Introduction to Hydro Energy

Re-Energy Backgrounder

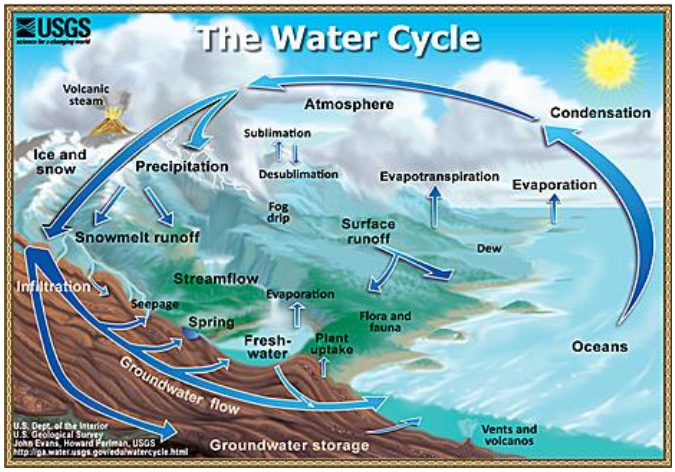
The Power of Moving Water

All around planet Earth, water is on the move. In rivers and creeks, water flows downhill under the force of gravity. It starts off as rain or snow falling on the highlands and mountains. Running water forms tiny rivulets and streams, which gather to form large rivers. Most rivers find their way to the edges of the continents, where they dump massive loads of fresh water and sediments into the oceans. Evaporation from the surface of rivers, lakes and oceans brings the water back into the atmosphere as invisible water vapour. Under the right conditions, unseen water vapour condenses from the air to form clouds and possible rain, snow, or hail. Seasonal rain and snowfalls bring fresh water back to the headwaters of streams, completing a very important ecological system called the "hydrologic cycle". By bringing fresh supplies of water to the highlands, the hydrologic cycle ensures that we always have energy available from flowing water.

Rivers and streams are among nature's most powerful forces. The force of water moving down a moderately-sized river can exceed several million horsepower. Over time, this force can slice through mountain ranges, and haul billions of tonnes of soil and debris to the oceans. This is the force humans attempt to harness when they build dams to generate electricity.

Rivers are the most familiar form of water in motion, but there are others! Oceans, waves, tides, and currents move unimaginable amounts of water around every day. Currents and waves are usually caused by winds blowing over the surface of the ocean, while tides are caused by the moon's gravity pulling gently on the earth. The action of waves, tides, and currents is especially noticeable near coastlines and islands, where they cause significant erosion.

Moving water is an important source of mechanical energy. Water is very dense compared to air and flowing water carries with it far more energy than a similar volume of moving air. Humans have long appreciated the power of moving water and have been using it for thousands of years.



The hydrologic cycle brings continuous supplies of freshwater to the uplands that feed river systems. *Photo courtesy of United States Geological Survey*

Early Water Power

The oldest machines for capturing the energy of moving water were waterwheels. In the days before electricity, it was common to use water wheels to provide the power for mills that ground grain or cut lumber. To start the mill, the miller simply opened the gate to let the water flow over the top of the wheel. The water wheel was connected to a massive milestone or metal saw blade through a system of gears. Water for the wheel usually came from a small dam and reservoir, called the millpond.

Large-scale Hydro Power

Canada has more fresh water in its lakes and rivers than any other country in the world. Many of Canadas largest rivers have been used to produce electricity. In fact, 61% of Canada's electricity comes from the energy of falling water. Electricity generated this way is called **hydroelectricity**.

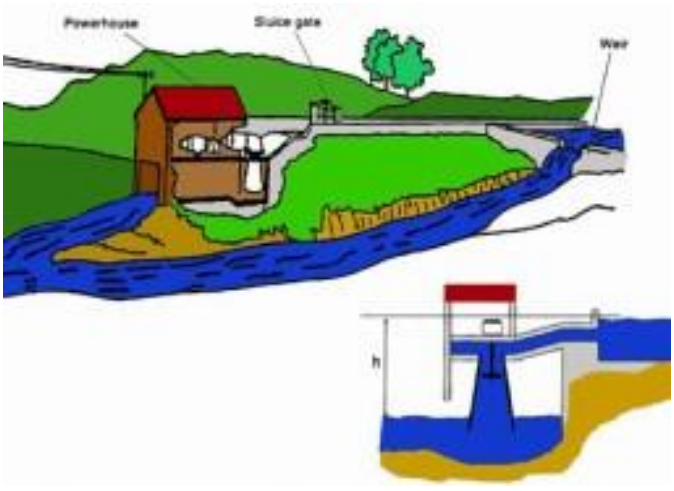
Hydroelectric facilities often depend on a dam to raise the level of the water in the reservoir. Water from this reservoir is allowed to fall through huge pipes to a building that houses water-driven turbines. Pressure from the falling water spins the turbines at high speed. The turbines are connected to huge generators that make electricity as they turn. This electricity is carried to cities and towns that may be located hundreds or even thousands of kilometres away.

Large-scale hydro usually has a big impact on the ecology of the river upstream from the dam. When the reservoir is filled, areas of forest or farmland are covered by water. Dams block the natural migration of fish and other creatures up and down the river and replace a flowing water ecosystem with an artificial lake. Salmon, which travel up rivers to spawn, are particularly affected by this ecosystem change. To reduce the impact of dams on salmon, some dams are equipped with "fish ladders"- narrow artificial streams up which the salmon can swim to get around the dam.

60% of Canada's electricity comes from hydroelectric facilities such as this one in Ontario, Canada shown below

Photo Courtesy of Shuttershock

There can also be environmental problems down-stream from the dam. Operations of the dam and generating station often cause the water level in the river to rise and fall drastically on a daily basis. Many organisms including most fish are not well adapted to such frequent and severe changes in water levels. Rivers that experience these changes usually contain fewer organisms than they would without the dam and reservoir.



A small-scale hydro system with a micro-hydro turbine. Photo courtesy of Murdoch University

Small-scale Hydro Power

One of the most environmentally friendly ways to make electricity is with a device called a micro-hydro turbine. The turbine itself may be as small as 10 centimetres in diameter and consists of spoon-shaped cups arranged around the centre of a wheel.

The wheel is mounted on a shaft that turns smoothly on sealed bearings. Jets of high-pressure water cause the wheel to spin at high speed. The spinning shaft can be used to power a variety of machines, including electrical generators, woodworking tools, pumps, fans, and more.

For communities in remote mountainous regions, small-scale hydro systems have a number of important environmental and social advantages:

- Micro-hydro is simple to install and maintain. The pipes, generators, and other parts are usually cheap and easy to find and are small enough to be handled without heavy equipment. This is especially helpful in areas where the terrain makes it expensive and difficult to build complex structures.
- Micro-hydro is environmentally friendly. It produces no pollution and requires only very slight changes to the flow of a small stream. No large dam or reservoir is necessary.
- Because the electricity is produced very close to where it is used, there is no need for an expensive electrical transmission line to carry the electricity to the community from far away.
- Micro-hydro systems are built with simple technology making it possible for local people with basic training to maintain their own power systems. This reduces the community's dependency on outside sources of energy and provides valuable local jobs.