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Carbon-Free Energy Storage

The Potential of the Goldendale Energy Storage Project

Executive Summary

The Goldendale Energy Storage Project is a pumped-hydro power facility under development in Washington state. Once operational, this carbon-free facility will serve as a much-needed power and energy storage resource benefiting Washington, Oregon, and much of the Pacific Northwest. Ultimately, it could provide most of the homes in the Seattle metro area with carbon-free, renewable electricity for 12 hours a day annually.

The need for the project arises from the evolution in which we produce, transport, and use energy. As part of the nation's transition to 100% renewable energy, we are seeing policies proposed and implemented that encourage the deployment of additional low or zero-carbon electric generation at the state, national and global level.

After much back and forth over the past several years, the country has rejoined the Paris climate agreement. This re-engagement is part of the Biden administration's pledge to achieve net-zero emissions by 2050. The return of a national climate commitment follows multiple efforts at the state level to reduce greenhouse gas emissions, particularly on the West Coast. These state efforts include Washington's Clean Energy Transformation Act, which requires the supply of 100 percent renewable or non-emitting energy in the state by 2045. Similar efforts are also taking hold in California and Oregon.

Beyond the headlines, ambition, and political plaudits lie a lesser-known set of facts we will highlight: the West Coast broadly - and Pacific Northwest specifically - has a significant energy storage capacity problem. The region will not meet its ambitious clean energy and climate action goals without a massive influx of storage capacity.

Fortunately, there is a solution: policymakers and regulators should look to support sensible energy projects that generate considerable amounts of electricity while also storing power from other renewable sources to deploy as needed. Key among those initiatives are efforts to invest in both battery and pumped-storage hydro facilities to harness and distribute this clean energy throughout the region. The Goldendale Energy Storage Project is just one of those sensible energy projects.

The Need For Storage Capacity On The West Coast and The Pacific Northwest

In August 2020, as Californians were grappling with the impacts of the COVID-19 pandemic, another calamity hit: rolling blackouts. The statewide outages affected hundreds of thousands of people from all walks of life, causing "everyone to point fingers" to the blackouts' exact cause.

Among the culprits: inadequate energy transmission and "an over-reliance on renewable energy."

The California outages, along with the early 2021 large-scale electric blackouts affecting much of Texas and the central United States, highlight a pressing issue: grid operators need reliable energy storage resources to keep up with the increasing demand for renewables. The storage capacity problem extends throughout the Pacific Northwest, with this dilemma underscoring the importance of large-scale energy storage projects - such as Goldendale - in maintaining a reliable electric grid.

A 2019 study framed the issue in stark terms. It found that the Pacific Northwest "faces a near-term capacity shortage of up to 7,000 megawatts (MW) by 2025 and up to 10,000 MW by 2030." Planned resources, the study added, "do not fill this gap."

According to a second 2019 study, public officials still need the storage capacity required to keep the power system in balance even as the push for renewable energy sources accelerates. "While renewables can readily replace the energy that coal resources have provided," it asserted, "they cannot easily replace the capacity that is needed for resource adequacy due to the variable nature of their energy sources."

Lack of storage capacity has consequences. As the California outages and the more recent blackouts in Texas illustrated, we must have a reliable, flexible grid, which includes storing renewable energy for when it is most needed. The Union of Concerned Scientists described the importance of energy storage working in tandem with renewable sources in avoiding grid issues and blackouts in a 2015 paper, stating: "Because some renewable energy technologies – such as wind and solar – have variable outputs, storage technologies have great potential for smoothing out the electricity supply from these sources and ensuring that the supply of generation matches the demand."

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The Lights Will Go Out, And Go Out More Often

Making the problem even more pressing as significant investments are deployed to bring additional wind and solar resources online: traditional renewable resources can at times be unreliable. Although the U.S. has made great strides in deploying renewable energy such as wind and solar, renewable resources are still, by their nature, intermittent, meaning that the electricity they produce can fluctuate daily and even hourly. As no less an authority and supporter of a clean energy future than Bill Gates put it: "Wind and solar-powered generation is expanding, but one challenge we face is how to store that energy when the sun isn't shining, or the wind isn't blowing."

