wheat into flour more than 2,000 years ago. In the early 1800s, American and European factories used water wheels to power machines.

The water wheel is a simple machine. The wheel picks up water in buckets located around the wheel. The weight of the water causes the wheel to turn. Water wheels convert the energy of the moving water into useful energy to grind grain, drive sawmills, or pump water.

In the late 19th century, hydropower was first used on the Fox River in Appleton, WI to generate electricity. The first **hydroelectric power plant** was built in 1882. In the years that followed, many more hydropower dams were built. By the 1940s, most of the best sites in the United States for large dams had been developed.

At about the same time, fossil fuel power plants began to be popular. These plants could make electricity more cheaply than hydropower plants. It wasn't until the price of oil skyrocketed in the 1970s that people became interested in hydropower again.

Hydropower Dams

It is easier to build a hydropower plant on a river where there is a natural waterfall, which is why a hydropower plant was built at Niagara Falls. Building **dams** across rivers to produce artificial waterfalls is the next best way.

Dams are built on rivers where the terrain of the land produces a lake or **reservoir** behind it. Today there are more than 92,000 dams in the United States, but only about 2,200 were built specifically to generate electricity on a large scale.

Most of the dams in the United States were built to control flooding, to irrigate farm land, or for recreation, not for electricity production. We could increase the amount of hydropower produced in this country by putting equipment to generate electricity on many of the existing dams.

Hydropower Plants

Hydropower plants use modern turbine **generators** to produce electricity just as coal, oil, or nuclear power plants do. The difference is in the source used to spin the turbine.

A typical hydropower plant is a system that has three main parts: a reservoir where water can be stored, a dam with gates to control water flow, and a power plant where the electricity is produced.

A hydropower plant uses the force of flowing water to produce electricity. A dam opens gates at the top to allow water from the reservoir to flow down large tubes called **penstocks**. At the bottom of the penstocks, the fast-moving water spins the blades of the turbines. The turbines are attached to generators to produce electricity, which is transported along transmission lines to a utility company.

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Storing Energy

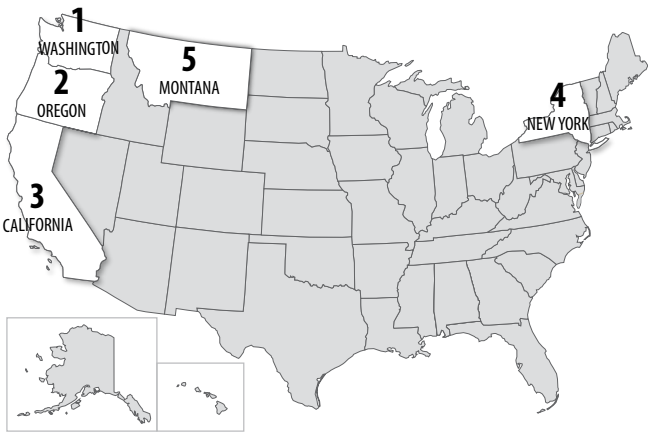
One of the biggest advantages of hydropower dams is their ability to store energy. After all, the water in the reservoir has **gravitational potential energy**. Water can be stored in a reservoir and released when electricity is needed. During the night, when consumers use less electricity, the gates can be closed and water held in the reservoir. Then, during the day, when consumers need more electricity, the gates can be opened so that the water can flow through the plant to generate electricity. Plants that use elevation to pump water back up at low demand and generate electricity again at periods of higher demand are called **pumped storage facilities**.

Amount and Cost of Hydropower

Depending upon the amount of rainfall during the year, hydropower can provide anywhere between five and 10 percent of the country's electricity. In 2025, hydropower provided about 5.5 percent of the nation's electricity. Globally, hydropower is a significant energy source, producing nearly 15 percent of the world's electricity. In South America, a little more than half of the electricity (54%) is produced by hydropower.

Hydropower is the cheapest way to generate electricity in the United States today. Hydropower is cheaper than electricity from coal or nuclear plants for many reasons. The fuel—flowing water—does not have to be transported and is free to use, unlike coal and uranium.

Top Hydropower-Producing States, 2025



Data: Energy Information Administration

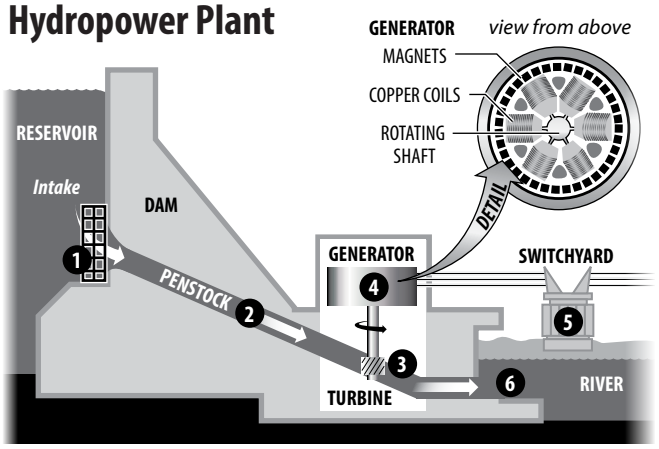
Hydropower and the Environment

Hydropower is a clean energy source. A hydropower plant produces no air pollution because it does not burn fuel, but it does affect the environment in other ways.

When dams are built, water patterns and the amount of flow in rivers are altered. Some wildlife and natural resources are also affected. Many dams today have **spillway gates** to control the flow of excess water, and incorporate **fish ladders**, elevators, and other devices to help fish swim up the river.

On the positive side, hydropower's fuel supply (flowing water) is clean and renewable—replenished by the water cycle. There are also other benefits. Dams can be designed to control flood water, and reservoirs provide lakes for boating, swimming, fishing, and other recreational activities.

Hydropower Plant



1. Water in a reservoir behind a hydropower dam flows through an intake screen, which filters out large debris but allows fish to pass through.
2. The water travels through a large pipe, called a penstock.
3. The force of the water spins a turbine at a low speed, allowing fish to pass through unharmed.
4. Inside the generator, the shaft spins coils of copper wire inside a ring of magnets. This creates an electric field, producing electricity.
5. Electricity is sent to a switchyard, where a transformer increases the voltage, allowing it to travel through the electric grid.
6. Water flows out of the penstock into the downstream river.

Top Ten Hydropower Countries

The countries below get over 90% of their electricity from hydropower.

1. **Venezuela**
2. **Malawi**
3. **Tajikistan**
4. **Albania**
5. **Ethiopia**
6. **Nepal**
7. **Central African Republic**
8. **Paraguay**
9. **Bhutan**
10. ***Norway**

*Norway gets about 89.6% percent of its electricity from hydropower.
Data: EIA

