Future droughts will severely impact power production

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Credit: Northeastern University

For every flip of a light switch, thermostat adjustment, and preheated oven, we have a thermoelectric power plant to thank. Thermoelectric plants include coal, nuclear, oil, and natural gas. These plants account for

90 percent of the electricity generated in the U.S.—and every one of them requires water for cooling.

In new research published Thursday in *Nature Scientific Reports*, Auroop Ganguly, professor of civil and environmental engineering at Northeastern, describes the future of thermoelectric power plants. Using a new approach in computational modeling, Ganguly and his colleagues found that by the 2030s, about 27 percent of America's power production will be severely impacted by future droughts and warmer, scarcer water. Here, he explains the research and its potential implications.

What does an impact in power production due to water stress look like to the average consumer?

The stress on power generation may be especially severe when power is also most in demand. For example, in drought conditions when water is scarcer and warmer, there may be an increase in the need for air conditioning—which further stresses power production. A rise in utility bills may be the direct and immediate result. In severe cases, power rationing may become the order of the day.

From Brazil and Venezuela to even Britain and Taiwan, the fear of power rationing continues to be real across the globe. Outages, both planned and unplanned, are likely, which may in turn impact other lifeline sectors such as transportation and water distribution or wastewater, as well as communication and cyber infrastructures. One only needs to look at other countries where water stress is the norm. For example, the 2012 outage in northern India—the largest in history in terms of population impacted—was at least partly a result of a surge in groundwater pumping due to agricultural water demand caused by extreme heat and delayed monsoons. The power outage impacted the

operations of the Indian Railway Network, which is the lifeline of that nation.

Record heat waves in early 2009 led to power outages in Melbourne, Australia, impacting urban life and bringing traffic to a near standstill. Severe droughts in Kenya in 2017 and India in 2016 led to human misery and economic losses. Here in the U.S., the Hoover Dam's generating capacity was reduced by 23 percent in 2010 and 30 percent in 2016 due to water scarcity.

What does "water stress" mean in this context?

Water stress in the context of power production includes measures of water scarcity combined with warmer waters. Water above certain temperatures may be less useful for cooling and would likely reduce the efficiency of the power generation process. In addition, higher temperatures of the input water are likely to result in warmer water that is discharged from the power plant, which in turn may cause thermal pollution in aquatic systems. Water scarcity in this context may be caused by increasing demand, such as through population movement or growth and changes in multi-sector water use, as well as changes in supply caused by climate variability or change, and other considerations such as land use changes or ground water pumping. Warming of waters may result from warmer air temperatures in the future, which may in turn be climate induced.

What can be done to prepare for water stress in the future? What measures should be taken now to lessen the impact on power production?

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E's goal through that specific grant program was to determine technology investment strategies and priorities in water-resilient power generation technologies—specifically, where the production process would need to work relatively efficiently with both less water and warmer waters. Besides technology advances in power production, water conservation along with optimization and regulation of water use across multiple sectors may be necessary. In the slightly longer term, addressing fundamental challenges such as unbridled urban development and climate change may prove most effective.

More information: Poulomi Ganguli et al. US Power Production at Risk from Water Stress in a Changing Climate, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-12133-9

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