

Winning the AI Race: Tapping into Pumped Storage Hydropower

National Hydropower Association

March 2026



Executive Summary

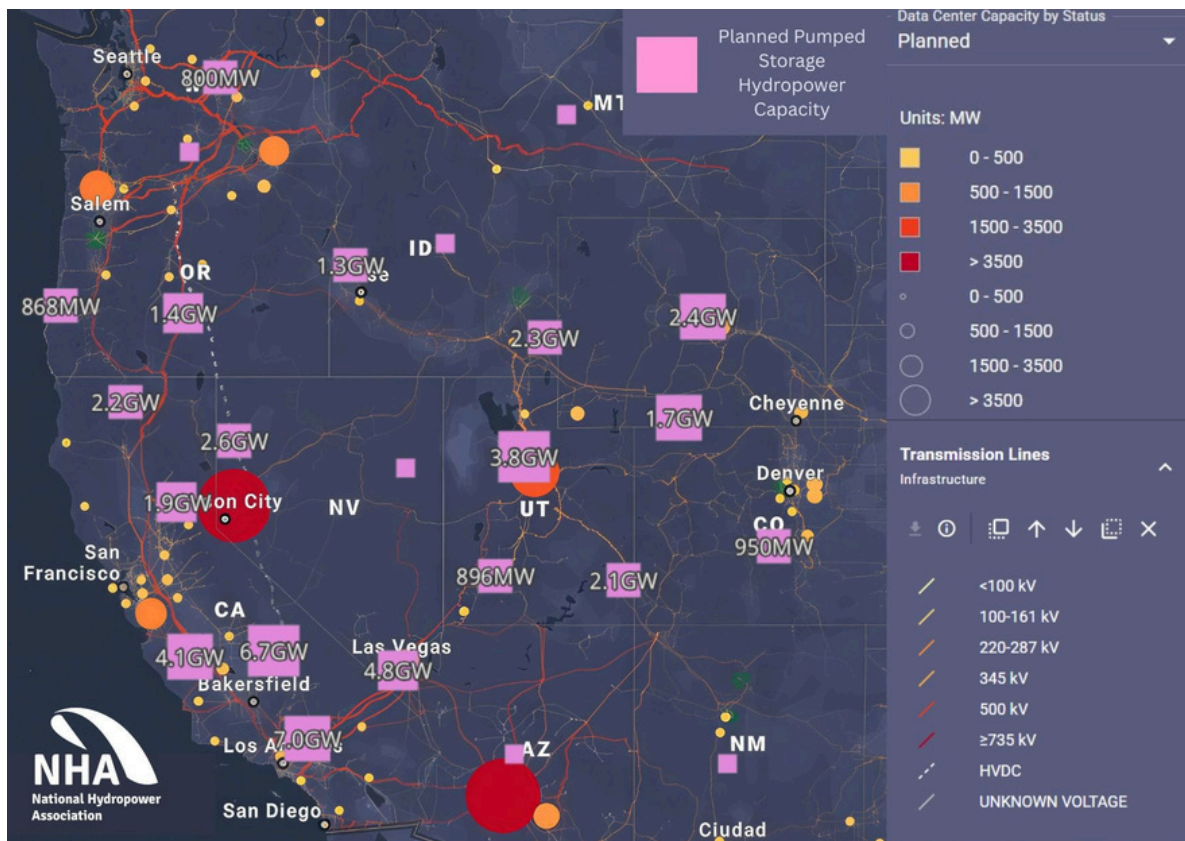
If the United States intends to win the race to power artificial intelligence and advanced manufacturing, it must first win the race to build reliable power. The central question is no longer whether the grid can produce enough electricity, but whether it can do so reliably, at the right locations, and on timelines that align with private investment.

This report highlights how the 60,000+ megawatts of proposed new pumped storage hydropower can help achieve American AI dominance. Eighty projects are currently pending in the U.S. Federal Energy Regulatory Commission licensing pipeline, 85% of which are located in the West where the power is needed most. Policies that unlock this proven yet often-overlooked technology are necessary to ensure that the nation has the 24/7 reliable power to win the AI race.