Yet the political pull of renewables is powerful, leading an increasing number of cities in Washington, Oregon, and California to ban or significantly limit natural gas for cooking and as a source of heat.

The Seattle City Council, for example, recently passed a measure to end most natural gas use in commercial buildings and some apartments. At the state level, the Washington state legislature in the 2021 session seriously considered "a first of its kind state-level natural gas ban." Although the political appeal of these measures is understandable, the practical effect is that policymakers on the West Coast have created an untenable energy situation -- a rapidly increasing demand for electricity while eliminating the options available to meet that demand.

This dire situation is a reliability challenge that policymakers must solve.

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> *- Bill Gates*

Benefits Of Large-Scale Storage Projects

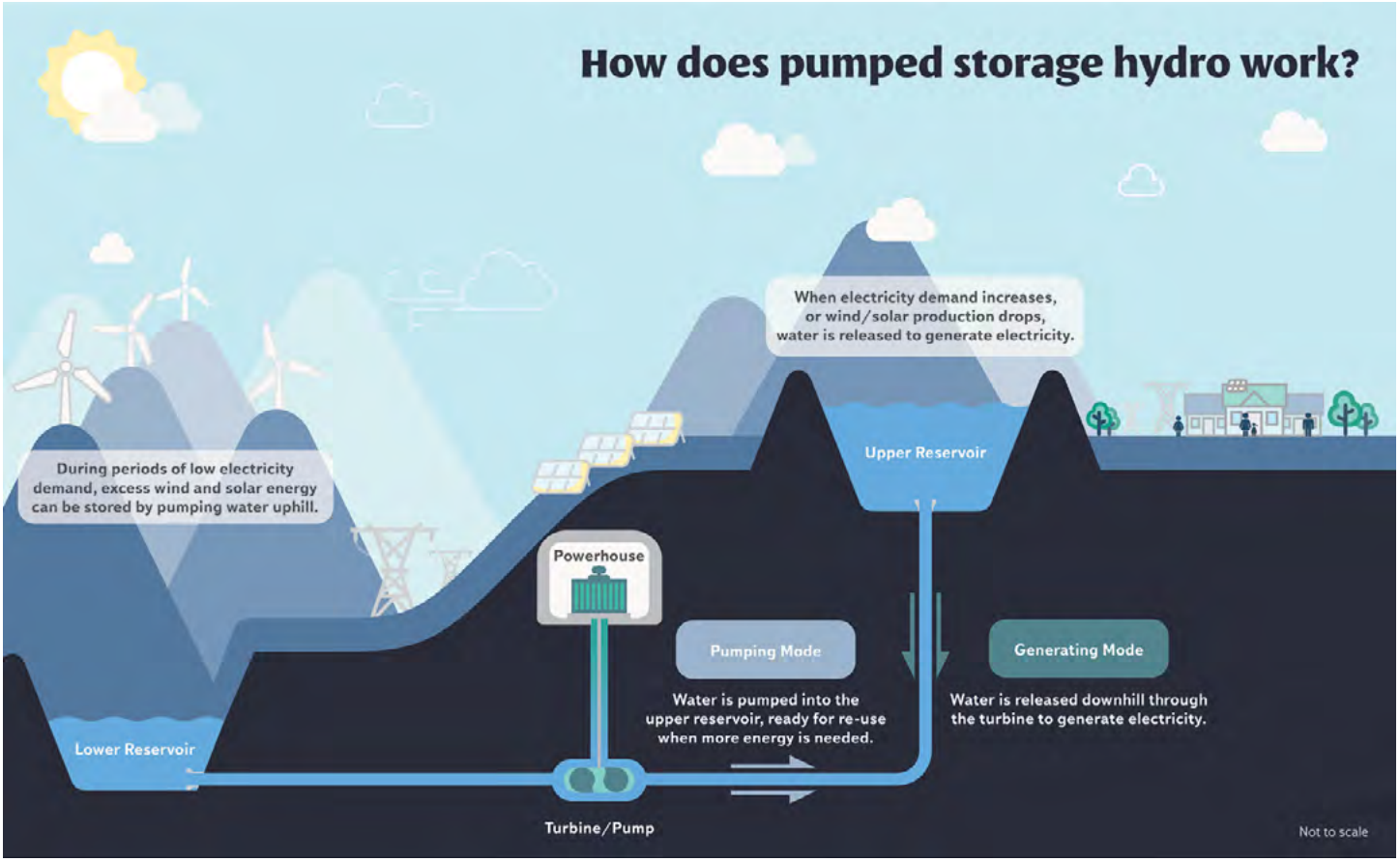
There is a solution to the potential crisis caused by inadequate storage capacity: large-scale, clean-energy storage projects that use pumped-storage hydropower (PSH). Unlike the intermittent nature of other clean energy sources like wind and solar, pumped storage enables grid operators to access reliable electricity 24/7.

