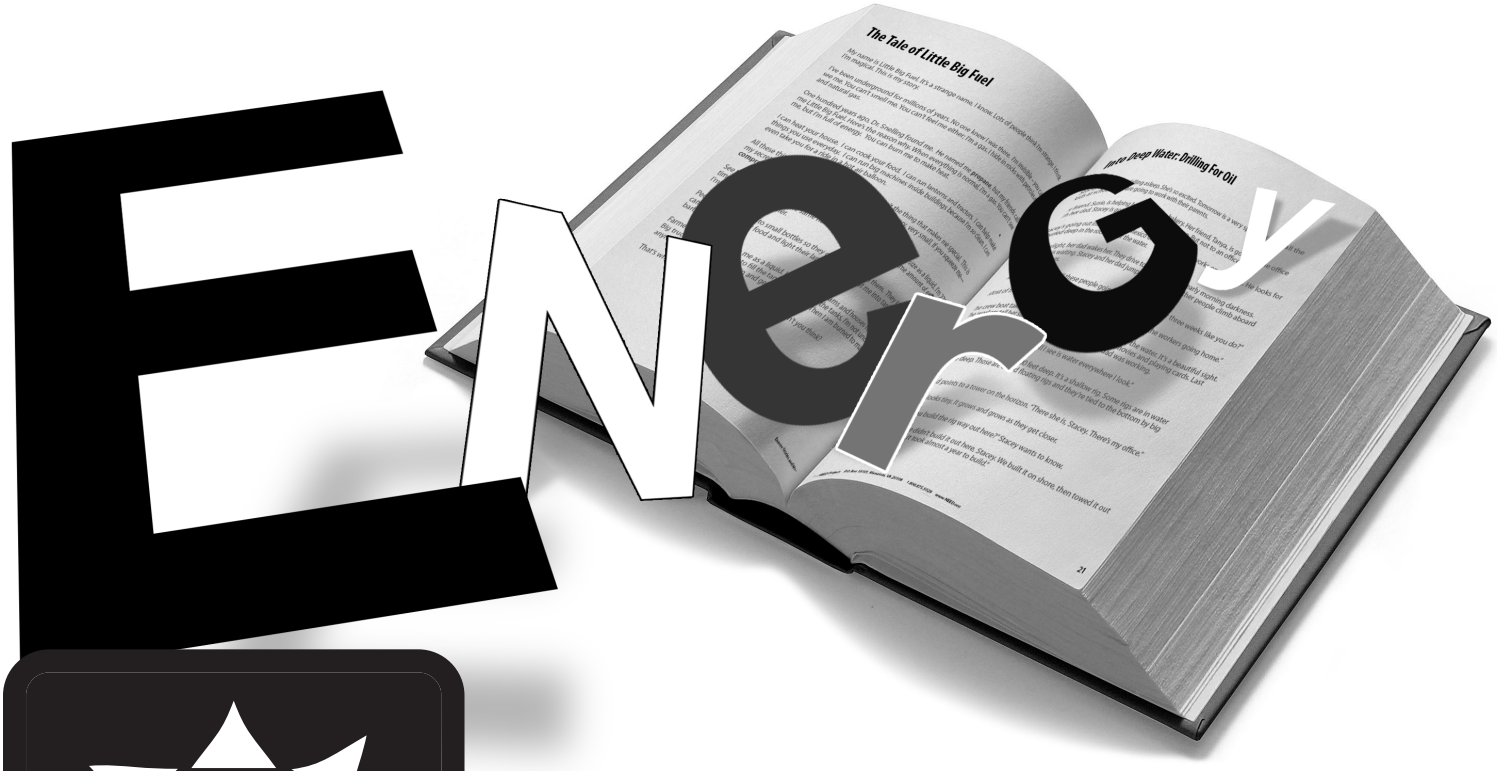
Energy Stories and More

A series of stories and hands-on activities that can be used to introduce basic energy concepts and the major energy sources to primary and elementary students.



