



WSU Energy Program Pumped Storage Hydropower Siting Study Summary

Pumped storage hydropower (PSH) is a proven, long-duration energy storage technology that currently provides over 90% of the utility-scale energy storage capacity in the United States. PSH uses two reservoirs at different elevations, storing water as potential energy in the upper reservoir and releasing water to the lower reservoir through turbines to create electricity for the grid when needed. When demand for energy is low and there is excess energy on the grid, water is pumped from the lower reservoir back to the upper reservoir to be stored until needed again. A typical PSH facility can provide eight or more hours of electricity.

Washington state is committed to an electricity supply free of greenhouse gas emissions by 2045. As the state shifts to fossil-free energy sources such as utility-scale solar and wind, increased capacity of energy storage systems such as PSH will be needed to store the intermittently produced renewable energy, thereby satisfying energy demands and balancing out the grid.

While PSH can help the state meet its energy goals, the construction and operation of PSH facilities can have potential impacts on Tribal cultural resources, wildlife and habitat, aquatic resources, water availability, and more. In House Bill 1216 in 2023, the Washington State Legislature directed the Washington State University Energy Program (WSU) to carry out a process to identify these impacts, as well as other issues and interests, and provide that information to the legislature, potential developers, and agencies. A final report was presented to the State Legislature in June 2025.

WSU engaged Tribes, agencies, local governments, and others to provide their insights about PSH in statewide online meetings, meetings with individuals and Tribes, and at Tribal-led conferences. Technical information about PSH was provided at these meetings. The meetings created opportunities for participants to discuss potential impacts from PSH on Tribal cultural resources, water quality and quantity, wildlife and habitat, geology and soils, socioeconomics, and more, as well as ways to avoid, minimize, or mitigate these impacts. Also briefly discussed were state and federal permitting, licensing, and environmental review processes.

The study did not propose or promote any specific PSH projects. It also was not intended to substitute for project-specific environmental review or consideration of project-specific adverse effects on Tribal resources.

Key Points

Four overarching themes surfaced from participant comments and discussion: concerns about Tribal cultural resources, water availability for closed-loop systems, impacts to terrestrial habitat, and impacts to aquatic ecosystems and fish from open-loop PSH.

Avoiding areas with Tribal cultural resources was often stated to be the best way to protect them, especially because many impacts cannot be adequately mitigated. Other major Tribal concerns included cumulative impacts from multiple projects, and Tribes being brought into the site identification, licensing, and environmental review processes too late. Suggestions included for developers and agencies to engage with Tribes before extensive planning resources are expended, and before developers become attached to a particular outcome.

Participants expressed concern that water was needed to fill reservoirs in “closed-loop” PSH systems, which are not directly connected to existing water bodies. Since most water rights in Washington state are already allocated, the need for water for PSH facilities could affect future water availability for other uses such as river flows and agriculture. This is especially true given the unknown future effects of climate change.

Wildlife and habitat disturbance and loss, disruption of migration routes, and the introduction of invasive plant species can result from the construction of PSH facilities. Tools and resources exist to help guide development away from critical wildlife areas, and other suggestions include not building during critical life events for wildlife.

Impacts to fish from loss of habitat and diversion into equipment were highlighted for “open loop” PSH systems, which are directly connected to existing water bodies. Suggestions made by participants to prevent or mitigate these impacts included establishing baseline habitat conditions with continuous monitoring, avoiding areas with the most listed species and important habitat, and establishing native vegetation after construction.

Mapping

In addition carrying out the siting process, the legislature also required WSU to develop a map with GIS data layers highlighting areas identified through the process. WSU created four maps using data from the National Renewable Energy Laboratory (NREL), which identified sites of theoretical pairs of reservoirs in the U.S. from publicly available data. The objective of NREL was to assess the pumped storage resource capacity for the U.S. It is not the intent of the PSH Siting Study that these maps be used for actual siting of PSH.

The different siting study maps show public land ownership, utility-scale solar and wind installations, and proximity of theoretical reservoir sites to rivers.

Recommendations

From subject matter experts, research in published reports, and participant comments and discussion, WSU identified some suggested recommendations regarding issues concerning the siting of PSH in the state:

- Prioritize early communications and engagement with Tribes and local communities.
- Research future water availability.
- Consider other approaches to PSH, such as add-on PSH where an upper reservoir is constructed and connected to an already existing dammed reservoir.
- Develop and utilize resources that can guide developers to areas with less impact on wildlife and habitat, such as tools and guidelines developed by Washington state agencies, to guide developers away from critical habitat for protected and other important species.
- Consider utilizing criteria for low impact PSH when available. Low impact criteria aim to avoid or minimize impacts such as those on the environment, Tribal cultural properties, and Tribal trust resources.

Potential PSH developers who follow some of the recommendations above, and that demonstrate understanding of and compliance with the issues and needs expressed by Tribes, local communities, agencies, local governments, NGOs, and others, may find that their projects have fewer obstacles and can advance in a more efficient manner to help the state reach its goal of fossil-free electricity.

To read the full report, visit the WSU Energy Program Pumped Storage Siting website at <https://www.energy.wsu.edu/CleanFuelsAltEnergy/PSHSiting.aspx>.



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