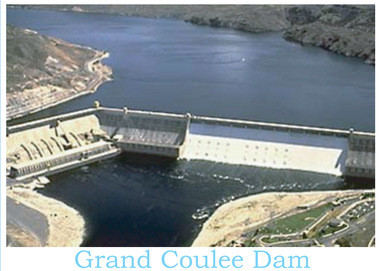


Grand Coulee Dam

Cle Elum Dam

French Canyon Dam

Hydropower

* Primary Contributor of Renewable Energy in U.S.
* Hydroelectricity currently produced each year in U.S. is equivalent to nearly 500 million barrels of oil
* Hydropower generation is not a contributor to atmospheric emissions
* 3% of the around 80,000 existing dams in the U.S. have hydropower facilities

History

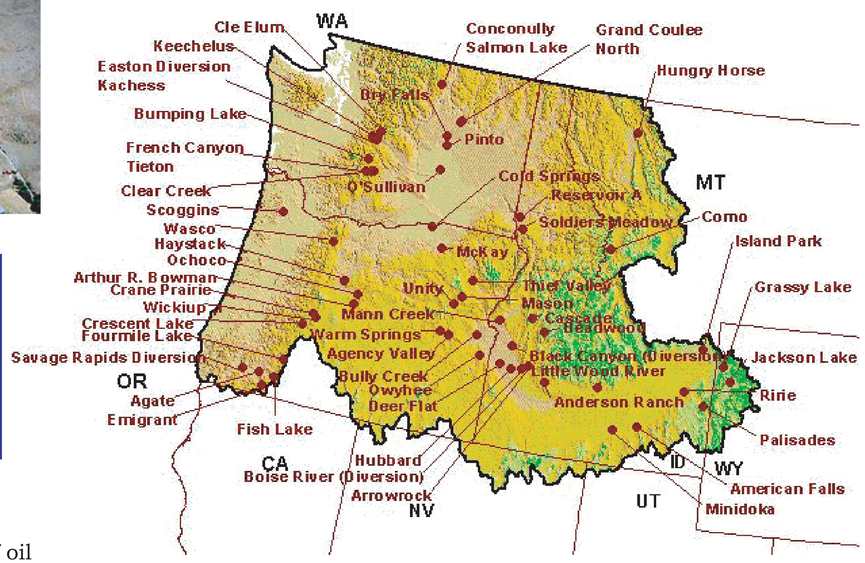
The Greeks used water wheels to grind wheat into flour more than 2,000 years ago. Besides grinding flour, the power of the water was used to saw wood and power textile mills and manufacturing plants. For more than a century, the technology for using falling water to create hydroelectricity has existed. The evolution of the modern hydropower turbine began in the mid-1700s when a French hydraulic and military engineer, Bernard Forest de Bélidor wrote *Architecture Hydraulique*. In this four volume work, he described using a vertical-axis versus a horizontal-axis machine.

During the 1700s and 1800s, water turbine development continued. In 1880, a brush arc light dynamo driven by a water turbine was used to provide theatre and storefront lighting in Grand Rapids, Michigan; and in 1881, a brush dynamo connected to a turbine in a flour mill provided street lighting at Niagara Falls, New York. These two projects used direct-current technology.

Alternating current is used today. That breakthrough came when the electric generator was coupled to the turbine, which resulted in the worlds, and the United States, first hydroelectric plant located in Appleton, Wisconsin, in 1882.