Grade Level:

Pri Primary

Ele Elementary

Subject Areas:

Science

Social Studies

Language Arts

Public Speaking

NEED

National Energy Education Development Project

Teacher Guide

Background

Energy Stories and More is a series of stories and hands-on activities for teachers to use to introduce basic energy concepts and the major energy sources to elementary students.

The short stories, each with an energy theme, are designed so that older students can illustrate them and make them into story books to share with younger students. Alternately, primary students can illustrate them with assistance from student leaders or teachers. Each story is written to stand alone and has one or more activities to reinforce the energy information in it.

Time

Approximately one-half hour to one hour for each story. Hands-on activities require additional time as noted.

Materials

- Construction paper
- Markers, crayons, etc.
- Binding materials—stapler or yarn
- *Supplemental activities may require additional materials.*

Procedure

Preparation

- Choose a story. Decide whether student leaders or all students will do the illustrations.
- If student leaders are planning and presenting the activity, assign committees to design and format the book, print the text, draw and color the illustrations, bind the finished product, gather the props for the supplemental activity, and present the activity to the students.
- If the whole group of students will illustrate the story, format the book and write or print the text on pages beforehand. If possible, format the pages so that each student is responsible for illustrating one page of the book.

Bookmaking and Reading

- Introduce the activity to the students or student leaders. Read the story to the whole class. Lead a short class discussion to ensure that all the students understand the story.
- Give each student one page of the story, reading the text several times, if necessary. Allow each student to illustrate the page in any way desired, offering assistance only if asked.
- Collect the finished pages and bind the book with staples or colorful yarn. Read the finished story again, letting all students see the finished product. Display it prominently in the classroom, library, and at PTA meetings. Share it with other primary classrooms in the school.

Discussion and Supplemental Activities

- Discuss the concepts in the stories with the students.
- At the end of each story are one or more supplemental activities to reinforce the basic energy theme of the story. Instructions for each reinforcement activity are included with the activity.

Additional Resources

Check out the following resources for additional activities, information, and extensions to the materials presented in this guide.

- *Elementary Energy Infobook*
- *Primary Energy Infobook*
- *Energy on Stage*
- *NEED Songbook*
- *Energy Rock Performances*

These resources and more are available for download at www.NEED.org.

When They Dammed the River

Billy and his Grandpa were fishing in their favorite spot down river from the hydropower plant. They had caught many fish in this spot over the years. From where they were sitting they could see workers placing a new turbine into the plant.

"What are they doing, Grandpa?" Billy asked.

"They are replacing an old turbine with a new, more efficient turbine. The new turbine will be able to produce more electricity with the same amount of water," Grandpa explained. "It sure is a lot different today than when I was your age."

Billy was confused, "What do you mean?"

"When I was your age the dam and the hydropower plant weren't here. It was a big change for our community when they decided to dam the river and put the hydropower plant in. I still remember the day I found out. I had heard at school that we were all going to have to move and I rushed home to look for my mom…

"Mom! Mom! Where are you, Mom?" I looked all around our little cabin, but my mother wasn't there. I found a note on the kitchen table. It said:

"Fred, I went to town with Grandma. I'll be back after supper. There is a sandwich in the refrigerator. Please do your homework before you go fishing. I love you."

I wasn't hungry, but I ate a sandwich anyway, then wandered aimlessly around the cabin. Finally, I picked up my fishing pole from behind the door. I had homework to finish, but I was too upset to read anything. I headed down the path to the fishing hole.

I climbed out on the low branch of my sycamore tree and dangled my feet in the water. This was my favorite place in the world, the place where I came whenever I needed to be alone to think. I'd spent all last summer here. Now I needed to think about the story I'd heard at school that day.

As the sun went down, I slowly reeled in my line. I hadn't even checked the bait the whole evening. I'd had too much on my mind. As I walked back up the path, I heard my grandma's old Ford coming up the hill. I ran to meet my mother.

When I saw her face, I knew that she'd heard the story, too. "Mom, is it true? Are we really going to have to move?"

"Oh, Fred!" she said and pulled me close to her. "I'm so sorry!"

