Introduction to Hydro Energy

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, starting as rain or snow falling on highlands and mountains. Most rivers find their way to the edges of continents, where they deposit massive loads of fresh water and sediments into the oceans. Evaporation from the surface of rivers, lakes, and oceans returns the water to the atmosphere as invisible water vapor. Seasonal rain and snowfall bring fresh water back to the headwaters of streams by condensing vapor back to its liquid form through the "hydrologic cycle" or water cycle.

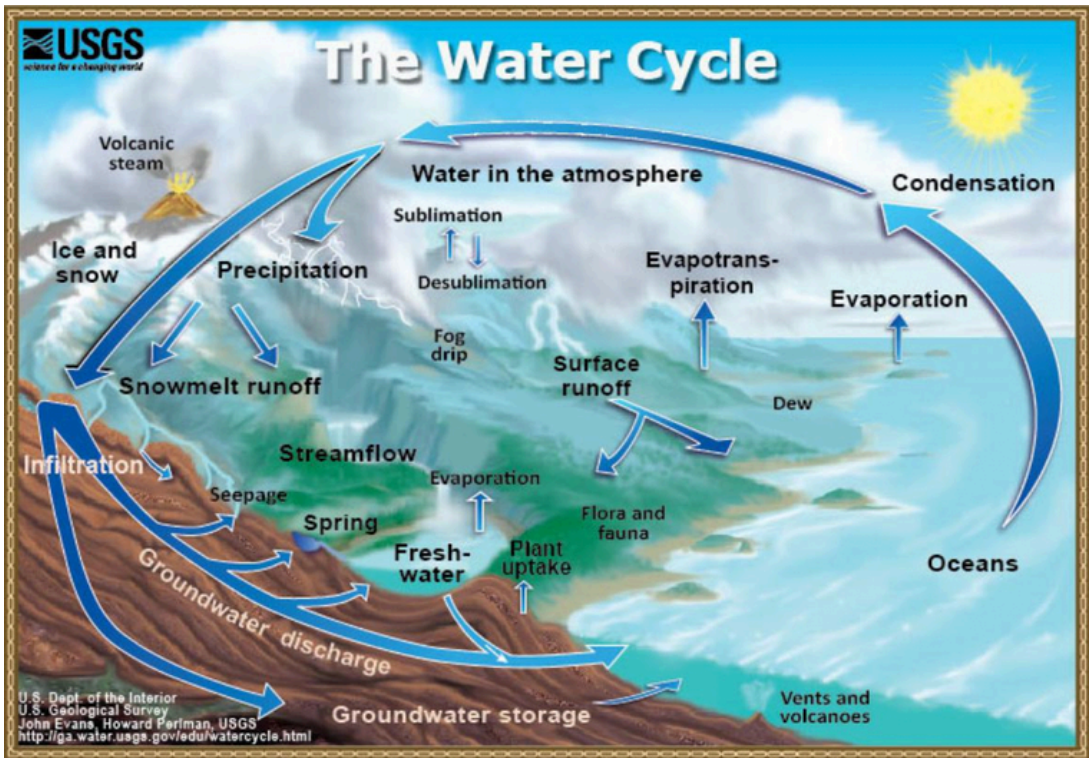

Figure 1. By bringing fresh supplies of water to the highlands, the hydrologic cycle ensures that we always have energy available from flowing water.
Photo courtesy of United States Geological Survey

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.

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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.

Photo Curtesy of James Peacock, Unsplash.
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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.

Early Water Power

The oldest machines for capturing the energy of moving water were water wheels. 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 millstone or metal saw blade through a system of gears. Water for the wheel usually came from a small dam and reservoir, called the millpond.

Example of a millpond.
Photo Courtesy of Pixabay. Retreived from: https://pixabay.com/photos/waterwheel-home-mill-water-4976889/

Large-scale Hydro Power

Canada has more fresh water in its lakes and rivers than any other country in the world. Many of Canada's largest rivers have been used to **hydroelectricity**, an electrical form that is generated using the force/flow of water.

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.

Did you know?

60% of Canada's electricity comes from hydroelectric facilities

Hydroelectric facility in Ontario, Canada. Photo Courtesy of Shuttershock.

Ecological Impact of Dams

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.

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.

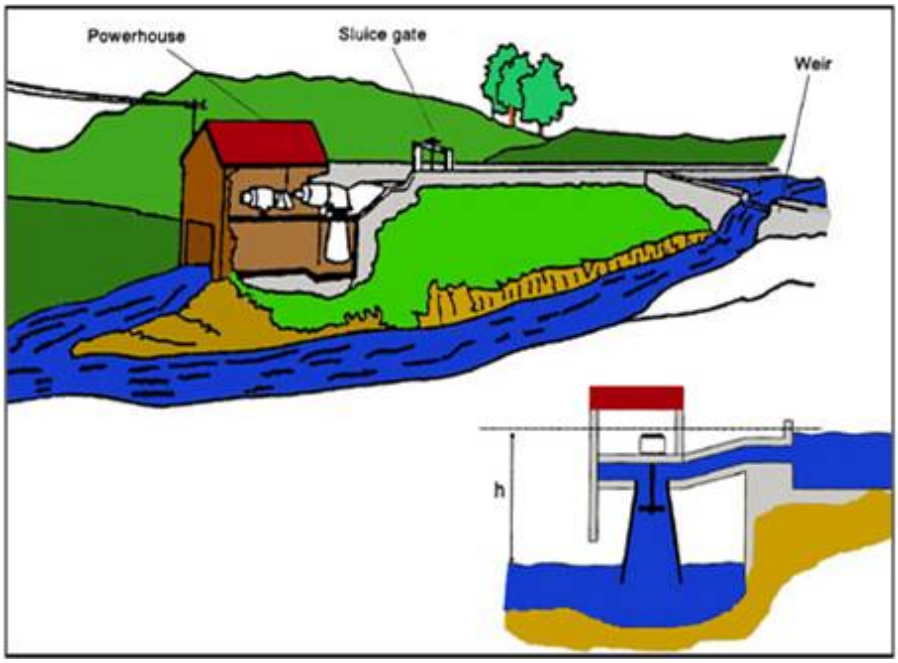
Small-scale Hydro Power

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.

Advantages of Small-scale Hydro Power in Remote Communities

- Simple installation and easy maintenance.
- Pipes, generators, and other parts are cheap, easy to find, and small enough to be handled without heavy equipment. This is helpful in areas where the terrain makes it expensive and difficult to build complex structures.
- Environmentally friendly. There is no need for large dams or reservoirs, produces no pollution, and low probability that you change the flow of a small stream.
- Don't require expensive electrical transmission line to carry the electricity to the community because the electricity is produced is close to where it is used.
- Reduce a community's dependency on external energy sources.
- Provides local jobs because small-scale hydro use simple technology so only basic training is needed.



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