# How Much Water Do Data Centers Use? Myth vs Reality (2026)

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## Executive Summary

Data centers withdraw water primarily to cool the servers, chips, and network equipment that run cloud computing and artificial intelligence (AI) workloads, and the scale of that withdrawal has become a measurable, contested, and rapidly growing part of the global water picture. In the United States, data centers directly consumed **66 billion liters** (about **17.4 billion gallons**) of water in 2023, up from 21.2 billion liters in 2014, according to the Lawrence Berkeley National Laboratory's (LBNL) 2024 United States Data Center Energy Usage Report, the most authoritative federal estimate available (Source: eta-publications.lbl.gov). That same report found indirect water consumption, the water used at power plants to generate the electricity data centers draw, was nearly **800 billion liters** in 2023, roughly twelve times the direct figure (Source: eta-publications.lbl.gov). Globally, the International Energy Agency (IEA) estimated total data center water consumption at **560 billion liters** in 2023, split between 373 billion liters indirect, 140 billion liters direct cooling, and 47 billion liters embedded in hardware manufacturing (Source: pmc.ncbi.nlm.nih.gov).

The hyperscale operators that run the largest share of world computing capacity now disclose annual figures, though inconsistently. **Google** reported that its total water consumption climbed **34% to 10.9 billion gallons** in 2025, more than double its 2021 level, with data centers accounting for most of the increase, according to its 2026 Environmental Report and Axios's review of it (Source: axios.com). **Microsoft** withdrew approximately 2.7 billion gallons of water in 2024 and reported a water usage effectiveness (WUE) of 0.27 liters per kilowatt-hour (L/kWh) for fiscal year 2025 (Source: trellis.net). **Amazon Web Services (AWS)** disclosed for the first time in June 2026 that its data centers withdrew **2.5 billion gallons** of water in 2025, achieving a WUE of 0.12 L/kWh, which the company describes as seven times better than the industry average (Source: trellis.net) (Source: sustainability.aboutamazon.com). **Meta** consumed 813 million gallons of water globally in 2023, of which 776 million gallons went to data centers, and separately discloses an indirect water intensity of 3.92 L/kWh for electricity purchased, the only major operator to do so (Source: pmc.ncbi.nlm.nih.gov).

On AI specifically, the widely repeated claim that a single chatbot prompt consumes a "bottle of water" traces to a 2023 University of California, Riverside preprint, "Making AI Less Thirsty," which estimated 10 to 50 prompts to GPT-3 together used about a 500-milliliter bottle, and to a September 2024 Washington Post story that misapplied the underlying methodology to GPT-4, implying a single 100-word email used a whole bottle

(Source: arxiv.org) (Source: blog.andymasley.com). Google's own August 2025 methodology paper puts the median Gemini Apps text prompt at **0.26 milliliters** of water, about five drops, using a comprehensive accounting method (Source: cloud.google.com).

Local impacts diverge sharply from these national averages. In Uruguay, a proposed Google data center in Canelones sparked protests during the country's worst drought since 1950, with campaigners using the slogan "it's not drought, it's pillage" (Source: theguardian.com). In Chile, a Chilean environmental court partially reversed Google's permit for its $200 million Cerrillos data center over aquifer concerns, prompting Google to redesign the facility for air cooling (Source: reuters.com). In Memphis, xAI's Colossus supercomputer prompted an $80 million wastewater treatment plant to avoid drawing from the city's drinking aquifer (Source: time.com). And in Arizona, a Ceres analysis projects Phoenix-area data center power-generation water use could grow 400% by the early 2030s, from about 2.9 billion to over 14.5 billion gallons annually (Source: ceres.org). Newer cooling technologies, from Nvidia's 100% liquid-cooled Rubin infrastructure to Microsoft's closed-loop, zero-water AI data center designs, promise to cut direct water consumption to near zero, even as indirect consumption from electricity generation remains the harder problem to solve (Source: blogs.nvidia.com) (Source: itif.org).

