

## **Subsidies and Hydropower Competitiveness in the United States**

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Hydropower has been a prominent source of energy for the United States in the past, providing as a renewable source that relies on the natural world. It has been especially important in regions such as the Pacific Northwest, and the Southeast. However, over the past two decades, solar and wind energy have been on the rise in the energy sector. Mostly due to government subsidy programs such as the federal Investment Tax Credit (ITC), Production Tax Credit (PTC), and the recent Inflation Reduction Act. These programs offer substantial financial incentives for new capacity investment. Solar and wind energy have used these programs to their benefit, while energy sources like hydropower have received comparatively less attention. As a result of this lack of subsidies, hydropower has gradually weakened, despite its long lifespan in the U.S. In replacement, newer technologies that benefit more directly from the subsidies have begun to take over. This paper examines how the U.S. government subsidies influence the competitiveness of hydropower, relative to solar and wind energy.

Hydropower has been a key factor in producing the U.S.'s energy output. Starting on the Fox River in Appleton, Wisconsin, hydroelectricity (another name for hydropower) has been the number one renewable energy producer. In 2019, it was replaced by being the key producer of renewable energy to one of the least producing. In 2022, hydroelectricity accounted for about 6.2% of the total utility-scale electricity, and about 28.7% of the total utility-scale renewable energy generation. Hydropower's economic structure is made up of high upfront capital, such as dam construction, reservoir infrastructure, and long-life equipment. Once built, its operating costs remain low. The electricity production is mainly determined by the water cycle, since it is powered by water. Rainfall, snowmelt, and river flow all produce more energy, while droughts or shifts in precipitation reduce the generated output. Despite its long lifespan and the low operation costs, hydropower's high upfront investment makes it difficult for new projects. Investments

dropped from \$75 billion in 2020 to \$54 billion in 2023. Since this is the case, the growth of new large-scale hydropower projects has slowed since the 1950's, especially since major dams were built by federal agencies before 1970, and new projects face environmental, regulatory, and ecological challenges.

In today's world, government subsidies play a crucial role in shaping investment decisions across renewable energy. According to the EIA's *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016-2022* report, 46% of U.S. federal energy subsidies during that period were associated with renewable energy. In addition, renewable-related federal support more than doubled from \$7.4 billion in fiscal year 2016, to \$15.6 billion in fiscal year 2022. Tax credits and deductions accounted for about 70% of total energy subsidy support in recent years. The two federal subsidy programs are the Production Tax Credit (PTC) and the Investment Tax Credit (ITC). The PTC rewards electricity output over time, and it especially benefits wind energy. The ITC deducts a portion of the upfront capital costs, which primarily benefits solar energy. Hydropower, however, has very limited access to these tax credits. Many of the federal support hydropower receives is through the DOE's Hydroelectric Incentives program, under Sections 242, 243, and 247 of the Energy Policy Act. This allows payments for electricity generation at these hydro projects and capital improvement incentives. The IRA has extended the ITC and PTC programs through at least 2032, but the provisions they made to them both remain in benefit of solar and wind energy and emphasize modernization rather than the large-scale projects of hydropower. While wind and solar benefit from these broad tax credits, hydropower is constrained by fewer incentives which focus on maintaining existing dams.

Solar and wind energy have exploded in the past few years in the United States. The EIA has predicted that solar energy will grow by 75% from 163 billion kWh in 2023, to 286 billion

kWh in 2025. With wind energy, they predicted that it would grow 11% from 430 billion kWh in 2023, to 476 billion kWh by the end of 2025. This growth can be factored into many reasons. First, analysts see that solar and wind projects can be built far quicker than other plants. A major factor as to why the separation of hydropower from the renewables sector is climate change. With the increasing droughts and sporadic rains, it is known that the climate is changing. And investing this much time, money, and effort into projects that rely solely on the climate is hard to satisfy investors.

A case study where hydropower is declining is in the Pacific Northwest, particularly Washington and Oregon. This region has primarily relied on hydropower for their electricity source due to its abundant river system, and large federal dams. In 2022, hydropower supplied 70% of Washington States electricity, which made it the most hydro-dependent state in the U.S. (EIA, 2023). However, recent changes in the river system due to climate change have reduced hydroelectric output. Washingtons utility-scale hydroelectric generation fell 10% between 2020 and 2022 due to drought conditions (NOAA,2023). To respond to this, Washington has accelerated the development of wind energy, particularly in the Columbia Gorge area. The capacity grew by 3.5 GW between 2018 and 2023. This was supported by its PTC eligibility, and shorter construction timelines (U.S. Department of Energy, 2021). This movement from hydroelectric to wind energy shows why states are moving toward different sources of energy production.

The current U.S. renewable energy subsidy framework is set up to reward capacity rather than a long-term system reliability. It favors technologies such as solar and wind, which benefit both from ITC and PTC. Progress comes from competitiveness. And to rebalance hydropower competitiveness with solar and energy, federal policy must shift toward acknowledging its role in

grid stability, and energy storage. The National Hydropower Association is an advocate for expanding investment tax credits to include dam safety and upgrades to the environmental checks. They proposed a 30% credit to support the modernization of hydropower, rather than overhauling the existing projects, and starting new-scale construction (National Hydropower Association, 2024). This aligns also with the International Hydropower Association, saying that hydropower should be financially compensated for services such as flexibility, regulation, and black-start capability rather than electricity generation (IHA, 2024). In addition, streamlining regulatory procedures would improve its competitiveness. The Federal Energy Regulatory Commission (FERC) licensing process, which takes 7-10 years and costs millions of dollars, keeps hydropower back from being on top.