We stood silent, our tears shining in the moonlight. Finally my mother shook herself and said, "Let's go inside and have some hot chocolate. I'll tell you all about it."

"Mom, we have to do something. We can't just let them take this all away. Please, Mom, can't we stop them?"

The lights in the cabin flickered off and on. I quickly lit the kerosene lantern that we kept on the table.

My mother pointed over to the city. "See those lights, Fred? That's why. Everybody wants electricity—they want radios and refrigerators, all kinds of new things that run on electricity. That's what the meeting was about in town tonight—building a dam to make enough power for everybody in the valley."

"I know that, Mom. But why here? Why can't they build it someplace else?"

"They've studied the whole river valley, Fred. They showed us the maps tonight. This is the best place. There's always lots of water in the river here and the valley is shaped right."

"But we'll have to move. I love this place."

"There isn't one place on this river, Fred, where there isn't a boy just like you who's got a special place. Most of the towns in the valley are right on the river. You know that. This is the only place where a whole town won't have to be moved."

"Mom, isn't there any other way to make electricity?" I asked.

"Yes, some places burn coal. The people at the meeting say the dam will be a lot cheaper and cleaner, though."

My mom put her arm around my shoulder and said, "I don't want to move either, Fred. But the dam will mean new industry. I'll be able to get a job. They'll pay us good money for this place, too. Enough to buy a nice house with a refrigerator and our own car."

"This river is my life, Mom. What'll I do without it?" I asked.

"Fred, the river isn't going to disappear. They're going to dam it up and make a big lake, but the river below the dam and above the lake will still be there. And the lake will be a great place to fish and swim. I won't take you away from the water, Fred. I promise. Maybe we can get a new place right on the lake."

I was quiet for a moment, then asked, "How does damming the river make electricity, anyway?"

"There will be big turbines and generators at the bottom of the dam to make the electricity. It takes a lot of force to spin the turbines, so they dam the river to raise the water level. The bigger the distance between the water level and the turbines, the larger the force of the water. The dam will have gates in it to let the water flow into big pipes that channel the water to the turbines. They say it's a sight to see."

Finally I smiled for the first time that day. "They ought to hire you, Mom, to do their talking for them."

"Oh, Fred," she said, "I know this is going to be hard. I just figure we should look for the good in things rather than the bad. Let's take our hot chocolate down to the river and sit awhile."

...We were able to move just a short distance away, and my mother did get a job at the hydropower plant, just like she said she could. And, we still have lots of good places for fishing, just like this one here."

"Wow, Grandpa. Damming the river sounds like it was a big project, but I'm glad they did," Billy said.

"I'm glad, too, Billy."

Hydropower

Hydro comes from the Greek word meaning water. **Hydropower** is the energy we make with moving water. Moving water has a lot of energy. We use that energy to make electricity.

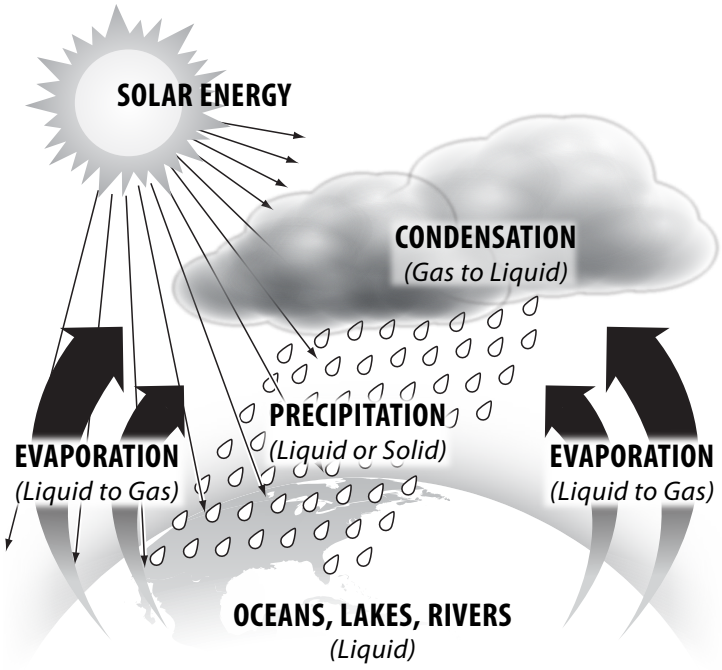
Gravity—the force of attraction between all objects—makes the water move. Gravity pulls the water from high ground to low ground. The rain that falls in the mountains flows down the valleys to the oceans.

