Issue Brief: Hydropower

Hydropower is the United States' oldest and most reliable renewable energy resource, and its potential still is not fully tapped. As we work to decarbonize the power sector, hydropower's unique benefits are an essential part of any climate solution. Moreover, hydropower has great potential to produce more power with a smaller environmental footprint than ever through new, innovative technologies.

Growth Potential

Clean and renewable hydropower provides energy to over 30 million American homes. In 2019 it was the second largest source of renewable energy in the United States after wind, accounting for 6.6 percent of total electricity generation, and 37.7 percent of renewable electricity generation.[1] As impressive as that sounds, its growth potential is immense. According to the Department of Energy's (DOE) Hydropower Vision Report, hydropower can sustainably grow its current 101 GW of capacity by an additional **50 GW by 2050.**

Deployable Hydropower Technologies

Non-powered dams. Today, only 3 percent of the nation's 80,000 dams have electricity generating equipment.[2] This provides an opportunity to produce a substantial amount of renewable electricity by converting some non-powered dams to include clean generation.

Conduit hydropower. Thousands of miles of man-made canals, pipes, tunnels, and aqueducts in the United States are constantly carrying water—for irrigation, to larger bodies of water, to households, or into municipal wastewater systems. Conduit hydropower improves upon existing water infrastructure to produce electricity without the need for a large dam or reservoir and instead harnesses kinetic energy as water is diverted through a pipe from a place of high potential energy. The water flows through hydraulic turbines on its way to its ultimate destination, which may be to irrigate crops or the city's municipal water system. By fitting these existing pipes with turbines, a new, clean, innovative power source harnesses energy that is otherwise uncaptured.

Run-of-the-river facilities channel part of the stream through a powerhouse before the water rejoins the main river. Generation depends on natural incoming flows.

Pumped storage hydropower works like a battery but can store power on a larger scale and over a longer time period. When demand for electricity is low, a pumped storage facility stores energy by pumping water from a lower to an upper reservoir. During periods of high electrical demand, the water is released back to the lower reservoir and turns a turbine, generating electricity.

Hydropower Innovation Research and Development

Current and tidal generation captures the energy from river currents and rising and falling tides with structures similar to wind turbines. The placement of turbines in the path of an **ocean current** can also harness the energy of moving water, although this technology is in development stages. Certain technologies are also being tested to capture the energy of waves in the ocean, using pressure differences to move hydraulic pumps.[3]

[1] U.S. Energy Information Administration (EIA), "What is U.S. electricity generation by energy source?," 2019. Available at https://www.eia.gov/tools/faqs/faq.php?id=427&t=3.

[2] Department of Energy, "Top 10 Things You Didn't Know About Hydropower," 27 April 2015. Available at https://www.energy.gov/articles/top-10-things-you-didnt-know-about-hydropower.

[3] Information on river current, tidal, and wave energy generation from Environmental and Energy Study Institute (EESI), "Hydropower and Other Water Energy Technologies," available at https://www.eesi.org/topics/water-hydropower-wave-power/description.

Benefits of Hydropower

Black start capability, energy balance, fuel reliability, flood control, and recreation

Hydroelectric facilities currently provide nearly 68,000 jobs in the United States, which could be greatly expanded given the large potential for growth.[4] They are a reliable energy source, given that they have a constant, nearly unlimited fuel source to draw from (except in cases of severe drought).[5] Hydropower is also a fundamental black start resource, since around 80 percent of the hydropower capacity in the U.S. can go from zero to maximum power output within 10 minutes.[6] Hydropower helps balance energy supply and demand—over daily and seasonal timeframes—enabling more wind and solar onto the grid. Dams also play a role in flood control, as they can capture floodwater and store it for later use or release it in a controlled fashion. Reservoirs are used for irrigation purposes as well: around 10 percent of crops grown in the United States are irrigated with water.[7]

CRES Forum Policy Recommendations

Build on the significant untapped hydropower potential in the country by upgrading existing facilities, retrofitting non-powered dams, and constructing new, smaller, more environmentally sound ones. The DOE's Hydropower Vision Report provides specific recommendations on how to achieve the potential 50 GW increase in generating capacity: 6.3 GW can be reached through upgrades at existing hydropower facilities; 4.8 GW by retrofitting existing, non-powered dams; 35.5 GW by constructing new pumped storage facilities and upgrading existing ones; and 1.7 GW through new stream-reach development.[8]

- **Create a more efficient licensing process** for hydropower projects, which currently takes up to 10 years, costs millions of dollars, and requires the involvement of multiple government agencies. These redundancies and inefficiencies slow the deployment of clean energy and delay much-needed environmental enhancements.
- **Level the playing field** for hydropower in tax and renewables policy.
  - **Tax policy** should treat hydropower on par with other renewable energy sources. Long-term extensions of the Production Tax Credit (PTC) and the Investment Tax Credit (ITC) are needed to accommodate the longer regulatory and development lead time associated with larger, capital-intensive projects.
  - As states and the federal government pursue policies to reduce greenhouse gas emissions and achieve net zero emissions by mid-century, **renewable and clean energy** policy should account for hydropower as a renewable energy resource.
- **Increase investment in hydropower R&D** to ensure the optimum modernization of hydroelectric infrastructure, including technological advancements in equipment and environmental mitigation.

[4]National Association of State Energy Officials (NASEO) and Energy Futures Initiative (EFI), 2020 U.S. Energy & Employment Report, available at https://www.usenergyjobs.org/.
[5]Jose R. Gracia, Patrick W. O'Connor, Lawrence C. Markel, Rui Shan, D. Thomas Rizy and Alfonso Tarditi, Hydropower Plants as Black Start Resources. U.S. Department of Energy, May 2019. Available at https://www.energy.gov/sites/prod/files/2019/05/f62/Hydro-Black-Start_May2019.pdf.
[6]Federal Emergency Management Agency (FEMA), "Benefits of Dams," 22 October 2019. Available at https://www.fema.gov/benefits-dams.
[7]Ibid.
[8]NHA, "50 by 2050: Hydropower's vision for growth." Available at https://www.hydropowervision.org/