## Introduction and Background

Every large data center generates heat that must be removed continuously to keep servers, storage arrays, and networking hardware within safe operating temperatures, and for decades the cheapest, most energy-efficient way to remove that heat has been evaporative cooling, a process that consumes water. As cloud computing and, more recently, generative AI have driven a construction boom in hyperscale facilities, the volume of water these buildings draw from local rivers, aquifers, and municipal utilities has moved from an obscure operational detail to a subject of congressional reports, court rulings, and street protests. This report examines how much water data centers actually use, how that water use is measured, where the largest operators stand as of mid-2026, and how the industry is responding to mounting local and regulatory pressure.

The distinction between water **withdrawal** and water **consumption** is central to understanding every figure in this space.Withdrawal is the total volume of water a facility draws from a source; consumption is the portion that is not returned, typically because it evaporates during cooling (Source: mostpolicyinitiative.org). A related distinction separates **direct** water use, the water applied on-site for cooling towers, chillers, and humidification, from **indirect** water use, the water consumed at the power plants that generate a data center's electricity, whether that plant burns natural gas, splits uranium atoms, or spins a hydroelectric turbine (Source: eta-publications.lbl.gov). The Information Technology and Innovation Foundation (ITIF) notes that in the United States, indirect consumption is "more than 10x direct consumption," even though data centers overall remain a small share of total national water use (Source: itif.org). That last qualifier, "a very small fraction," is where public perception and industry data most sharply diverge, since national averages say little about the specific watersheds, some already stressed by drought, where individual hyperscale campuses are sited.

The industry's standard efficiency metric, **Water Usage Effectiveness (WUE)**, was developed in 2011 by The Green Grid, a data center trade consortium, as a companion to the earlier Power Usage Effectiveness (PUE) metric. WUE divides a facility's total water consumption (in liters) by the electricity delivered to its information technology (IT) equipment (in kilowatt-hours), producing a unit of L/kWh (Source: www.thegreengrid.org). LBNL's 2024 report distinguishes "site WUE," which counts only on-site water, from "source WUE," which folds in the water consumed generating the facility's electricity, and finds the industry-wide average site WUE has held just over 0.36 L/kWh through 2023, with a range across cooling system types that spans from near zero for air-cooled chillers to well over 1 L/kWh for water-cooled chiller systems without economizers (Source: eta-publications.lbl.gov).

Public attention to this issue accelerated for two reasons. First, corporate sustainability reporting improved enough, however unevenly, that journalists and researchers could compare Google, Microsoft, Amazon, and Meta's disclosed figures against one another and against IEA and LBNL benchmarks. Second, the generative AI boom that began with ChatGPT's late-2022 launch attached a face, and a per-query number, to what had previously been an abstract infrastructure statistic, prompting both legitimate scientific inquiry (the 2023 "Making AI Less Thirsty" preprint) and, subsequently, widely circulated but methodologically flawed viral claims about individual chatbot queries. This report separates the two: what the aggregate, audited numbers show about data center water use broadly, and what more careful per-query analysis shows about AI specifically.

## What Counts as Data Center Water Use: Definitions and Measurement

Understanding the numbers that follow requires fixing four terms that are frequently conflated in press coverage.

- **Withdrawal**: the total volume of water a facility draws from any source (municipal supply, groundwater, surface water, or reclaimed wastewater), regardless of whether it is later returned.
- **Consumption**: the portion of withdrawn water that is not returned to the local water system, typically lost to evaporation in a cooling tower or humidification system. Equinix, for example, reported withdrawing 1.4 billion gallons in a recent year and consuming 1.2 billion gallons of it, or 85%, illustrating how high the consumption share can run for evaporative systems (Source: mostpolicyinitiative.org).

- **Direct (site) water use**: water applied physically inside or immediately around the data center building for cooling towers, chillers, and evaporative or adiabatic pre-coolers.
- **Indirect (source) water use**: water consumed off-site, at the power plant, to generate the electricity the facility draws from the grid. LBNL calculated a national average indirect water intensity of 4.52 L/kWh for U.S. data centers in 2023, versus 4.35 L/kWh for the average U.S. kilowatt-hour overall, reflecting the regional electricity mixes that happen to supply major data center clusters (Source: eta-publications.lbl.gov).