Hydropower is Renewable

The sun heats the water in the oceans, lakes, and rivers, turning some of it into **water vapor**, a gas, almost like steam. This is called **evaporation**. The water vapor rises and turns into clouds. When it reaches the cold air above the Earth, it turns back into liquid water. This is called **condensation**. The clouds release the water as **precipitation**—rain or snow—that falls to the Earth. The water flows back into rivers, lakes, and the oceans, and the cycle starts again. This process is called the **water cycle**.

The water cycle will keep going forever. The water on Earth will always be there. We won't run out of it. That's why we call hydropower a **renewable** energy source.

The Water Cycle



People Can Use Hydropower

Early settlers used **water wheels** to grind grain and run sawmills. Factories used water wheels to run their machines. In many countries, water wheels are still used.

Water wheels can use the energy of moving water. A water wheel has buckets around a big wheel. The buckets fill with water at the top of the wheel. The weight of the water turns the wheel and dumps the water at the bottom.

Moving Water Can Make Electricity

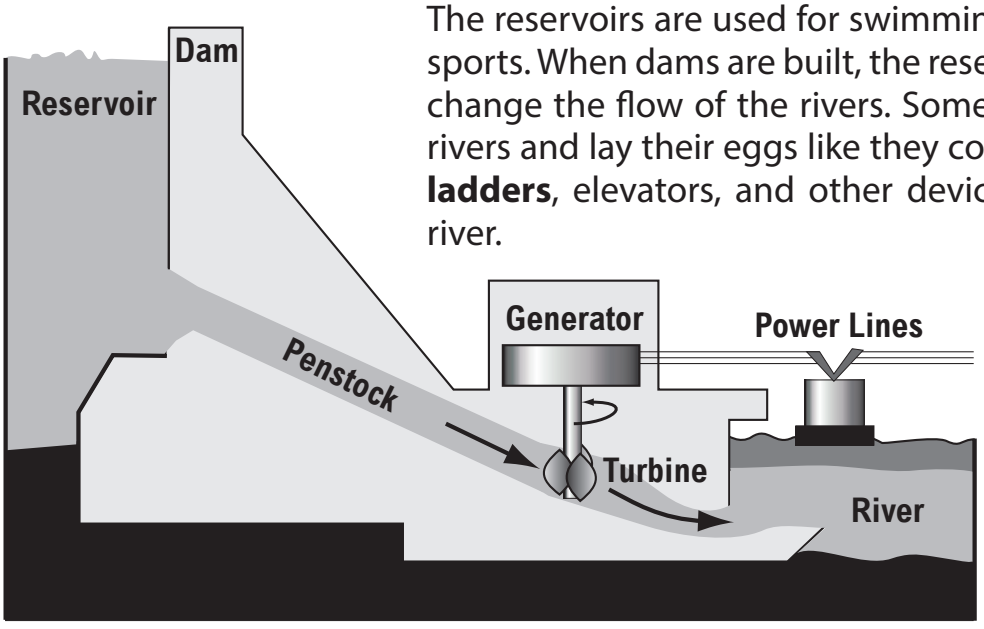
Moving water can be used to make **electricity**. First, a **dam** is built across a river. This stops the water and makes a big lake behind the dam. This lake is called a **reservoir**.

When gates in the dam are opened, water flows down big pipes called **penstocks** and turns giant wheels, called turbines. The **turbines** power **generators** to make electricity. The first hydropower plant was built on the Fox River in Appleton, Wisconsin, in 1882. Today, there are more than 2,000 dams in the United States that make electricity.