Pumped Storage Hydropower is Uniquely Positioned to Support American AI Dominance

 **60,000+ MW**
in the regulatory pipeline

 **85%**
Located in the West



Overlay of Planned Data Center Capacity with Pending FERC Pumped Storage Hydropower Permits,
Source: NREL Speed to Power Map and ORNL FY25 Development Pipeline Dataset

The Power of Pumped Storage

Pumped storage hydropower (PSH) is one of the oldest and most reliable forms of energy storage, dating back to the early 20th century. Initially developed to store excess baseload electricity, like nuclear power, generated during periods of low demand, PSH has evolved into a critical component of modern energy grids. Originally, these facilities were used to pump water from a lower reservoir to an upper reservoir during off-peak times when excess power is available, then reversing the flow during periods of high demand to generate electricity using turbines. In addition to this energy arbitrage, these same facilities increasingly are being used to firm up variable renewables and provide essential grid reliability services. These simple yet effective "water batteries" have been instrumental in balancing electricity supply and demand for nearly a century.



Raccoon Mountain Pumped Storage Plant, photo credit Tennessee Valley Authority

Despite the growth of batteries, PSH remains nearly 90% of the United States' long-duration energy storage.¹ While traditional batteries typically have the capacity to store 2–4 hours' worth of electricity, many PSH facilities can provide 8+ hours of storage, which is increasingly critical as the nation faces more frequent extreme weather events. PSH can also be constructed off-river and closed-loop (not connected to a natural water source), so there is minimal impact on the environment. Closed-loop PSH systems also have the lowest global warming potential across energy storage technologies when accounting for the full impacts of materials and construction.²

Beyond these benefits, PSH provides several key services that are essential for grid stability:³

- **Grid Integration:** PSH is particularly effective at balancing the grid when other resources suddenly become unavailable, such as when a nuclear unit trips offline or a coal pile freezes. In addition, PSH can integrate renewable energy sources, firming up generation at night or when the wind isn't blowing.
- **Essential Grid Reliability Services:** Rotational inertia is an inherent feature of PSH systems that helps stabilize the grid by providing resistance to grid fluctuations. Rotational or mechanical inertia is becoming important for network operators with the increasing penetration of renewable technologies such as solar and wind, and conventional sources of direct inertia are retired.

- **Longevity:** Its typical lifespan is 80–100 years, including periodic equipment replacements and regular maintenance. PSH facilities outlast all currently available battery systems, which typically require replacement within 10–15 years.
- **Efficiency:** Modern PSH systems can return up to about 80% of the electricity they store⁴, making them highly efficient. In addition, efficiency does not degrade with time or cycling, as is the case with other energy storage technologies, such as lithium-ion batteries.
- **Cost-Effectiveness:** Despite high initial capital costs, PSH offers low operational costs and a significantly longer lifespan than other energy storage technologies, making it a more economical choice over the long term.

An NREL report found almost 15,000 potential sites, representing 35 terawatt-hours (TWh) of energy storage potential (3.5 TW of capacity at 10-hour storage).⁵

As such, PSH is uniquely positioned to help policymakers expand grid capacity, accelerate interconnection of large loads, and ensure the reliability and affordability of power as demand from data centers that power AI and advanced manufacturing continue to rise.

¹ "U.S. Hydropower Market Report 2025 Update," Oak Ridge National Laboratory, available at <https://hydropowermarketreport.ornl.gov/>

² "Life Cycle Assessment of Closed-Loop Pumped Storage Hydropower in the United States," Environmental Science and Technology, Daniel Inman, Gregory Avery, Rebecca Hanes, Dylan Hettinger, and Garvin Heath, NREL (Aug. 2023), available at <https://www.energy.gov/eere/water/articles/new-analysis-reveals-pumped-storage-hydropower-has-low-global-warming-potential>

³ "The Ultimate Water Battery: Unleashing The Power of Hydropower Energy Storage," National Hydropower Association and Kleinschmidt, (2024), available at <https://www.nha2024pshreport.com/nha-psh-2024/technology-for-an-evolving-grid>