Water intensity varies enormously by generation source. The Green Grid's original 2011 methodology paper assigned an Energy-Water Intensity Factor (EWIF) of zero L/kWh to solar photovoltaic and wind power, 0.8 L/kWh to natural gas, 2.2 L/kWh to coal, and 3.3 L/kWh to nuclear power, while noting that hydroelectric power can carry an EWIF as high as 68 L/kWh when reservoir evaporation is fully attributed to electricity output (Source: www.thegreengrid.org). Writer Andy Masley, reviewing the underlying "Making AI Less Thirsty" dataset, found that roughly 50% of the U.S. grid's average consumptive water cost per kilowatt-hour is water evaporated from lakes and reservoirs behind hydroelectric dams that would likely evaporate whether or not a data center existed nearby, a nuance that complicates simple "water per prompt" comparisons (Source: blog.andymasley.com).

Transparency remains the field's central unresolved problem. Summarizing a February 2026 commentary in AGU Advances, an American Geophysical Union journal, the AGU science outlet Eos reported that the paper's authors argue "more transparency is necessary for communicating the water usage of data centers, and for supporting effective regulation and community planning" (Source: mavensnotebook.com). A 2021 peer-reviewed study in npj Clean Water similarly found that "less than a third of data center operators" measure and track water consumption at all (Source: www.nature.com). A 2026 peer-reviewed comparison of the largest AI buyers, published via PubMed Central, found that "no company reports any AI-specific metrics" for water or carbon, even though firms including Google, Meta, and Microsoft attribute rising electricity and water use to AI growth in their own disclosures (Source: pmc.ncbi.nlm.nih.gov).

## Cooling Technologies and Their Water Footprints

The technology a data center uses to remove heat determines its water intensity more than any other single design choice. LBNL's 2024 report models nine major cooling system types deployed across the United States, and the differences among them are stark.

- **Water-cooled chillers with cooling towers**: the traditional, most water-intensive approach, in which heat is rejected through evaporative cooling towers; LBNL finds these systems "exhibit the highest WUE, largely attributed to substantial cooling tower water usage" (Source: eta-publications.lbl.gov).
- **Air-cooled chillers**: use no on-site water at all but consume more electricity, illustrating a persistent tradeoff between water efficiency and energy efficiency (Source: eta-publications.lbl.gov).
- **Airside and waterside economizers**: use outdoor air or naturally cool water to reduce or eliminate mechanical refrigeration during favorable weather, cutting both energy and, in the airside case, water use.
- **Dry coolers with adiabatic assist**: reject heat to ambient air like a car radiator and use water only sporadically, during hot spells, for evaporative pre-cooling.
- **Direct-to-chip and rear-door liquid cooling**: circulate liquid coolant directly to the processor rather than cooling the entire room, allowing higher operating temperatures and greater use of "free" economizer cooling.
- **Immersion cooling**: submerges hardware entirely in a dielectric (non-conductive) fluid that absorbs heat directly, eliminating the water/air heat-exchange step altogether; the Environmental and Energy Study Institute (EESI) describes it as comparable to "the difference between drip irrigation and flooding in agriculture" when set against evaporative air cooling (Source: www.eesi.org).

Two-phase immersion systems, which use fluids that boil and condense in a sealed loop, can require 2 to 5 times the capital expenditure of conventional cooling and depend on a supply chain complicated by 3M's exit from the market for the PFAS-based ("forever chemical") dielectric fluids that two-phase systems have historically required, according to ITIF (Source: itif.org).

Two further engineering approaches target the indirect side of the water ledger, at the power plant that supplies a facility's electricity, rather than at the data center itself. Dry cooling, which replaces evaporative cooling towers with air-cooled heat exchangers, "cuts water consumption by more than 90 percent" at thermoelectric plants, and California has "effectively banned once-through cooling at coastal plants" as a result (Source: itif.org). The tradeoff is thermal: dry cooling "requires roughly 1 to 1.5 percent of plant output to power its fans, compared with 0.5 percent for a wet tower," and its "performance degrades sharply on hot days" precisely when grid demand peaks and ambient air is least effective as a heat sink (Source: itif.org). Hybrid systems that blend wet and dry operation "reduce annual evaporative losses by up to 75 percent without imposing the full cost of all-dry operation," while zero-liquid-discharge systems apply reverse osmosis to recover and recycle wastewater periodically purged from recirculating cooling towers, a process ITIF says "can be implemented at less than 0.1 percent of a facility's annual electricity output" (Source: itif.org).