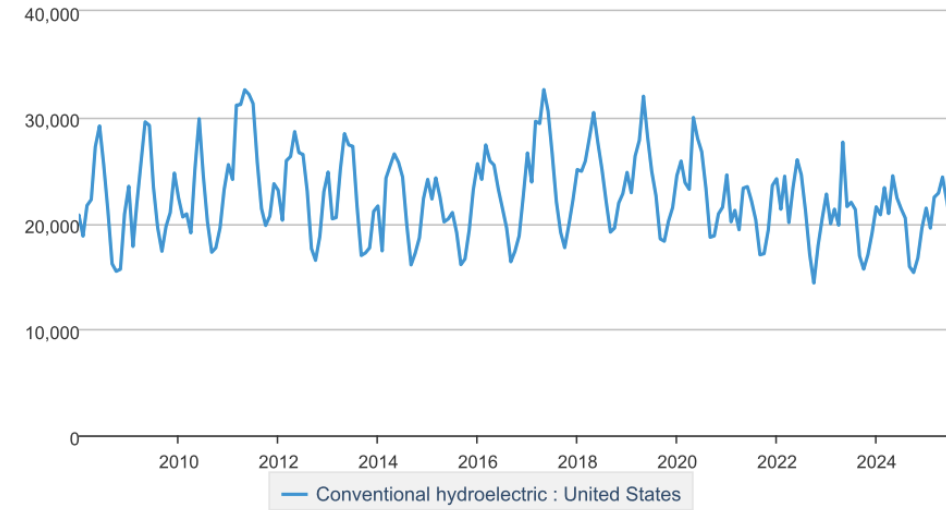
A second case study to look at is in Europe. Europe provides a contrasting example of how hydropower competitiveness has been shaped by different policies. Countries such as Norway, Austria, and Switzerland rely heavily on hydropower. Norway specifically generates over 90% of its electricity from hydro, primarily due to its favorable geographic setting (International Energy Agency, 2023). However, new large-scale hydropower expansion has slowed down because of environmental restrictions, and similarly to the U.S., climate change affecting rivers. So instead, subsidy frameworks under the European Union Renewable Energy Directive have increasingly prioritized solar and wind energy through feed-in tariffs and auction-based contracts. Due to this, the European Union's wind capacity grew from 170 GW in 2018 to 255 GW in 2024. All while hydropower remains relatively constant (European Commission, 2024). Countries like Germany and Spain use hydropower to complement solar and wind technologies. This demonstrates how hydropower is shifting from a source on its own, to a resource other sources of energy can use.

Looking forward, hydropower is unlikely to ever be the most prominent energy source again. Instead, it is likely it will be used as a complementary resource that enhances solar and wind integration. There are many policies that support hybrid renewable systems, such as pumped-storage hydropower with large-scale solar installations. This could potentially store solar energy and be used during peak demand periods. The International Energy Agency projects that solar energy could be the world's most dominant electricity source by 2050, while hydropower remains a stable output through the modernization initiatives discussed (IEA, 2023). So, future federal subsidies should prioritize reliability, making hydropower a forefront of concentration. Under this approach. Hydropower strengthens rather than competes with subsidy-driven renewables.

Hydropower has historically been a reliable and long-term energy source in the United States. However, in recent years government subsidies have sided with faster moving renewable energy sources, wind and solar. Tax-based incentives such as the ITC and PTC, reinforced under the Inflation Reduction Act, have increased the investments of these energies, while hydropower expansion has declined due to high upfront capital costs. Despite all the opposition of expansion, hydropower remains critical for grid reliability, storage, and energy stabilization.

### Net generation for all sectors, monthly

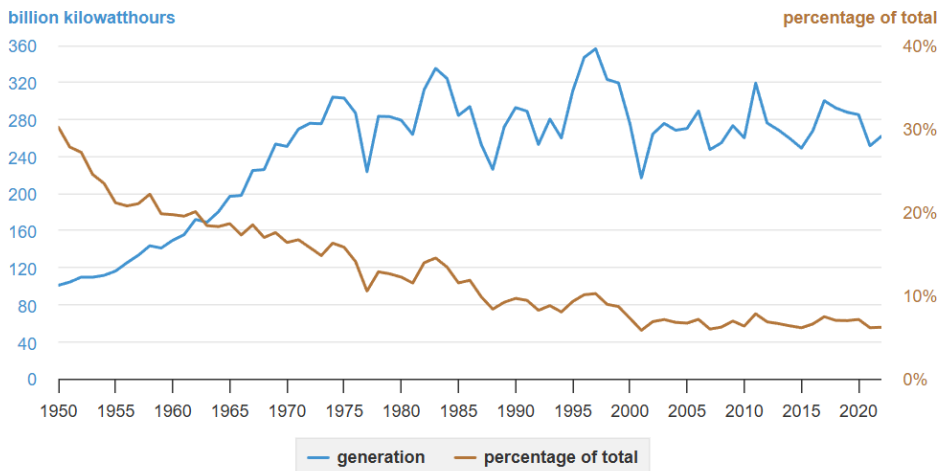
thousand megawatthours



eia Data source: U.S. Energy Information Administration

Figure A: The generation of hydroelectricity in the state of Washington

### Hydroelectricity generation and share of total U.S. electricity generation, 1950-2022



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2.a, March 2023 and *Electric Power Monthly*, Table 1.1, February 2023, preliminary data for 2022  
 Note: Includes utility-scale conventional hydroelectricity plants with a least 1 megawatt of generation capacity.

Figure B: The amount of hydroelectricity being generated in the U.S. compared to the total share

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