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GETTING PRETTY TEURSTY CHATGPT'SHIDDEN WATER FOOTPRINT

ne bottle of water to generate a 100-word email using GPT-4. This is the hidden cost, on average, of outsourcing our everyday tasks to ChatGPT's newest large language model.

Artificial intelligence (AI) models require immense amounts of water for server cooling and electricity generation, which raises concerns in an era of freshwater scarcity.

By 2030, nearly half of the world's population is expected to endure severe water stress, and AI's footprint is only expanding.

AI models like OpenAI's GPT–4 run in data centers the size of warehouses. These centers run thousands of computations to deliver results within seconds. This means they consume a lot of electricity (much of which is water–generated), which causes physical hardware to heat up. To prevent overheating, water is funneled in and out of these centers as a cooling mechanism, similar to humans sweating on a hot day.

For context, Microsoft used nearly 2.1 billion gallons of water in 2023, equivalent to around 3,100 Olympic–sized swimming pools and a 67% increase from 2021. AI is responsible for much of this spike after Microsoft's multi–billion dollar investments in OpenAI.

There are over 8,000 data centers globally, which affects local communities differently considering that temperature and freshwater availability vary by region. In hotter areas, data centers require more cooling resources. This is problematic for nearby residents who need access to the same limited water.

The American Southwest is a popular choice for new data centers because of inexpensive available land, but the region is battling climate extremes. Greater Phoenix is a data center hub but also the hottest U.S. city (in 2024, it experienced 113 consecutive days above 100 degrees Fahrenheit). The weather, combined with drought, left water resources scarce. More centers are being proposed here, but communities are now having to fight back to protect themselves.

Arizona Attorney General Kris Mayes told The Atlantic that "allowing one more data center to come to our state is an easy but stupid decision in a lot of cases. It's like the cotton candy of economic development." Despite BY DESSY DUSICHKA, COMPUTER SCIENCE & BIOLOGY, 2025 DESIGN BY LILY WONG, CELL & MOLECULAR BIOLOGY, 2026

the immediate economic appeal, these data centers represent limited long-term benefit for communities, ultimately representing a shallow investment. However, the uneven distribution of water can also be usedadvantageously. The resource-intensive process of training models can be strategically scheduled to occur in cooler, more water-abundant regions. OpenAI did this in Iowa

to train GPT-4, where data centers can take advantage of cooler temperatures and consequently use less water. The Pacific Northwest is another booming region, although too much development here can put pressure on the power grid.

Big tech corporations are vowing to reduce their resource usage, but keeping them accountable is tough when they aren't always transparent. Efforts to meet carbon footprint goals can also hurt water usage and vice versa, so balancing the two goals is a delicate tradeoff for organizations hoping to be sustainable. Finally,

corporate sustainability plans often include purchasing carbon offsets or funding water replenishment initiatives. These measures fail to minimize usage in the first place and often don't benefit the local communities their actions hurt the most.

There are still some actions that big technology companies can take. Underwater data centers are being explored as a sustainable option powered by renewable energy. Additionally, collaboration between AI developers and relevant stakeholders can help both parties understand the external effects of these complex algorithms. Utilizing pre-trained models and advanced techniques like deep learning algorithms can also improve AI's power efficiency.

If channeled effectively, investing in AI might make other processes more sustainable. For example, AI–powered irrigation systems can help make water use more efficient. Being mindful of our own AI usage can make change on a small scale, but holding corporations accountable will make more difference in the long run. After all, what's the value of a software if the planet can't sustain its users?

Communications of the ACM (2023). DOI: 10.48550/arXiv.2304.03271 GAIA - Ecological Perspectives for Science and Society (2023). DOI: 10.14512/ gaia.32.S1.10

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