Hydropolitics in the cloud

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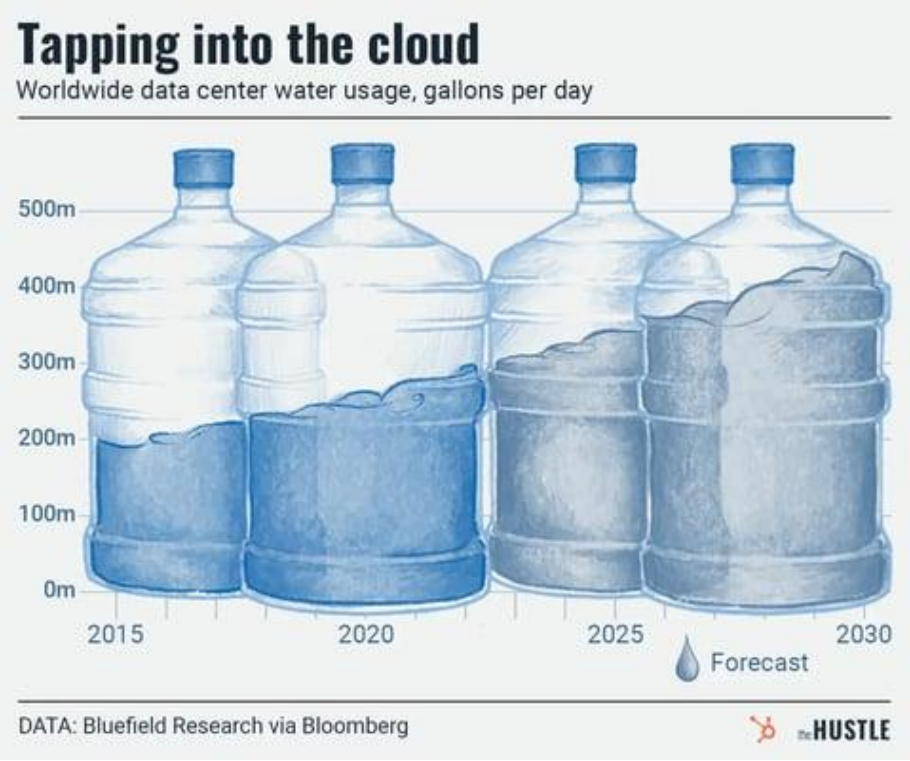
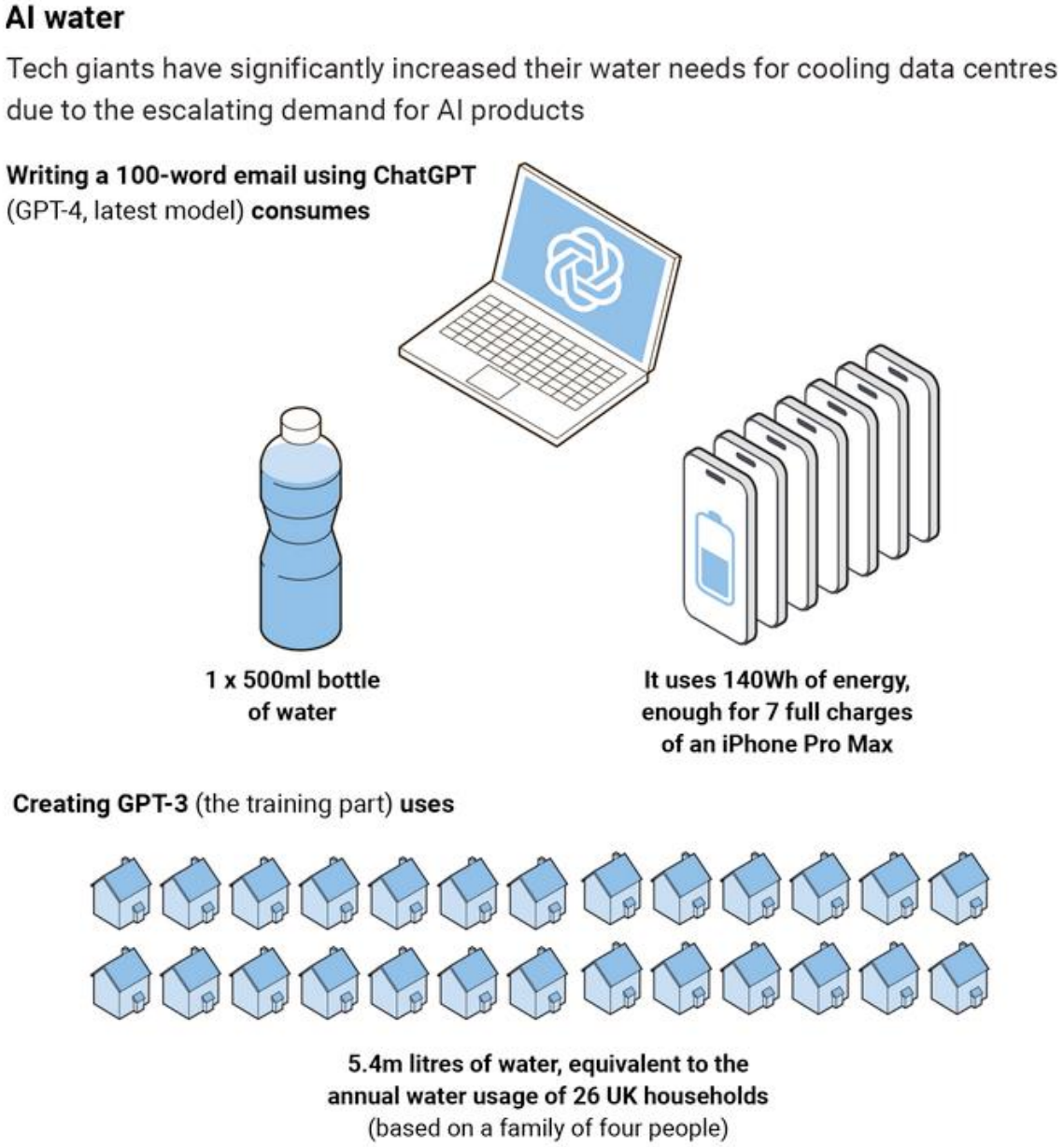
Image source: Amanda Andrade-Rhoades / The Washington Post

