Warming climate likely to have 'minor' impact on power plant output

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Future climate warming will likely cause only minor cuts in energy output at most U.S. coal- or gas-fired power plants, a new Duke University study finds.

The study—the first of its kind based on real-world data—rebuts recent modeling-based studies that warn rising temperatures will significantly lower the efficiency of power plants' cooling systems, thereby reducing

plants' energy output. Those studies estimated that plant efficiencies could drop by as much as 1.3 percent for each 1 degree Celsius of climate warming.

"Our data suggest that drops in efficiency at plants with open-loop, or once-through, cooling systems will be a full order of magnitude smaller than this," said Candise L. Henry, a doctoral student at Duke's Nicholas School of the Environment. "Reductions at plants with wet-circulation, or closed-loop, systems—which can be identified by their cooling towers—may be even smaller."

"In large part, this is because plant operators are already constantly adjusting operations to optimize plant performance under changing environmental conditions," she said. "That's a key consideration the past studies overlooked."

The new findings do not, however, signal an all's clear for the power industry, the Duke researchers cautioned.

"The impact of future droughts associated with global warming could still significantly affect plant operations and output by reducing the availability of water for cooling," said Lincoln F. Pratson, Semans-Brown Professor of Earth and Ocean Sciences at Duke.

Henry and Pratson published their findings this month in the peer-reviewed journal *Environmental Science & Technology*.

To conduct their study, they analyzed hourly temperature and humidity data recorded at National Climatic Data Center (NCDC) stations and U.S. Geological Survey river gauges near 39 U.S. coal- or natural-gas-fired power plants over a seven- to 14-year period. By correlating this data with the plants' hourly heat input and energy output records, obtained through the EPA's Air Markets Program Data website, they

were able to extrapolate how much of each plant's output was the result of daily and seasonal variations in temperature.

"These variations exceed estimates of the average future annual increase in warming under a moderate global warming scenario," Henry noted, "so we could actually see—based on empirical evidence—how plants' operations are affected by temperature changes much more dramatic than what is projected to occur."

To ensure a representative sample, the study included both closed-loop and open-loop plants from the Northeast, Mid-Atlantic, Southeast, Midwest, Deep South, Great Plains and Rocky Mountain regions. Output capacities ranged from less than 500 megawatts up to 3,000 megawatts.

The cooling efficiency and energy output of every plant—regardless of location, generating capacity or fuel type—was found to be more resilient to climate warming than previous studies predicted.

Plants with closed-loop cooling systems were found to be particularly resilient.

"This provides additional rationale for section 316b of the EPA's Clean Water Act, which requires most electric generators to install closed-loop recirculating systems," said Pratson.

"The EPA enacted section 316b to protect fish, shellfish and other aquatic animals from being pulled into, and harmed or killed in power plants' cooling water-intake structures," he noted. "Our study shows it could also provide the added benefit of helping protect the power plants themselves from the impact of climate warming."

More information: Candise L. Henry et al, Effects of Environmental Temperature Change on the Efficiency of Coal- and Natural Gas-Fired

Power Plants, *Environmental Science & Technology* (2016). DOI: 10.1021/acs.est.6b01503