Hydropower is Clean Energy

Hydropower is a clean source of energy. No fuel is burned, so the air is not polluted. It is the cheapest source of electricity because the water is free to use. And we won't run out of water—it is renewable.

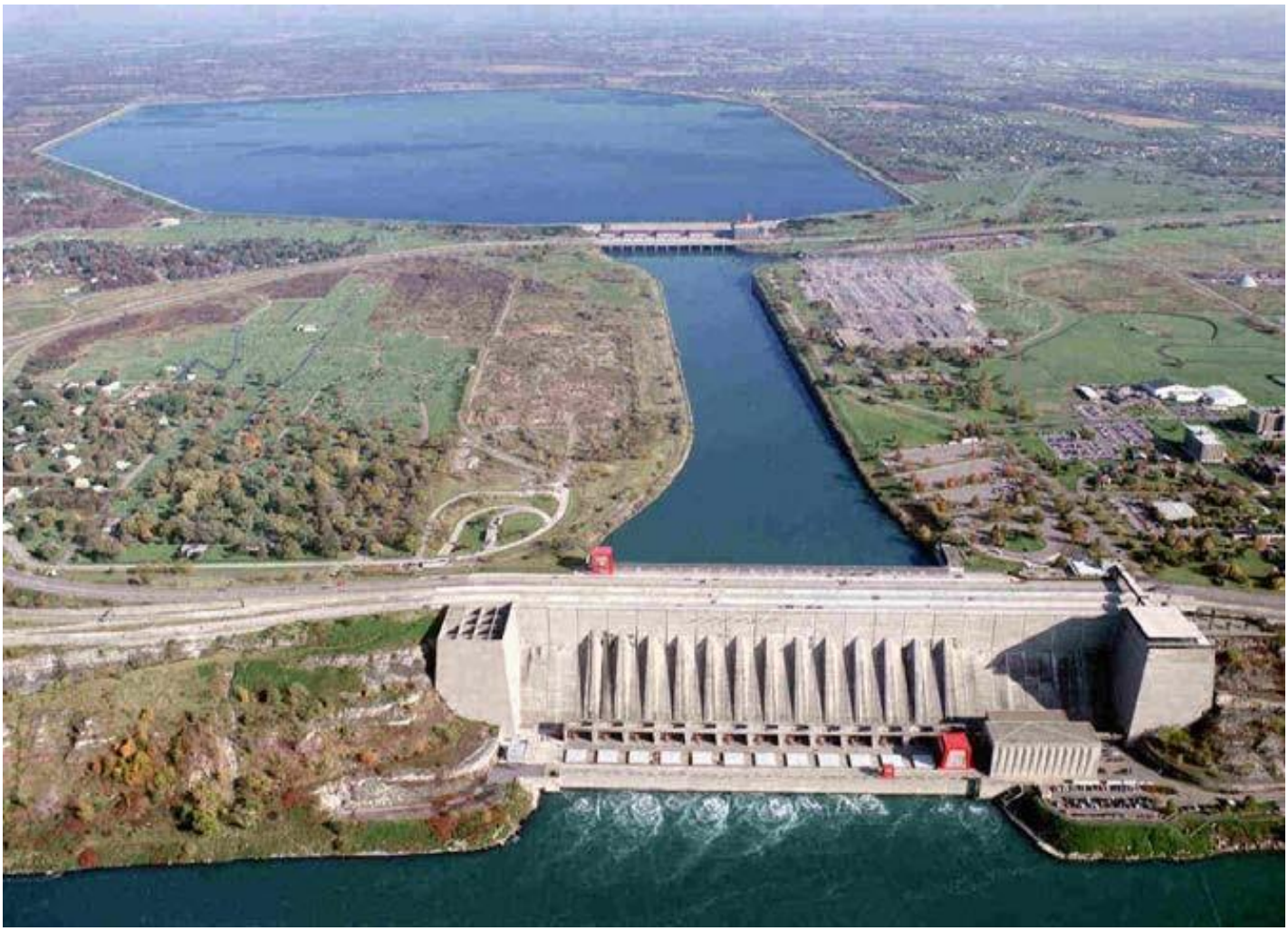
The reservoirs are used for swimming, fishing, boating, and other sports. When dams are built, the reservoirs flood a lot of land. They change the flow of the rivers. Sometimes, fish can't swim up the rivers and lay their eggs like they could before, so dams have **fish ladders**, elevators, and other devices to help fish move up the river.



