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"The world"s capacity to generate renewable electricity is expanding faster than at any time in the last three decades," theInternational Energy Agency said in a report published earlier this year. This sign of growth offers "a real chance of achieving the goal of tripling global capacity by 2030 that governments set at the COP28 climate change conference."

In 2022, 29.1% of the world"s electricity was generated by renewable energy resources, and in 2023, renewable capacity grew another 50%. That year, 21.4% of total U.S. energy was produced by renewables, and in April of this year alone, solar, wind, hydropower and biomass provided 31% of the nation"s electricity.

Because renewable energy sources depend on the environment, both the supply of and demand for renewables are affected by climate impacts such as high heat, drought, altered precipitation patterns, flooding, extreme weather and wildfires. Geothermal energy, which depends on heat from the Earth"s interior, is the renewable energy source least affected by climate change impacts, but it provides only 0.4% of U.S. electricity.

"Where there may be impacts on renewable generating facilities, we need to plan for that and prepare for that," saidRomany Webb, deputy director of theSabin Center for Climate Change Lawat the Columbia Climate School. "But we need to think about how climate change will impact the energy system as a whole because, unfortunately, no electricity generating system is immune from the impacts of climate change."

Webb said that the North American Electric Reliability Corporation and others suggest that fossil fuel-based resources are actually at much higher risk from climate impacts. For example, most fossil fuel facilities are designed to operate at a specific temperature and require water for cooling. As air temperatures rise and increase water temperatures, fossil fuel and nuclear facilities have had to shut down because nearby water bodies were too warm to draw from, or the plants couldn"t release used water into them because that would have exceeded their thermal limits.

How are renewable energy resources affected by climate change?

Hydropower, which produces5.7%of electricity in the U.S, and 44% of all global renewable energy (the largest renewable source) is susceptible to heat and drought. Higher temperatures result in shrinking glaciers and reduced snow melt in some areas, and increased evaporation and less precipitation reduce the amount of water in reservoirs and the generating capacity of hydropower.

"I think hydropower is very challenging in a climate-changed world," said Webb. "We’ve seen that in California, which has traditionally been so heavily reliant on hydropower. There has been such variation due to drought reducing stores there."

Early snow melt also has a huge impact, she added. "Previously, the snowpack would melt gradually and provide a source of water over an extended period of time. Now, with temperatures rising rapidly, we see earlier and faster snow melt that can just overwhelm the system so you can’t get the most out of it. That means that you have these extended, long summer dry periods." For instance, in 2021, Lake Oroville in California was at only 35% of capacity, forcing the Hyatt hydropower station, which supplied 60% of the county"s power, to be shut down.

In Zambia, a shorter rainy season and droughts are presently affecting hydropower, which provides 80% of the country"s electricity, resulting in blackouts and power rationing.Ecuador is currently imposing nighttime blackouts and a ban on remote working because the worst drought in decades is impacting the reservoirs that generate its hydropower.

Global electrical energy storage relies almost entirely (99%) on pumped hydro storage, which is also dependent on the availability of water in reservoirs. It generates power by storing water in a reservoir at a higher elevation, then releasing it through turbines to generate electricity.

Changes in precipitation, runoff and river flow can also affect hydropower, and extreme rain and floods can damage dam infrastructure. And while floods and storms may increase hydropower"s resources, the gains areoffsetby droughts and heat waves.

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