B.C. Hydropower used by the Greeks to turn water wheels for grinding wheat into flour, more than 2,000 years ago.
Mid-1770s French hydraulic and military engineer Bernard Forest de Bélidor wrote Architecture Hydraulique, a four-volume work describing vertical- and horizontal-axis machines.
1775 U.S. Army Corps of Engineers founded, with establishment of Chief Engineer for the Continental Army.
1880 Michigan's Grand Rapids Electric Light and Power Company, generating electricity by dynamo belted to a water turbine at the Wolverine Chair Factory, lit up 16 brush-arc lamps.
1881 Niagara Falls city street lamps powered by hydropower.
1882 World's first hydroelectric power plant began operation on the Fox River in Appleton, Wisconsin.
1886 About 45 water-powered electric plants in the U.S. and Canada.
1887 San Bernardino, Ca., opens first hydroelectric plant in the west.
1889 Two hundred electric plants in the U.S. use waterpower for some or all generation.
1901 First Federal Water Power Act.
1902 Bureau of Reclamation established.
1907 Hydropower provided 15% of U.S. electrical generation.
1920 Hydropower provided 25% of U.S. electrical generation. Federal Power Act establishes Federal Power Commission authority to issue licenses for hydro development on public lands.
1933 Tennessee Valley Authority established.
1935 Federal Power Commission authority extended to all hydroelectric projects built by utilities engaged in interstate commerce.
1937 Bonneville Dam, first Federal dam, begins operation on the Columbia River. Bonneville Power Administration established.
1940 Hydropower provided 40% of electrical generation. Conventional capacity tripled in United States since 1920.
1980 Conventional capacity nearly tripled in United States since 1940.
2003 About 10% of U.S. electricity comes from hydropower. Today, there is about 80,000 MW of conventional capacity and 18,000 MW of pumped storage.

http://www.eere.energy.gov/windandhydro/hydro_history.html



Bumping Lake Dam

* Potential sites for all types of hydropower exist that would double the U.S. hydroelectric production if they could be developed.
A variety of restraints exist, some natural and some imposed by our society. Finding solutions to the problems demands extensive engineering efforts. Sometimes no solution is possible, or is so expensive that the entire project becomes impractical.

Environmental Challenges

Reservoirs associated with large dams can cover land and river habitat with water and displace human populations. Diverting water out of the stream channel (or storing water for future electrical generation) can dry out streamside vegetation. Insufficient stream flow degrades habitat for fish and other aquatic organisms in the affected river reach below the dam. Water in the reservoir is stagnant compared to a free-flowing river, so water-borne sediments and nutrients can be trapped, resulting in the growth and spread of algae and aquatic weeds.

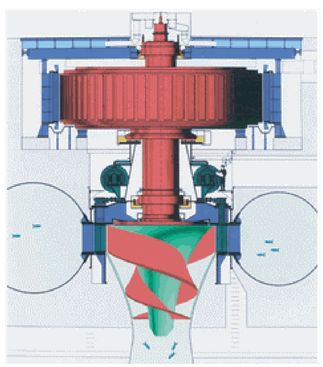
Hydropower projects can also affect aquatic organisms directly. The dam can block upstream movements of migratory fish such as salmon, steelhead, American shad, sturgeon, paddlefish, and eels. Downstream-moving fish may be drawn into the power plant intake flow and pass through the turbine. These fish are exposed to physical stresses that may cause disorientatioin, physiological stress, injury, or death.

http://www.eere.energy.gov

Hydromet

The bureau of Reclamation operates a network of automated hydrologic and meteorologic (Hydromet) monitoring stations located throughout the Great Plains and Pacific Northwest. This network collects remote field data and transmits it via satellite to provide real-time water management capability. Hydromet is then integrated with other sources of information to provide streamflow forecasting and current run off conditions for river and reservoir operations.

http://www.usbr.gov/



http://www.eere.energy.gov/windandhydro/hydro_how.html

Hydro Turbine Development

In the mid-1900s, the U.S. Department of Energy began researching into advanced hydropower technology. The goal is to develop systems that generate more electricity with less environmental impact. D.O.E. funded the conceptual designs of four turbine types: a redesigned Kaplan and Francis turbine, a dissolved -oxygen- enhancing turbine, and a new type that borrows technology from the food processing industry. This image shows what the new turbine design would look like.

compiled by Robyn Montgomery