Given this reliability, it should come as no surprise that former U.S. Energy Secretary and Nobel laureate, Steven Chu, remarked in 2020 that "in terms of energy storage, it [pumped-hydropower] is really one of the best."

According to the non-partisan Energy Information Administration, that innovative approach has already made PSH the largest contributor to U.S. energy storage, with an installed capacity of 21.6 GW. That is about 95 percent of all commercial storage capacity nationwide.

The Goldendale project illustrates how it works: Goldendale will be a closed-loop system, meaning its functions are tied to the public's demand for power. Water is pumped from one reservoir to another, at a significantly higher elevation, to be utilized when electricity demand and prices are at their lowest. When power demand and prices are highest, the water is subsequently released from the upper reservoir utilizing gravity to flow down to the lower pool through a hydropower turbine system. And, unlike open-looped PSH projects, which require the use of a dam, closed-loop pumped storage projects like Goldendale are off-river and do not require the construction of any new dams.

While comparable lithium-ion batters tend to get more attention, pumped storage is actually doing the work – work that can help electric grid managers balance a rapidly evolving electricity supply throughout the Pacific Northwest.



Renewable Energy Requirements Among Pacific Coast States		
California	SB 100	Signed by Gov. Edmund G. Brown Jr. Requires that 50% of California's electricity be powered by renewable resources in 2025; 60% in 2030; 100% in 2045.
Washington	Washington Clean Energy Transformation Act, SB 5116	Signed by Gov. Jay Inslee requires that 100% of electricity for Washington customers be renewable or non-emitting by 2045.
Oregon	SB 1547	Oregon's Renewable Portfolio Standard requires that 50% of the electricity Oregonians use come from renewable resources by 2040.

And even with all of that capacity, PSH is actually cheaper than other storage options. It's widely recognized as the most affordable way to store energy. An analysis conducted for Puget Sound Energy's 2021 Integrated Resource Plan found that pumped storage is significantly cheaper than lithium-ion batteries. It can provide stable, long-duration energy storage with a mere fraction of the physical footprint required for equivalent lithium-ion battery warehouses statewide.

Similarly, the U.S. Department of Energy and Argonne National Laboratory's 2021 Pumped Storage Hydropower Valuation Guidebook, found that "PSH is very competitive with other energy storage technologies and is one of the lowest cost options on both a $/kW and a $/kWh basis."

Since it does not come with the battery industry's negative environmental impacts – which relies on heavy mining operations, toxic chemicals, and fossil fuel for transportation – pumped storage can help better integrate renewable energy resources into the national grid.

According to the National Hydropower Association's 2018 Pumped Storage Report: "Hydropower generation, including PSH, can facilitate the integration of variable generation resources such as wind and solar into the national power grid due to its ability to provide grid flexibility, reserve capacity, and system inertia."

These varied benefits mean that PSH is increasingly considered a vital part of America's energy future. As the Department of Energy put it in a 2018 report: "The United States has significant resource potential for new PSH development as a continued storage technology, enabling grid flexibility and greater integration of variable generation resources, such as wind and solar."