*Table 1* below summarizes the water intensity ranges LBNL simulated across major cooling architectures, expressed as WUE in liters per kilowatt-hour of IT electricity delivered.

| COOLING SYSTEM TYPE | APPROXIMATE WATER INTENSITY | TYPICAL DEPLOYMENT | NOTES |
|---|---|---|---|
| **Water-cooled chiller (no economizer)** | Highest of all modeled systems, often >1 L/kWh | Legacy enterprise and some colocation facilities | Relies on evaporative cooling towers; highest evaporative loss (Source: eta-publications.lbl.gov) |
| **Waterside economizer (water-cooled chiller)** | High, but lower than chiller-only systems | Large-scale colocation | Uses natural water sources when outdoor conditions allow, still evaporative overall |
| **Airside economizer with adiabatic cooling** | Low; "minimal water consumption" for much of the year | Common at hyperscale campuses | Sporadic adiabatic assist only during heat waves (Source: eta-publications.lbl.gov) |
| **Air-cooled chiller (no water)** | 0 L/kWh on-site | Facilities in water-stressed or space-constrained sites | Preferred "where minimal on-site water consumption is crucial" (Source: eta-publications.lbl.gov); trades water for higher electricity use |
| **Direct-to-chip / immersion liquid cooling** | Approaching 0 L/kWh with dry-cooler backends | Newest AI-optimized hyperscale campuses | Nvidia's Rubin architecture claims near-total elimination of on-site water via 45°C (113°F) closed liquid loops (Source: blogs.nvidia.com) |

As *Table 1* shows, the industry's cooling technology mix is shifting rapidly toward the lower end of the water-intensity spectrum, driven less by environmental mandate than by the sheer heat density of AI accelerator racks, which increasingly cannot be cooled economically with room-level air conditioning at all. LBNL's aggregate site WUE for the U.S. fleet stood at 0.36 L/kWh through 2023 but is projected to rise to between 0.45 and 0.48 L/kWh by 2028 as more hyperscale and liquid-cooled AI capacity comes online, even as individual facilities using the newest liquid-cooling designs approach zero (Source: eta-publications.lbl.gov). That apparent contradiction, average water intensity rising while best-in-class facilities approach zero, reflects the fact that overall electricity and cooling demand is growing faster than efficiency gains can offset it, a dynamic explored further in the Data Analysis section below.

## Hyperscaler Water Disclosures: Google, Microsoft, Amazon, and Meta

Corporate sustainability reports are the primary public window into company-level data center water use, but the four largest cloud and AI infrastructure operators disclose data on different fiscal calendars, in different units, and with different scopes, which complicates direct comparison.

**Google** publishes the most granular per-facility figures among the group. Its 2025 Environmental Report, covering fiscal year 2024, disclosed that the company's water stewardship projects replenished approximately **4.5 billion gallons** of water (17 billion liters), equal to 64% of its freshwater consumption that year, up from just 18% replenished in 2023 (Source: www.gstatic.com). Separately, a policy analysis drawing on that same report calculated that Google's data centers withdrew a total of **7.8 billion gallons** of water across the U.S. and Canada in 2024, consuming 78% of it, with its largest single facility, in Council Bluffs, Iowa, withdrawing an average of 3.9 million gallons per day (Source: mostpolicyinitiative.org). Google's newest report, the 2026 Environmental Report covering fiscal year 2025, shows the trend accelerating sharply: total water consumption rose **34% year over year to 10.9 billion gallons**, more than double the company's 2021 level, which Axios attributes to Google's AI data center buildout (Source: axios.com). The same 2026 report states Google replenished 78% of its 2025 freshwater consumption through 165 active water stewardship projects spanning 97 watersheds (Source: sustainability.google). Google's fleet-wide average power usage effectiveness (PUE) reached 1.09 in 2024, which the company says is 84% more efficient than the industry average of 1.56 (Source: www.gstatic.com).

