HYDROPOWER

LPRO: LEGISLATIVE POLICY AND RESEARCH OFFICE

BACKGROUND BRIEF

WHAT IS HYDROPOWER?

Hydropower is one of the oldest sources of energy for producing mechanical and electrical energy. Hydropower was used thousands of years ago to turn paddle wheels to help grind grain. Before steam power and electricity were available in the United States, grain and lumber mills were powered directly with hydropower. Today, most hydroelectricity in the United States is produced at large dams on major rivers, and most of these hydroelectric dams were built before the mid-1970s.[1]

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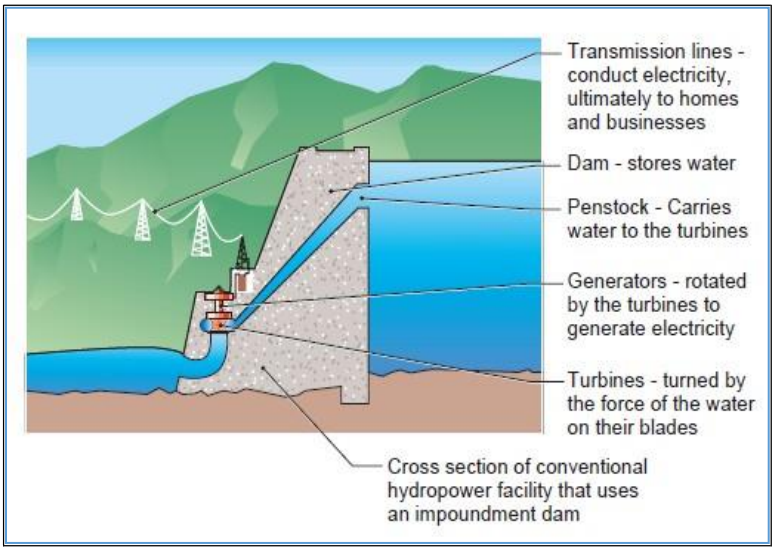
Figure 1: Impoundment Hydropower Facility Figure



Published by the U.S. Department of Energy

Hydropower, or hydroelectric power, uses the energy of flowing and falling water to create electricity. A typical hydropower system passes water through turbines connected to generators that create electricity as they rotate (see Figure 1). The amount of energy that can be produced depends upon water flow, volume and pressure.

[1] https://www.eia.gov/energyexplained/index.php?page=hydropower_home

TYPES OF DEVELOPMENTS

There are several types of hydropower facilities:

- **Impoundments** block river flow and selectively release water stored in the reservoir. They are the most common type of hydropower plant.
- **Diversion** facilities have an intake that withdraws water from the river without a reservoir.
- **Pumped storage** facilities move water between two reservoirs by releasing water from an upper reservoir to a lower reservoir to generate electricity during periods of high-power demand. During low demand, the water is pumped from the lower reservoir back to the upper reservoir.
- **Conduit** projects usually incorporate small turbines into existing infrastructure such as tunnels, pipelines, and canals to generate electricity from flowing water.

Impoundment facilities can have impacts on the environment including interruptions to migratory patterns of fish and other animals, methane off-gassing from reservoirs, and reduced downstream flows and resultant changes in stream temperature, oxygen levels, and habitat.

Since conduit projects can avoid the impacts to natural resources associated with other kinds of hydro projects, many new technologies focus on conduit designed for irrigation canals, municipal pipes and other types of artificial water conveyance structures. Examples in Oregon of hydropower innovation include Natel Energy's project for North Unit Irrigation District at a Bureau of Reclamation facility near Madras and Lucid Energy's installation in the City of Portland's municipal water pipes.

HYDRO ENERGY STORAGE

An affordable, grid-scale option for energy storage is **pumped storage**, which stores energy by pumping water uphill during times of low electricity demand. When demand for electricity is high, the stored water can be released to flow downhill and generate electricity. Pumped storage downsides include a relatively high cost per megawatt (**MW**) and potential incompatibility with restrictions on Columbia River Basin hydropower operations, including flow requirements and fish protections.

There are no pumped water storage projects in Oregon, but in April 2019, the Federal Energy Regulatory Commission (**FERC**) approved a license for the Swan Lake North Pumped Storage Hydroelectric Project near Klamath Falls, Oregon. If built, it will be the largest energy storage facility in the Pacific Northwest, with a 393 MW capacity, enough to meet the instantaneous demand of up to 390,000 homes.

OREGON AND HYDROPOWER

Hydropower in Oregon is considered a zero-emissions resource and has a low lifecycle carbon footprint from the embedded greenhouse gas emissions from manufacturing and construction. Dams also have significant stream flow and temperature impacts on fish habitat, alter sediment and nutrient regimens, and affect the ability of fish to migrate

from the river to the ocean and back. Additionally, initial dam construction inundates land while continued operation changes water levels through the year.

Hydropower is one of the top three sources for electricity generation in Oregon, joined by natural gas and wind. Per the 2018 Biennial Energy Report published by the Oregon Department of Energy, in 2016, Oregon generated 60,182,012 MWh of electricity, and hydropower was responsible for more than 57 percent of the state's electricity generation.[2] Of the electricity uses, hydropower makes up just over 40 percent of the state's resource mix.

Map 1: Map of Dams by Ownership

Published by the Army Corps of Engineers

There are 88 hydropower facilities in the state ranging from .04 MW to 2,160 MW, with 12 facilities that produce over 100 MW of electricity. Much of this power comes from the Federal Columbia River Power System, which includes 31 hydroelectric facilities across four states with a total capacity greater than 22,000 MW of power. The dams are operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation, and the Bonneville Power Administration markets the power from the system. 10 of these hydropower facilities are fully located in Oregon, and four of the largest projects—Bonneville, The Dalles, John Day, and McNary—span the Oregon and Washington state borders on the Columbia River (see Map 1).

[2] Oregon Department of Energy 2018 Biennial Energy Report: https://www.oregon.gov/energy/Data-and-Reports/Documents/2018-Biennial-Energy-Report.PDF

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