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The Future of Dams Along the Columbia: Competing Visions and Viable Alternatives

An especially attractive feature of pumped storage projects is their ability to generate carbon-free electricity without building new dams on rivers.

Third-party studies tied to the facility's application process concluded that the Goldendale Project does not adversely affect the Columbia River, including fish and wildlife habitat.

This conclusion becomes apparent when comparing the Goldendale Project's water consumption with the John Day Dam, located just east of the project's proposed site. The Goldendale Project would utilize 2.83 billion gallons of water and would require another 1.2 million annually to make up for evaporated water and regular operations. This volume is equivalent to the same amount of water that passes through the John Day Dam in less than one hour and 1.3 seconds, respectively – all at low river flow. From another perspective, the amount of water needed for the Goldendale Project is 1/1.2 million, the amount that flows through its neighboring dam each year, and 1/50 million that amount each additional year.

The evidence shows that deploying more closed-loop PSH is a strategy that environmental groups and energy companies can get behind.

And while dams are a significant part of our energy mix today, policymakers continue to debate their future role in a majority carbon-free electricity environment. Only three percent of the nation's 80,000 dams currently generate electricity, and a vast majority were built more than half a century ago.

Dams that are operating well beyond their original design life could also present a potential safety risk. A 2015 FEMA National Dam Safety Program report raised some concerns along these lines, noting, "There are now approximately 28,000 dams in the U.S. whose failure could cause property damage or a potential loss of life. More than 15,000 of these are considered high-hazard potential, meaning their failure would result in probable loss of life." The Association of State Dam Safety Officials added that, "Nationally, the percentage of state-regulated high-hazard potential dams with an Emergency Action Plan has increased from 35% to 81% for the period of 1999 to 2018."

In contrast, PSH projects under development in the U.S. today would be less risky and have a massive effect on increasing storage capacity producing minimal environmental impact. According to the U.S. Department of Energy, "new closed-loop pumped-storage projects are being developed internationally and are expected to produce minimal environmental impacts versus traditional open-loop designs."

Challenges of Utilizing Renewable Resources From Outside of Washington

Solving the storage capacity problem afflicting Washington and the rest of the Pacific Northwest requires intelligent solutions. One such handy fix is building more capacity at home -- because bringing it in from out of state presents a myriad of challenges.

Though sources such as wind turbines and solar panels offer an abundance of renewable energy, they may not be located near the consumers who need them the most. This issue of distance presents a dilemma for grid operators and developers, who must transmit power across state lines to meet consumer demand. This process is expensive, time-consuming, and contributes to greenhouse gas emissions.

Building the transmission infrastructure required to bring more renewable energy into Washington would likely face increased regulatory challenges, as well as unforeseen legal hurdles. In the Midwest, for example, environmental groups have objected in court to plans to transfer renewable energy across state lines.

In February, the groups filed a lawsuit challenging federal approval for a 102-mile, high-voltage transmission line to bring renewable energy from Iowa to Wisconsin. They charged in their complaint that the federal review process did not correctly consider less-harmful alternatives leading to the Fish & Wildlife Service unlawful approval of a right-of-way through a wildlife refuge for the power line.

According to Inside EPA's Climate Extra, which covers "the burgeoning federal commitment to climate controls," environmentalists "are targeting the $500 million Cardinal-Hickory Creek line because it would run through the Upper Mississippi River National Wildlife and Fish Refuge without considering other options, such as cheaper line upgrades and potential routes around the refuge."

The publication reports that environmental groups "say they will continue to closely scrutinize a crucial component of the clean energy infrastructure" that the Biden administration supports, namely "transmission lines that are necessary to bring large amounts of renewable electricity to the grid and often run through pristine, undeveloped areas."

Even without legal challenges, the additional costs and considerable regulatory hurdles to build large-scale transmission lines capable of moving large amounts of wind and solar resources across state lines are likely to be significant. The Department of Energy's Berkeley National Laboratory reviewed more than 40 transmission-planning studies. The lab's analysis found that the unit transmission costs for wind could run as high as $1,500/kW, with most falling close to $500/kW or roughly 25% of the cost of building some wind projects. Policymakers and regulators will need to weigh the costs of potential transmission projects utilizing out-of-state renewable resources versus alternatives that encourage the development of renewable resources closer to existing population centers.