**Microsoft** aims to be "water positive" globally by 2030, meaning it will replenish more water than it consumes across its operations, and it targets a 40% reduction in water use intensity across owned data centers by 2030 from a 2022 baseline (Source: cdn-dynmedia-1.microsoft.com). In its fiscal year 2023 report, Microsoft disclosed total water consumption of 7,843,744 cubic meters (about 2.07 billion gallons), and separately said it had contracted replenishment projects with an estimated lifetime benefit of more than 61 million cubic meters (Source: cdn-dynmedia-1.microsoft.com). By fiscal year 2024, Microsoft's withdrawal had grown to approximately 2.7 billion gallons, and its fiscal year 2025 WUE improved to 0.27 L/kWh (Source:

trellis.net). Crucially, the company states that its "new datacenters are designed and optimized to support AI workloads and will consume zero water for cooling," a commitment built around continuously recirculating fluid through closed-loop, direct-to-chip cooling (Source: cdn-dynmedia-1.microsoft.com) (Source: itif.org). Trade outlet Carbon Credits reported in 2026 that Microsoft "hit a significant sustainability goal by becoming water positive in fiscal year 2025, five years early," and that the company "has improved the water efficiency of its data centers by nearly 90% since the early 2000s," with average WUE falling from 2.3 L/kWh to 0.27 L/kWh over that period (Source: carboncredits.com) (Source: carboncredits.com).

**Amazon** was, for years, the least transparent of the four major cloud providers on water. That changed on June 10, 2026, when AWS disclosed for the first time that its data centers withdrew **2.5 billion gallons** of water in 2025, alongside a global WUE of 0.12 L/kWh, which it characterizes as seven times better than an industry average of 0.84 L/kWh withdrawal-basis (Source: trellis.net) (Source: sustainability.aboutamazon.com). AWS says water withdrawals at its owned-and-operated sites fell 2% between 2024 and 2025 even as capacity grew, driven by expanded use of recycled water at 24 data centers globally and by running servers at higher temperatures (Source: trellis.net). AWS has pledged to be "water positive" by 2030 and reported it was 75% of the way to that goal in 2025, up from 53% in 2024 (Source: sustainability.aboutamazon.com). "Communities want increased transparency," AWS's head of Americas power and water, Brandon Oyer, said of the decision to publish withdrawal data for the first time (Source: trellis.net).

**Meta** discloses the most complete accounting of indirect water use among the four. In 2023, Meta consumed 813 million gallons of water globally (3.1 billion liters), 95% of which, 776 million gallons (2.9 billion liters), was used by data centers (Source: gijn.org). A peer-reviewed 2026 analysis in Cell Press's iScience-affiliated journal found Meta's reported direct water consumption at 3,123,000 cubic meters and, uniquely among the majors, an indirect water intensity from purchased electricity of **3.92 liters per kilowatt-hour**, the only comparable disclosure of its kind among large AI buyers (Source: pmc.ncbi.nlm.nih.gov). In 2024 alone, Meta says its water restoration projects returned more than 1.6 billion gallons of water to high- and medium-water-stress regions (Source: sustainability.atmeta.com).

The Wall Street Journal, reviewing all four companies' 2025 and 2026 disclosures, concluded that "among this group of titans, only Meta tallies water used at the power stations that feed them electricity, in addition to the water used on-site," meaning Google's, Microsoft's, and Amazon's headline figures systematically understate each company's full water footprint relative to what a complete direct-plus-indirect accounting would show (Source: www.wsj.com). No law currently obligates any of these companies to report water use comprehensively; the Journal notes this reporting gap "has historically been about 12 times as great as the amount they directly consume," citing LBNL's national indirect-to-direct ratio (Source: www.wsj.com).

*Table 2* below consolidates the most recent disclosed figures for the four largest operators.

