

New and Emerging Hydropower and Battery Technologies

Supporting a 21st Century Carbon-Free Energy Stack

Engineers across the country are not just relying on current technologies and tools to meet power generation needs. Their problem solving is introducing new innovations and developing new technologies that create bridges to a carbon-free power generation future.

Pumped Storage Hydropower Projects

Pumped storage projects operate like conventional hydropower storage projects, but with a twist.

Water is pumped to an upper reservoir for storage. It's released downhill to turn turbines and generate electricity when demand is highest, also called peak periods, or when other weather dependent sources like wind and solar aren't available. Water is then pumped back to the upper reservoir when power generators normally run below capacity or sit idle.

You can think of pumped storage like a rechargeable battery. It provides energy on demand when needed, and then when energy is no longer needed or is exhausted, the battery can be charged up by another energy source.

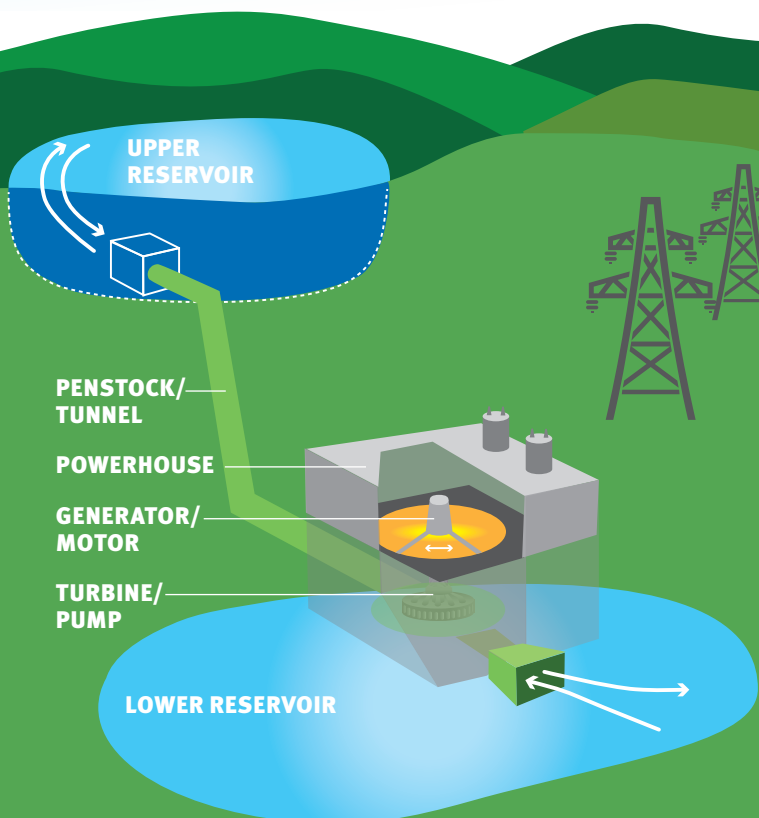
Like conventional hydropower, this flexibility makes pumped storage an ideal partner for solar and wind power projects. "Closed loop" pumped storage projects have the added benefit of continuously recirculating water between the lower and upper reservoirs. By largely or completely decoupling operations from river flows, environmental impacts can be minimized.

Currently, the John W. Keys III Pump Generating Plant at Grand Coulee Dam is the Northwest's only pumped storage project. The Swan Lake Energy Storage Project in Oregon is scheduled to open in 2029.

The capital cost of large pumped storage projects are very high, and they take over 10 years to move through the design, permitting and construction process. 🌍

PUMPED STORAGE HYDROPOWER

Closed loop projects like this are not continuously connected to a flowing river, thus minimizing environmental impacts.



HYDROPOWER: Putting Excess Water Supply to Good Use

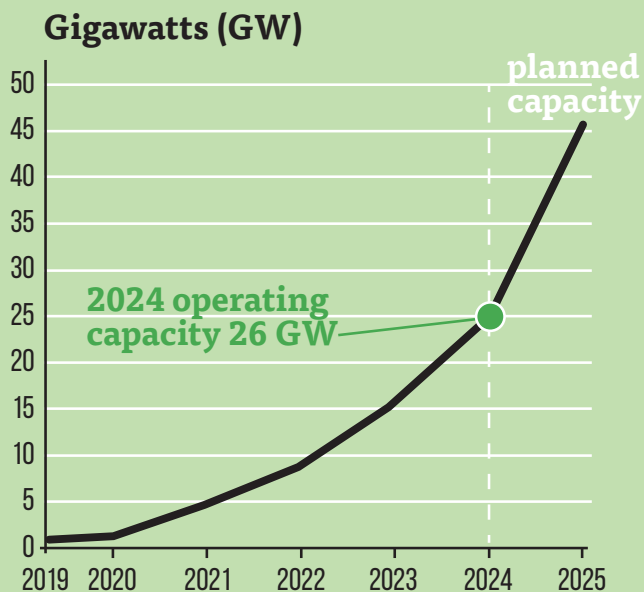
Battery Storage

Innovations in battery technology are an exciting part of a carbon-free energy future. Whether it's a solar panel on your home or larger utility scale wind and solar projects, battery storage keeps the power flowing when the wind isn't blowing or the sun shining. And like pumped storage projects, power can be stored for use when demand and cost is highest.

The good news is that the cost of producing lithium-ion batteries for utility scale battery storage decreased by 76 percent from 2013 to 2025. As costs go down, utility-scale battery storage projects are dramatically rising nationally, growing from 214 megawatts in 2014 to 26,000 megawatts in 2024.

The average length of battery availability, however, is only four hours. This makes it most helpful for smoothing out solar and wind power availability to meet peak demand and short-term supply needs. 🌍

UTILITY-SCALE BATTERY STORAGE IS DRAMATICALLY RISING



Renewable, weather-dependent power generation can also sit idle when there is plenty of supply but not enough electricity demand. When hydropower projects are idle, water goes downstream without the opportunity to generate power.

In 2025 Douglas County PUD in Central Washington is scheduled to open a hydrogen plant using an excess supply of hydropower. Hydrogen fuel cells can be used to operate everything from forklifts, to cars and buses, to providing back-up power for buildings and equipment.

This carbon-free, non-polluting power innovation is a perfect marriage in two ways. First, creating hydrogen fuel is very power intensive, making low-cost hydropower an excellent partner. And second, it's called "green hydrogen" because one carbon-free generation resource (hydropower) is being used to create another carbon-free generation resource (fuel cells) that can be exported and stored for later use. This also supports goals to reduce carbon emissions across industries. 🌍

