



Pumped storage hydropower systems, like the one shown here, provide the largest source of energy storage on the U.S. grid. *Photo courtesy of the National Hydropower Association*

Improved Cost Estimates to Boost Pumped Storage Hydropower Construction

Pumped storage hydropower (PSH) facilities are like large batteries that use water and gravity. They can store up to 12 hours' worth of clean, renewable energy and send that power to the grid the moment it's needed (for comparison, batteries provide about 4 hours of energy storage).

As the United States' power grid evolves, receiving more variable clean energy sources, like solar power and wind energy, PSH plants could play a key role in ensuring that grid is not only carbon free but also reliable and resilient.

Today, PSH is often overlooked in future grid planning efforts, in part because the cost to build a new facility is not always clear. That's why the National Renewable Energy Laboratory (NREL), along with the U.S. Department of Energy's Water Power Technologies Office, is developing improved cost estimates and cost models to reduce that uncertainty and give developers the data they need to decide where and when to construct new PSH facilities to support the country's evolving energy grid.

The Cost of Pumped Storage Hydropower

PSH is already the largest contributor to U.S. energy storage, representing **roughly 93%** of all commercial storage capacity in the United States. But most of the publicly available data on PSH construction costs are years if not decades old, which

makes it difficult to accurately assess how much these facilities might cost today. Faced with a lack of accurate data, many project planners add contingency plans (the right to back out if certain conditions are not met), which can increase project costs and make PSH appear less desirable for investors.

Now, in close collaboration with industry experts, NREL researchers are using data from case studies and market analyses to develop improved cost estimates for PSH construction. Next, the team will use that data to standardize PSH cost models that can estimate a project's cost versus energy production—a valuable measure of a facility's potential financial success. These enhanced tools could serve a range of end users, including potential PSH developers, utility decision makers, regional and independent system operators, and industry regulators.

Open-Source Technology Analysis and Grid Modeling Tools

Once complete, NREL's improved PSH cost models will be made publicly available and easily adaptable for a variety of purposes and users. The research team will also incorporate the new data into NREL's [Annual Technology Baseline](#) and

[Standard Scenarios](#) tools, which provide consistent, open-source data for users to analyze a wider range of energy technologies and future grid scenarios.

Together, these tools can help ensure that forward-looking grid studies reflect the true expected costs of renewable energy installations. And, with more accurate data and cost estimates, decision makers can make well-informed choices about which tools, including PSH, the country needs to build a reliable and resilient carbon-emission-free power grid.

This project is part of the U.S. Department of Energy's [Hydro Water Innovation for a Resilient Electricity System \(HydroWIRES\) Initiative](#) to understand, enable, and improve hydropower's contributions to reliability, resilience, and integration in the rapidly evolving U.S. electricity system.

For more information contact:

Daniel Inman, Daniel.Inman@nrel.gov



Hydropower plants, like this one in Willamette Falls, have played a key role in providing flexible, low-carbon electricity to the U.S. electricity system for over a century. *Photo by Rafael Kaup, U.S. Department of Energy*