| COMPANY | MOST RECENT REPORTED DIRECT WATER WITHDRAWAL | WUE (L/KWH) | WATER POSITIVE TARGET | DISTINCT FEATURE OF DISCLOSURE |
|---|---|---|---|---|
| **Google** | 10.9 billion gallons consumed, FY2025 (up 34% year over year) | Not separately disclosed | Aims to replenish 120% of consumption by 2030; achieved 78% in 2025 | Publishes per-facility water figures for individual U.S./Canada sites (Source: mostpolicyinitiative.org) |
| **Microsoft** | ~2.7 billion gallons withdrawn, FY2024 | 0.27 (FY2025) | Reached water positive in FY2025, five years ahead of its 2030 target (Source: carboncredits.com) | New AI data centers designed for zero-water cooling |
| **Amazon (AWS)** | 2.5 billion gallons withdrawn, 2025 (first-ever disclosure) | 0.12 (2025) | Water positive by 2030; 75% of the way there in 2025 | Figure covers AWS only, not all of Amazon's operations |
| **Meta** | 813 million gallons consumed globally, 2023 (776 million gallons to data centers) | Direct WUE 0.19; indirect intensity 3.92 (electricity-embedded) | Restoring more water than consumed in priority basins; returned 1.6 billion gallons in 2024 | Only major operator publicly reporting indirect (electricity-embedded) water intensity |

As *Table 2* illustrates, cross-company comparison is inherently imperfect: the companies use different fiscal years, some report calendar-year data, scopes vary between "all operations" and "data centers only," and only Meta attempts a full direct-plus-indirect accounting. Even so, three patterns are consistent across all four disclosures. First, absolute water withdrawal is rising for every operator that reports comparable year-over-year data, driven by AI-related capacity growth. Second, all four have adopted "water positive" replenishment commitments with 2030 target dates, none of which offset the underlying growth in gross consumption, since replenishment is a separate accounting category from reduction. Third, WUE, the efficiency metric, is improving even as absolute consumption rises, which is the expected result of adding large amounts of new capacity built with the more water-efficient cooling technologies described in the preceding section.

## Does AI Use "a Lot" of Water? Separating the Per-Query Math From the Aggregate Trend

The question of whether AI specifically, as distinct from data centers generally, uses "a lot" of water depends entirely on the unit of comparison. At the level of a single query, the honest answer, according to the researchers who produced the original estimates, is: very little, and less than widely reported.

The 2023 preprint "Making AI Less Thirsty," by researchers including Shaolei Ren at the University of California, Riverside, was the first rigorous attempt to quantify AI's water footprint. It found that training the GPT-3 language model in Microsoft's U.S. data centers could directly evaporate **700,000 liters** of clean freshwater, and separately projected that global AI demand could account for 4.2 to 6.6 billion cubic meters of water withdrawal by 2027, "more than the total annual water withdrawal of 4 to 6 Denmark[s] or half of the United Kingdom" (Source: arxiv.org). That paper's per-query estimate for GPT-3, extrapolated by journalists at the time, suggested roughly 10 to 50 prompts together consumed a 500-milliliter bottle of water.

The number that went viral, however, came from a different source: a September 2024 Washington Post article that applied a scaled-up energy assumption, 140 watt-hours per query for GPT-4, to Ren's methodology and concluded a single 100-word email prompt used approximately a full bottle of water. Andy Masley, an independent researcher who later corresponded directly with Ren, found the 140 Wh energy assumption behind that claim was "wildly, wildly unrealistic" and failed multiple sanity checks against real-world model serving costs (Source: blog.andymasley.com). Ren himself later confirmed to Masley that "the actual water cost of GPT-4 was likely much lower, at around 15 mL per prompt, and only 5 mL in the data center itself, as opposed to a 500 mL bottle of water," and that AI models have become substantially more water- and energy-efficient since the original 2023 study (Source: blog.andymasley.com). Masley's own recalculation, correcting for the inflated energy assumption, put the onsite water cost of a realistic GPT-4-class prompt at roughly **2.2 mL**, or about 1/227th of a 500 mL bottle (Source: blog.andymasley.com).

That figure is corroborated by Google's own, independently produced methodology. In August 2025, Google Cloud published a technical paper detailing a comprehensive accounting of energy, emissions, and water per prompt for its Gemini Apps, finding the median text prompt uses 0.24 watt-hours of energy, emits 0.03 grams of carbon dioxide equivalent, and consumes **0.26 milliliters** of water, "about five drops" (Source: cloud.google.com). Google reports the energy footprint of its median text prompt fell 33-fold over a recent 12-month period through mid-2025 as efficiency work compounded (Source: cloud.google.com). Masley notes this figure is "surprisingly close" to his own corrected estimate, suggesting the original viral "bottle of water" claim overstated true per-prompt water cost by somewhere between 50 and 250 times (Source: blog.andymasley.com).