Niagara Power Station Intakes

These towers hold the equipment that adjusts how much water flows over Niagara Falls. Beneath the towers are the valves that open and close the intake pipes which divert water from this point, a few miles upstream of the falls, through massive underground pipelines to the New York Power Authority's hydroelectric project, 4.5 miles downstream. While it is rarely done, the infrastructure exists to virtually turn off the flow over the falls. A 1950 treaty with Canada (located on the other side of the falls) requires that at least half the normal flow over the falls is maintained, at least during the daytime of the tourist season, but at night and during the winter months, the flow may be reduced to a quarter. For over a century, Niagara Falls has been the focus of grand ideas about power production and industrial utopias. This electrical generation system, comprised of the intake pipes, two turbine stations, and a massive forebay and water storage reservoir downstream, was the largest hydropower facility in the country when it went on line in 1961. It was a project of New York's master builder, Robert Moses, who was head of the New York Power Authority.

The New York Power Authority's Niagara Power Project is the largest renewable electricity producer in the state and the fifth largest in the nation. It meets more than 10 percent of New York's power needs. Since 1961 this hydroelectric facility has transformed the energy of the Niagara River and Niagara Falls into a treasure trove of economic benefits, saving the state's residents and businesses hundreds of millions of dollars a year in electricity costs. The project's power is among the lowest-cost in the state. It supplies energy to job-producing industries, steel making to ice cream packing, along the Niagara Frontier and in other parts of New York and to adjacent states.



Hoover Dam

The **Mike O'Callaghan–Pat Tillman Memorial Bridge**


Grand Coulee Dam – Washington State

Glen Canyon Dam - Arizona

Taum Sauk Hydroelectric Power Station - Missouri

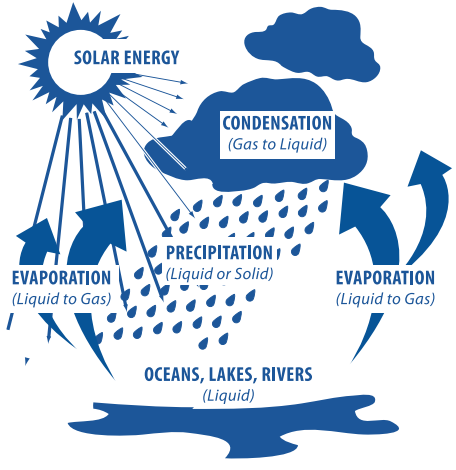
Hydroelectric power stations are typically located near water sources, or on the source itself, such as dams on rivers. But Taum Sauk Hydroelectric Power Station is located more than 80 kilometers from the nearest water source – the Mississippi river. Built on top of the mountainous St. Francois region of the Missouri Ozarks, approximately 140 km south of St. Louis near Lesterville, Missouri, the Taum Sauk Hydroelectric Power Station is a pure pumped-storage hydroelectric plant, designed to help meet peak power demands during the day. During periods of high electrical demand, water stored in a kidney-shaped reservoir on top of Proffit Mountain is released through turbines into a lower reservoir, two kilometers away, on the East Fork of the Black River. At night, when electrical demand is low, the excess electricity available on the power grid is used to pump water back to the mountaintop. In essence, the power plant functions like a huge battery, storing excess power until it is needed.

HYDROPOWER AT A GLANCE

WHAT IS HYDROPOWER?