⁴ "Utility-scale batteries and pumped storage return about 80% of the electricity they store," Today in Energy, Alex May, U.S. Energy Information Administration (Feb. 2021), available at <https://www.eia.gov/todayinenergy/detail.php?id=46756#>

⁵ "Closed-Loop Pumped Storage Hydropower Resource Assessment for the United States," Final Report on HydroWIREs: Improving Hydropower and PSH Representations in Capacity Expansion Models, Evan Rosenlieb (NREL), Donna Heimiller (NREL), and Stuart Cohen (NREL), May 2022, available at <https://docs.nrel.gov/docs/fy22osti/81277.pdf>

In the West, Structural Reliability Problems Hamper AI

Electricity demand in the Western Interconnection, a section of the U.S. power grid that covers the Pacific coast to the Rocky Mountain states, is projected to grow more than 20 percent over the next decade, driven largely by data centers, advanced manufacturing, and electrification.⁶ At the same time, more than 24 gigawatts of coal, natural gas, and nuclear capacity are scheduled to retire. The resource mix replacing those units is overwhelmingly variable renewables and short-duration battery storage.

This transition creates a structural reliability problem. Data centers cannot tolerate voltage instability, frequency deviations, or extended outages, yet the grid is losing the synchronous, spinning-mass generation that historically provided essential grid reliability services, including inertia (a grid's ability to maintain a steady frequency), voltage support, and black-start capability (the initial burst of electricity needed to restart a grid).

This creates a problem for the Western Electricity Coordinating Council (WECC), which oversees reliability in the Western Interconnect region. Inertia levels in the WECC have already declined materially and are projected to fall further as conventional units retire. Pumped storage directly addresses this gap by providing physical inertia, and dispatchable, long-duration energy storage that extends well beyond daily peak management.

Energy load growth also exposes a second, equally binding constraint: transmission congestion. Much of the West's new generation is located far from centers with high energy demand, and chronic congestion along major transmission corridors frequently prevents low-cost energy from reaching demand.

Pumped storage plays a unique role in addressing transmission congestion. When located near load, it functions as a dispatchable generator that reduces reliance on constrained imports. When located near power generation, it absorbs surplus energy that would otherwise be curtailed. In both cases, it expands effective transfer capability without the need to build expensive and time-consuming new transmission wires.

This dual role allows pumped storage to act as a transmission asset as much as a storage resource -- unlocking incremental load growth in regions where building new transmission or baseload generation would take a decade or more.

At the same time, as a long-duration energy storage resource, PSH optimizes the output of existing nuclear, wind, and solar facilities, converting variable or inflexible generation into firm, dispatchable capacity without requiring additional baseload or variable resources.

PSH's Untapped Potential in the West

Of the roughly 60 gigawatts of pumped storage capacity currently in the U.S. development pipeline, approximately 85 percent of it is in the Western Interconnection. Several of these projects are fully licensed and shovel-ready, yet none are under construction today, largely due to financing challenges and a punishing regulatory environment.

Still, they'll be exactly where they need to be to meet the moment. Many proposed pumped storage facilities are located near major Western load centers, including Phoenix, Salt Lake City, Portland, and California's coastal metros, and along transmission corridors already identified by the Department of Energy as chronic congestion points. These projects represent one of the few near-term options to secure firm, affordable, reliable power at scale.

Americans are fast embracing the AI tools made possible by these data centers but are also concerned about the impact of the data centers on household power bills and grid reliability. PSH can address both of these sentiments.

Simply put, the construction of new PSH is one of the best ways to ensure America can meet data center demand as AI use grows and address concerns from local communities about energy reliability and affordability.



⁶ "Western Assessment of Resource Adequacy," Western Electricity Coordinating Council, (2024), available at <https://feature.wecc.org/wara/>



Policy Recommendations to Win the AI Race

The United States has entered a new era where power generation determines the speed of our progress in the AI race. To unlock the potential of PSH to help America win the AI race, policymakers in Washington must quickly and boldly enact reforms. This section provides a host of options available to lawmakers in Congress and the administration.

