What You Need to Know About Hydropower

Gemma Alexander

This article is the third in a six-part series that explores how how we get our electricity and how renewable — and non-renewable — electric power is generated.

Even though electricity is a major component of our ecological footprint, we tend to ignore it in favor of recycling and consumer choices.

It often seems like you can't do much about the energy you use, but it's important to understand where your energy comes from and how it affects your environmental footprint. Knowing your own energy source and its ecological cost can help you decide where to focus your own actions to make the biggest difference.

Power Mix

In the United States, few people rely on a single energy source. The overall mix of power sources in the U.S. can vary widely by state and region. In Arizona, natural gas and coal produce the majority of the state's electricity. In Washington state, where the Grand Coulee Dam is located, 74 percent of the energy used comes from hydropower.

Hydroelectricity is a form of renewable energy. That means its source — water — is naturally renewing and doesn't get used up in the process of generating power. Other renewable energy sources include solar power, wind power, biomass, and increasingly, geothermal energy. Hydropower is the single largest source of renewable energy in the U.S. Combined, renewable sources produce 17 percent of the United States' energy, with 7 percent coming from hydropower.

How Hydropower Works

To generate hydroelectricity, a dam is built across a body of moving water. The water backs up behind the dam, forming a reservoir, from which water is allowed to flow steeply downward through the dam at a controlled rate. As the water flows through the dam, it rotates a turbine, which then turns a generator, resulting in electricity.

Relative to other energy sources, hydroelectricity is cost-effective. Dams are expensive to build, but inexpensive to operate, often resulting in lower energy rates over the long term.

Environmental Benefits of Hydropower

Obviously, being renewable is a major environmental benefit of hydropower. But in addition to being renewable, hydropower is also considered a clean energy source.

Operating dams does not generate toxic air pollutants like coal plants do or hazardous solid wastes like waste-to-energy. Nor does it produce radioactive waste like nuclear power. Since dams control the flow of rivers, they minimize or even eliminate the risk of impacts from extreme weather. Dams prevent downstream flooding after heavy rains and during snowmelt. During droughts, reservoirs provide irrigation water. In the United States, the reservoirs are naturalistic, park-like areas that provide outdoor recreational opportunities and habitat for wildlife.

Ghost Dam and Reservoir, Alberta, Canada. Photo: Ingo Schwarze (CC BY 4.0), Wikimedia Commons

There Are Negative Environmental Impacts of Hydropower

Unfortunately, those recreational areas are not entirely natural.

Although the lakes created by hydroelectric dams can become ecosystems themselves, they permanently destroy the natural river ecosystem that existed before the construction of a dam. Native species — like salmon — that depend on the river can become threatened or even extinct. Around the world, major dam projects have also been responsible for the displacement and destruction of human communities, with ethnic minorities and impoverished communities particularly affected.

The upstream flooding that creates the reservoir is the most obvious environmental impact of hydropower. But newer science indicates that it may not be the most significant one.

Recent studies have revealed ways that hydropower is not as clean as previously thought. A growing body of research has identified reservoirs as significant producers of greenhouse gases. Because this is a fairly new area of study, efforts to quantify the impact are not definitive. But methane generated by reservoirs may be as much as 1 billion CO_2 equivalents.

Environmental Balance of Hydropower

Hydropower is much more problematic than other renewables like solar and wind power. In some cases, inefficient old dams are being removed and their habitats restored. But despite the environmental and social drawbacks, new hydropower plants are usually orders of magnitude cleaner than comparable coal plants. This makes the decision to build new hydropower plants a fraught choice for the lesser among evils rather than a truly sustainable option.

However, truly sustainable energy sources still cost much more. They also cannot always be scaled to meet energy needs. Especially in developing nations, hydropower is still the clear winner for large-scale energy production.

Three Gorges Dam hydroelectric plant, China. Photo: Le Grand Portage (CC BY 2.0), Wikimedia Commons

Run-of-River Hydropower

Most people think of conventional mega-dams like Hoover Dam when they think of hydropower. These impoundment hydroelectric systems are the most common type. But very small-scale and even dam-less hydropower systems are possible.

Run-of-river systems, also called diversion facilities or small hydro, channel some of the water from a river through the turbines with little or no water reservoir storage. This eliminates most of the environmental damage caused by a traditional dam structure. With no reservoir, their area of impact is much smaller, and they do not produce methane.

Run-of-river systems can generate distributed power in small facilities with a capacity of up to 100 kilowatts or less. They can also be scaled up to as much as 50 megawatts (MW). Unfortunately, they do not produce energy on a scale to replace existing dam infrastructure. For example, the world's largest dam, Three Gorges, despite its problems, produces 22,500 MW; Grand Coulee, America's largest, produces 6,800 MW.

Still, small hydro is renewable, sustainable, and inexpensive — a trifecta rarely found in energy production. Countries with abundant running rivers, like Canada, are beginning to explore run-of-river systems as an alternative to diesel generators in remote areas. In circumstances like these where small hydro is feasible, few other energy sources can compete.

What You Can Do

Very few people have homes built near running water with suitable conditions for an individual or community-scale diversion hydropower plant. Fortunately, many of us do have access to community renewable programs like the ones offered by Pacific Gas and Electric Company or Puget Sound Energy. These programs allow utility customers to purchase a more sustainable energy mix. Contact your local utility provider to find out if such a program is available where you live.

No matter what energy source you use, the most sustainable choice is to use less of it. If you aren't sure where you could improve, start with a home energy audit and prioritize changes based on the results. Many local utility companies also have efficiency programs to help customers reduce their energy use.

Feature image by Walter Siegmund (CC BY-SA 3.0), Wikimedia Commons

You Might Also Like...