Power & water demand are entangled





Understanding local water impacts

Direct Water Usage (onsite)

water used for air-conditioning / cooling servers (Scope 1)

A typical hyperscale data center can use 3-5 million gallons of water a day

Currently 728 hyerscale data centers globally & >1,000 exp. by end of 2024.

1 Fifth of data center water is drawn from regions with moderate to high water stress

Indirect Water Usage (offsite)

~75% water consumption for data centers happens in energy production (Scope 2)

This doesn't include water used in the tech supply chain (manufacturing semiconductors, computer hardware etc.) (Scope 3)

NOTE: Power capacity issues will affect water consumption eg. Nuclear uses a lot of water + generates thermal pollution

Impacts to water *quality*

Considers threats to water quality and sustainability from data centers

Eg. Increase in impervious surfaces might threated local water quality (increased impervious surfaces → increased run-off → decreased infiltration (ground water) → rising water salination

Water Usage Effectiveness (WUE)

an industry metric to measure water usage

doesn't measure total usage but usage in relation to power consumption

useful to an extent for comparisons but it obscures a information on total consumption & impacts to water sources

Net Water Positive

putting back more water into the environment than they consume

BUT often doesn't go back to the same source

Needs more transparency

Sources:

- Li, P., Yang, J., Islam, M. A., & Ren, S. (2023). *Making AI Less "Thirsty": Uncovering and Addressing the Secret Water Footprint of AI Models* (arXiv:2304.03271)
- Siddik, M. A. B., Shehabi, A., & Marston, L. (2021). The environmental footprint of data centers in the United States. *Environmental Research Letters*, *16*(6), 064017. https://doi.org/10.1088/1748-9326/abfba1

Industry solutions

Microsoft's Project Natick (Image Source: Green Marine)

Liquid Immersion Cooling (Image Source:)

- Alternative water sources
  - Sea water
  - Underwater data centers
- Closed-loop cooling systems
- Ambient cooling in cool climates
  - Underground data centers
- Immersion cooling
  - Server immersion
  - Direct-to-chip cooling
- Recycling excess heat
  - District heating
  - Swimming pools
  - Greenhouses
  - Turbines
- AI tools to find water efficiency

Research avenues / policy interventions

Areas for further research:

- Efficacy of ALT cooling methods
- Assess cooling needs in different climates and seasons
- Water sources: assess the reliance on groundwater, surface water, or municipal water supplies
- Evaluate tradeoffs between data centers and other local needs (eg. Agriculture, drinking water, industry)
- Assess impacts on equity – which communities are most affected by data center water usage?

Policy areas:

Transparency in Water Usage:

- Require data centers to report water and power usage & impacts on sources (SB 285 – Danica Roem)
- Also need transparency in indirect water consumption from energy production

Water Efficiency Standards:

- Set benchmarks for acceptable WUE, but pair w/ reporting on water consumption, and source monitoring
- Encourage alternative cooling technologies, direct liquid cooling, immersion cooling, and free cooling

Water Source Management:

- Prioritize the use of recycled water or non-potable water sources
- Require ongoing evaluation of impacts to local watershed for cumulative development (not just site by site basis)
- Require net zero water policies to be transparent about where water is drawn from and returned to

Monitoring and Auditing:

- Mandate regular water usage and consumption audits to identify areas for improvement