None of this means AI's aggregate water footprint is trivial. The per-query cost is genuinely small, but multiplied across the billions of daily queries served by the major AI platforms, plus the far larger water and energy cost of training frontier models in the first place, the totals reported in the Hyperscaler Water Disclosures section above are real, are growing, and are concentrated geographically in ways that create acute local risk even when they remain a rounding error nationally. The distinction that matters for policy and for individual decision-making is between the marginal cost of one more query, which is small, and the infrastructure buildout required to serve hundreds of millions of users at scale, which is not.

## Data Analysis and Evidence

The clearest quantitative picture of U.S. data center water demand comes from LBNL's December 2024 report to Congress, mandated under the Energy Act of 2020 and produced with the U.S. Department of Energy (DOE). It found total U.S. data center electricity consumption climbed from **58 terawatt-hours (TWh)** in 2014 to **176 TWh** in 2023, now representing 4.4% of total U.S. electricity consumption, and is projected to reach between 325 and 580 TWh by 2028, or 6.7% to 12.0% of the national total (Source: www.energy.gov). Direct water consumption tracked that same trajectory: from **21.2 billion liters** in 2014 to **66 billion liters** in 2023, with hyperscale and colocation facilities now accounting for 84% of the total, up from a minority share a decade earlier (Source: eta-publications.lbl.gov). LBNL projects hyperscale data centers alone could consume between **60 and 124 billion liters** of direct cooling water by 2028 (Source: eta-publications.lbl.gov). Indirect water consumption, water used to generate the electricity, was nearly **800 billion liters** in 2023 on the same basis (Source: eta-publications.lbl.gov).

Framed against total national consumption, these totals look modest. ITIF calculates that direct plus indirect water consumption by U.S. data centers, using the LBNL figures of 17.4 billion gallons direct and 211 billion gallons indirect, amounts to "less than 1 percent of total U.S. water consumption," based on the U.S. Geological Survey's most recent national consumptive-use assessment covering roughly 90% of national water withdrawals (Source: itif.org). The same report cautions that the LBNL estimate may understate true indirect consumption because it excludes behind-the-meter power and power purchase agreements, and flags a methodological disagreement with U.S. Geological Survey figures that puts LBNL's implied thermoelectric water-consumption rate at roughly 3.15 million gallons per day per unit output, versus 1.2 to 1.4 million gallons per day per TWh implied by USGS and National Laboratory of the Rockies data, a gap ITIF attributes primarily to LBNL's inclusion of hydropower (Source: itif.org).

Globally, the IEA's benchmark figure for 2023 puts total data center water consumption at **560 billion liters**, split 373 billion liters indirect (67%), 140 billion liters direct cooling (25%), and 47 billion liters in hardware manufacturing (8%) (Source: pmc.ncbi.nlm.nih.gov). Across the seven companies that report both electricity consumption and direct water consumption data in a peer-reviewed 2026 comparison, total direct water consumption came to **55.8 million cubic meters** (55.8 billion liters) against 97.8 TWh of electricity, a weighted average of 0.59 L/kWh, roughly consistent with LBNL's industry-wide 0.36 to 0.48 L/kWh site WUE range once methodology differences are accounted for (Source: pmc.ncbi.nlm.nih.gov).

Broader estimates of data center water use vary widely depending on methodology and scope, underscoring how immature standardized measurement remains. The 2021 npj Clean Water study estimated U.S. data centers consumed 1.7 billion liters per day, small next to the country's 1,218-billion-liter daily total consumption but concentrated in specific watersheds (Source: www.nature.com). EESI cites separate estimates that individual large data centers can consume up to **5 million gallons per day**, comparable to the water use of a town of 10,000 to 50,000 people (Source: www.eesi.org). Independent journalists and academic reviewers have found reported per-facility figures ranging from about 50,000 to 5 million gallons per day, a wide spread that Grist and other outlets attribute to inconsistent public reporting standards across jurisdictions (Source: www.preventionweb.net).