Legislative Solutions

There are several legislative fixes that Congress should enact swiftly to support the growth of PSH and hydropower in general, but two are of primary importance:

One solution is enacting legislation to modernize the Federal Power Act, which is the primary law regulating the hydropower industry. Currently, the licensing process for hydropower facilities, including PSH, is costly, time consuming, and cumbersome. The current process causes uncertainty, as licensing and relicensing can become bogged down with delays and costs related to bureaucratic reviews imposed by multiple agencies. Depending on location, relicensing a hydropower facility could involve up to thirteen major federal statutes and five major federal agencies, as well as numerous state resource agencies.

The hydropower industry advocates limiting mandatory conditioning authority of the Federal Power Act solely to the effects directly related to hydropower projects. This reform aims to rein in resource agency overreach, reduce unnecessary regulatory burdens, and ensure that mandatory conditions for a project's approval are relevant and appropriate to the project's impact. This ensures thorough oversight that doesn't needlessly hamper energy production.

Second, Congress should pass legislation that provides greater tax support to preserve and enhance existing hydropower facilities, including PSH, so these "forever assets" can continue to meet growing energy demand in their communities. In the current 119th Congress, Senators Lisa Murkowski (R-AK), Maria Cantwell (D-WA) along with Representatives Adrian Smith (R-NE) and Suzan Del Bene (D-WA) have introduced legislation to achieve this. Titled the Maintaining and Enhancing Hydroelectricity and River Restoration Act⁷, this bipartisan, bicameral bill extends a 30 percent investment tax credit (ITC) to incentivize investments in dam safety and ecosystem improvements at existing hydropower facilities.

⁷ S.1183, available at [www.congress.gov/bills/119th-congress/senate-bill/1183](https://www.congress.gov/bills/119/congress/senate/bills/1183), and H.R. 2160, available at [www.congress.gov/bills/119th-congress/house-bill/2160](https://www.congress.gov/bills/119/congress/house/bills/2160)

Regulatory Solutions at FERC

Federal Energy Regulatory Commission (FERC) action is essential to correct energy market failures preventing the construction of new PSH.

The flexibility provided by PSH is highly valued by grid operators, yet existing energy markets fail to provide adequate compensation. They also fail to appropriately pay for the wide range of essential grid reliability services, such as inertia, frequency response, and black-start, that PSH provides.

FERC has authority under the Federal Power Act to direct regional transmission organizations (RTOs) and independent system operators (ISOs) to revise unjust, unreasonable, or unduly discriminatory market rules. For example, FERC had success with FERC Order 764, which required markets to accommodate variable renewable generation, and FERC Order 841, which

required markets to open participation to battery storage. Long-duration Energy Storage (LDES), which includes PSH, now faces a similar inflection point.

A dedicated FERC-led effort on LDES can modernize participation models to reflect long-duration operations, establish appropriate compensation for grid-forming services, and reform capacity accreditation frameworks to account for duration and seasonal performance. These reforms would not favor a single technology. They would create market conditions that properly value reliability, enabling pumped storage and a broader array of long-duration storage solutions to compete on their merits.

Department of Energy Solutions

There are also several specific actions the Department of Energy (DOE) can take to encourage new pumped storage and help make these long construction-lead projects more attractive to private sector off-takers.

1. Use DOE's Energy Dominance Financing Title XVII loan guarantee authority to provide utility developers with a construction risk backstop

One of the most impactful roles DOE's Energy Dominance Financing Office (EDF) can play is mitigating construction risk for large, capital-intensive reliability assets like PSH.

On October 28th, 2025, DOE issued its Energy Dominance Financing interim final rule, which revises the Title XVII loan guarantee program under section 1706 of the One Big Beautiful Bill Act. Among the most consequential changes is DOE's new definition of an eligible energy infrastructure project, which now includes resources that:

"...support or enable the provision of known or forecastable electric supply at time intervals necessary to maintain or enhance grid reliability or other system adequacy needs."⁸

Here, the EDF recognizes that reliability is not solely a matter of generation capacity but also of the temporal alignment between supply and demand. This means that PSH now qualifies under Title XVII not merely as an emissions-reducing asset, but as critical reliability infrastructure that supports the 24/7 availability of power demanded by data centers and industrial loads.