The challenges of bringing in power from out of state, even from renewable resources, reinforce the Goldendale Project's unique appeal, which would provide Washington with a local, clean energy source while not requiring significant investment in transmission infrastructure compared to wind and solar projects.

The Goldendale Energy Storage Project: A Project of Statewide Significance

The Goldendale Energy Storage Project presents a potential solution to all of the problems and challenges outlined above. It would provide a significant amount of power in an environmentally friendly way and go a long way toward addressing the region's energy storage capacity issues.

Here is how it would work:
The proposed project, located about eight miles southeast of Goldendale, Washington, would consist of a closed-loop pumped-storage hydropower facility with an upper and lower reservoir with more than 2,400 feet of maximum gross head. It would utilize variable-speed, pump-turbine generator units and provide balancing services and renewable energy flexible capacity to utilities in the Pacific Northwest and potentially California.

Here is what it would power:
The Goldendale project would generate upwards of 1,200 MW with 25,506 MWh of storage (12-20 hours of storage). When fully operational, it could power most of the homes in the Seattle metro area carbon-free, renewable electricity for 12 hours a day annually.

That is a lot of power.

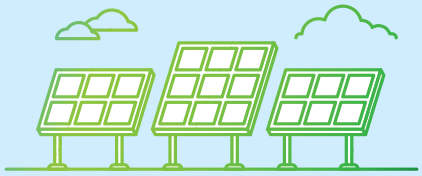
Of great importance, the Goldendale Energy Storage Project has also earned the distinction of being considered a "Project of Statewide Significance" by the Washington state legislature. The reason: its investment in environmental improvement and innovation activities.

For comparison, the project's amount of generative capacity is equivalent to approximately the same amount as 7,320 acres of wind turbines or 53,640 acres of solar, without the environmental impacts.

The Goldendale project's amount of generative capacity is equivalent to:

7,320 acres
of wind turbines
(11 sq. miles)

53,640 acres
of solar panels
(84 sq. miles)



Goldendale provides this capacity without the environmental impacts of wind and solar.

And the benefits of Goldendale are likely even broader. As proposed, it would create more than 3,000 family-wage jobs during its four-year construction period, then another 50 to 70 permanent jobs in an area of the state that needs them. It would infuse more than $2 billion into rural Washington and Oregon, benefiting local economies throughout the Gorge and providing Klickitat County with more than $14 million in new tax revenue annually.

All of this means that a completed Goldendale Project would fall perfectly in line with the current administration's focus on clean energy and curbing climate change, along with its broader goals, including the emissions reductions included in the Paris Climate Agreement. Goldendale would accomplish the critically important goal of reducing greenhouse gas emissions and society's dependence on fossil fuels.

Moreover, in the Pacific Northwest, it would play a critical role in helping Washington meet its 100% renewable energy goals by the 2045 mandate, along with providing similar help to Oregon and California in meeting renewable energy goals and mandates in those states.

Conclusion

Sweeping clean energy goals are essential and vital, and policymakers need to adopt sensible energy projects that will help them meet their goals– and move towards a carbon-free future.

The Federal Energy Regulatory Commission (FERC) and Washington's Department of Ecology are currently reviewing the permits and applications for this laudable clean energy storage project. Both agencies will ultimately determine the region's resource mix to ensure that Washington and the Pacific Northwest have a reliable electric grid during the nation's transition to renewable energy sources.

It has become clear that pumped storage hydropower will play a critical role in decarbonizing our nation's electricity grid.

The Goldendale Energy Storage Project is poised to help communities in the Pacific Northwest meet their energy and climate goals while maintaining an affordable and reliable energy supply.

Project Timeline

2018
Preliminary permit issued

2020
Final license application submitted to FERC

2021-2022
FERC Environmental Assessment or Environmental Impact Statement

2022-2024
Final design

2025-2027
Construction

2028
Begin commercial operation

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