Researchers examine cooling power plants with brackish groundwater

May 22 2023

Credit: CC0 Public Domain

A new analysis led by a University of Wyoming researcher shows that brackish or salty groundwater has the potential to replace fresh water to cool coal- and natural gas-fired power plants and strengthen resilience in

the energy infrastructure, although there's a cost associated with doing so.

The research appears in the journal *Nature Water*.

With freshwater supplies threatened due to drought, climate change and rapid socioeconomic growth, water competition is increasing between the electric power sector and other sectors. While transitioning to a low-carbon energy future, decarbonization of fossil fuel-fired power plants by carbon capture and storage would significantly increase water consumption and exacerbate water competition. Water challenges drive power plant operators to explore alternative water sources.

"Non-traditional water sources can be deployed to help cope with climate-induced water risks and tackle the increasing water demand for decarbonization of fossil fuel-fired power plants," wrote the research team, led by Haibo Zhai, UW's Roy and Caryl Cline Distinguished Chair in the College of Engineering and Physical Sciences.

"Treatment of brackish groundwater for thermoelectric generation cooling can help alleviate potential competition for freshwater resources among various sectors in water-stressed regions."

The research includes Zhai's UW Ph.D. student, Zitao Wu, as the lead author of the paper. Other contributors are from the National Energy Technology Laboratory in Pittsburgh, Pa. It's the second paper of a multiyear project; the first paper, published last year in the journal *Applied Energy*, examined the possibility of switching from water cooling towers to dry cooling systems at fossil fuel-fired plants.

Removing excess dissolved salts and minerals from brackish water can itself be energy-intensive and produce concentrated brines requiring disposal. A method called zero liquid discharge minimizes

environmental impacts of desalination but is particularly costly.

The researchers examined the technical and economic feasibility of multiple desalination processes. They also estimated how much fresh water would be saved as a result of treating brackish water for power plant cooling, and they evaluated the cost-effectiveness of brackish water treatment retrofits—and the impact on the net generating capacity of power plants. They concluded that retrofitting power plants to treat brackish groundwater could nearly eliminate the use of fresh water but would increase the cost of electricity generation by 8% to 10%.

"Our study reveals trade-offs in freshwater savings, cost and generating capacity shortfalls from desalination deployment," Wu says.

The researchers call for further development of technologies to treat brackish water, along with exploration of using other non-traditional water sources for cooling of power plants. Those include treated municipal wastewater, as well as water produced from oil and gas extraction and carbon dioxide storage reservoirs.

The trade-offs identified for various non-traditional water sources will fill knowledge gaps to better inform water-for-energy decisions and management, the researchers say.

More information: Zitao Wu et al, Treatment of brackish water for fossil power plant cooling, *Nature Water* (2023). DOI: 10.1038/s44221-023-00072-x

Provided by University of Wyoming