To deliver on this clear mandate from the President and Congress, EDF should leverage their \$250B in loan guarantee authority to prioritize pumped storage hydropower.

One option for EDF to support utility developers is through a construction risk backstop. In this structure, a utility develops a pumped storage project within its regulated rate base, while DOE support is used to limit ratepayer exposure and ease state commission approval. Project financing would combine senior debt from bonds, commercial lenders, or institutional investors with an EDF loan guarantee that covers a portion of the senior debt—typically up to 80 percent—against defined construction cost overrun risks.

The guarantee would activate if total costs exceed the project's best estimate value (P50) and reach an agreed upon threshold. It would apply only during the construction phase prior to commercial operation and would be sized to cover incremental overruns within a defined scenario. Funding flows would follow a layered structure: the utility would maintain a contingency reserve for moderate overruns, while the EDF backstop would supply additional liquidity if costs exceed that reserve. Any EDF disbursements would later be repaid under a negotiated cost-sharing arrangement among project stakeholders.

⁸ "Federal Register: Energy Dominance Financing Amendments," (Oct 2025), available at <https://www.federalregister.gov/documents/2025/10/28/2025-19675/energy-dominance-financing-amendments>

2. Use the Grid Resilience and Innovation Partnerships Program (GRIP) to provide merchant developers with a post-commercial operation date (COD) revenue adjustment.

DOE should also use its Grid Resilience and Innovation Partnerships (GRIP) program to offer merchant developers (those who build projects to sell) a post-commercial operation date (COD) revenue adjustment that strengthens project bankability.

Under this approach, a developer secures a long-term revenue agreement and DOE provides a supplemental Revenue Adjustment Agreement alongside a guaranteed loan. This conditional, time-limited grant would ensure a minimum level of operating income in early years to support debt service.

The adjustment would activate only if predefined, uncontrollable risk events materially affect project economics. Claims would be independently verified, and support would be structured as a temporary capacity-payment uplift or fixed annual adder tied to debt needs. Payments would sunset after five to ten years once operations stabilize.

GRIP already supports grid-enhancing technologies, including energy storage, as demonstrated by DOE's 2024 cost-sharing award to the Virginia Department of Energy for battery storage near the Iron Mountain Data Center. However, the program has not yet been used for spinning mass, LDES like pumped storage.

With \$10.5 billion in appropriations, DOE should leverage GRIP to support pumped storage and other technologies that improve grid resilience and speed to power, giving merchant developers a practical pathway to manage early operational revenue risk.

3. Use the DOE 42 U.S.C. § 7256 flexible contracting authority to establish a pilot program to provide merchant developers with floor and ceiling revenue stabilization

Another approach would have DOE establish a new pilot program under Section 646(f) of the Department of Energy Organization Act (42 U.S.C. § 7256(f)). Using the flexible "other transactions" authority, the DOE could test run a full floor-and-ceiling revenue stabilization structure similar to the United Kingdom's Contracts-for-Difference scheme.

Under this model, DOE would provide a defined revenue floor during the early years of operation for privately financed pumped storage projects, mitigating downside risk that otherwise limits merchant financing. In return, DOE would also share in a portion of upside revenues above an agreed-upon ceiling. This reciprocal structure would reduce federal exposure, create a natural budgetary offset, and align incentives between DOE and the developer.

Operationally, DOE would execute a performance-based agreement that activates only when verified post-financial-close events materially depress revenues, such as regulatory changes or operational constraints outside the developer's control. Conversely, if market conditions yield revenues above the agreed ceiling, a share of those proceeds would flow back to DOE, supporting program sustainability. All payments would be independently validated and would sunset after a fixed term. A §646 pilot of this kind would allow DOE to test a balanced revenue stabilization instrument that supports reliability-critical assets while offering a credible path to limit net federal cost.

Pumped storage hydropower is the nation's largest and most proven form of long-duration energy storage, and it is uniquely positioned to support the rapid expansion of data centers and other reliability-critical loads, especially in the West.

If the United States intends to win the race to power artificial intelligence and advanced manufacturing, it must first win the race to build reliable power. Pumped storage hydropower is ready. The policy framework and wholesale market design now need to catch up.