Hydropower (from the Greek word hydor, meaning water) is energy that comes from the force of moving water. The fall and movement of water is part of a continuous natural cycle called the water cycle. Energy from the sun evaporates water in the Earth's oceans and rivers and draws it upward as water vapor. When the water vapor reaches the cooler air in the atmosphere, it condenses and forms clouds. The moisture eventually falls to the Earth as rain or snow, replenishing the water in the oceans and rivers. Gravity drives the moving water, transporting it from high ground to low ground. The force of moving water can be extremely powerful.

THE WATER CYCLE



HYDROPOWER PLANT

A typical hydropower plant is a system with three parts: a power plant where the electricity is produced; a dam that can be opened or closed to control water flow; and a reservoir (artificial lake) where water can be stored.

HEAD AND FLOW

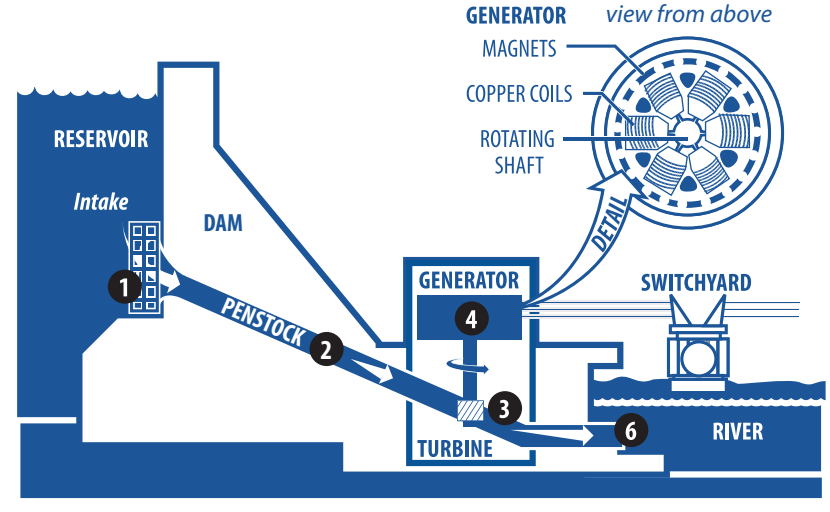
The amount of electricity that can be generated at a hydro plant is determined by two factors: head and flow. Head is how far the water drops. It is the distance from the highest level of the dammed water to the point where it goes through the power-producing turbine. Flow is how much water moves through the system—the more water that moves through a system, the higher the flow. Generally, a high-head plant needs less water flow than a low-head plant to produce the same amount of electricity.

STORING ENERGY

One of the biggest advantages of a hydropower plant is its ability to store energy. The water in a reservoir is, after all, stored energy. Water can be stored in a reservoir and released when needed for electricity production. During the day when people use more electricity, water can flow through a plant to generate electricity. Then, during the night when people use less electricity, water can be held back in the reservoir. Storage also makes it possible to save water from winter rains for generating power during the summer, or to save water from wet years for generating electricity during dry years.

PUMPED STORAGE SYSTEMS

Some hydropower plants use pumped storage systems. A pumped storage system operates much like a public fountain does; the same water is used again and again. At a pumped storage hydropower plant, flowing water is used to make electricity and then stored in a lower pool. Depending on how much electricity is needed, the water may be pumped back to an upper pool. Pumping water to the upper pool requires electricity so hydro plants usually use pumped storage systems only when there is peak demand for electricity



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 HYDRO STATES

WASHINGTON

OREGON

NEW YORK

CALIFORNIA

MONTANA

Data: Energy Information Administration

Vocabulary Terms

Hydropower – Hydro comes from the Greek word meaning water. Hydropower is the energy we make with moving water. Moving water has a lot of energy. That energy is converted into electricity at hydropower plants.

Gravity – is the force of attraction between all objects. Gravity makes water move by pulling water from high ground to low ground. The rain that falls in the mountains flows down the valleys to the oceans.

The Water Cycle

Evaporation – Liquid to gas.
Condensation – Gas to a liquid
Precipitation – Liquid or Solid

Eminent Domain – the right of the government to take private property for public use and compensate to owner of the property with a fair dollar amount.