The water and electricity dimensions of this growth are increasingly linked in the eyes of ratepayers and regulators alike. The U.S. Environmental Protection Agency estimates that the average American household uses more than 300 gallons of water per day (Source: www.epa.gov), a baseline against which a single large data center's draw of up to 5 million gallons daily is "as much as 16,000-plus average U.S. households, according to Environmental Protection Agency estimates," per Consumer Reports' analysis (Source: www.consumerreports.org). The electricity side of that equation is geographically concentrated: Virginia, which hosts nearly 600 data centers, saw facilities account for "almost 40 percent of the state's total consumption in 2024," according to a Bloomberg News analysis cited by Consumer Reports (Source: www.consumerreports.org), and the same analysis found that "areas with high concentrations of data centers saw electricity prices jump 267 percent over the past five years" (Source: www.consumerreports.org).

The political response to this growth has been rapid. ITIF documents that more than **200 bills** addressing data centers were introduced across all 50 U.S. states in 2025 alone, of which more than 40 were enacted into law, and that bans or moratoriums on new data center construction were under active discussion in more than 20 states as of mid-2026 (Source: itif.org). The same analysis reports that more than **$130 billion** in data center projects were delayed or abandoned in the first quarter of 2026 alone, exceeding the total for all of 2025 combined (Source: itif.org). Minnesota became the first U.S. state to establish a formal pre-application water-permitting requirement for large data centers in 2025, with its Department of Natural Resources required to evaluate water conservation measures before issuing permits, and tiering review intensity based on local watershed stress levels (Source: itif.org).

# Case Studies and Real-World Examples

## Uruguay: Google's Canelones Data Center and the "It's Not Drought, It's Pillage" Protests

In 2023, Google's proposal to build a data center in Canelones, southern Uruguay, collided with the country's worst drought since 1950, a crisis severe enough that Montevideo, the capital, faced shortages of drinking water (Source: www.theguardian.com). Google had initially proposed using millions of liters of fresh water to cool the facility, prompting protests under the slogan "no es sequía, es saqueo," or "it's not drought, it's pillage" (Source: borgenproject.org). María Selva Ortiz of Friends of the Earth Uruguay calculated the proposed facility would require energy equivalent to that used by 222,898 households in a country of just over 3 million people (Source: www.theguardian.com). Uruguay's environmental authorities ultimately approved a redesigned facility that uses air conditioning rather than evaporative water cooling, though critics including academic Daniel Pena argued the electricity demand of air cooling carries its own environmental cost (Source: www.theguardian.com). The approved facility is projected to release 25,000 tonnes of carbon dioxide annually and generate 86 tonnes of hazardous waste per year, according to the government's environmental assessment (Source: www.theguardian.com).

## Chile: A Court Reverses Google's Cerrillos Permit Over Aquifer Concerns

Google's proposed $200 million Cerrillos data center in Santiago, Chile, first authorized in early 2020, drew sustained opposition over its potential impact on the city's aquifer amid a drought that has persisted for over a decade (Source: www.reuters.com). In February 2024, a Chilean environmental court partially reversed the project's permit, ordering Google to incorporate the effects of climate change into its evaluation of the

Central Santiago Aquifer and consider modifying the servers' cooling system (Source: www.reuters.com). Google had already submitted a design change in February 2022 to switch the facility from water cooling to air cooling, and a company spokesperson said it would "continue to collaborate with the requirements of local authorities" (Source: www.reuters.com). Chile is also fifteen years into what officials describe as an unprecedented drought, with the government enforcing water rationing beginning in 2022, a backdrop that shaped the court's ruling (Source: www.datacenterdynamics.com). Announcing the project's pause later that year, Google said "a new process will start from scratch," calling sustainability "at the heart of everything we do" (Source: www.datacenterdynamics.com). The Chile case illustrates a pattern seen elsewhere: legal and community pressure over water forced a design change well before the facility was completed, rather than after operations revealed a problem.

## Netherlands: Microsoft's Wieringermeer Complex and a Drought-Year Discrepancy

In August 2022, Dutch outlet Noordhollands Dagblad revealed that Microsoft's data center complex in Middenmeer, North Holland, had consumed **84 million liters** (84,000 cubic meters) of water during 2021, a year in which the Netherlands officially declared a drought (Source: www.datacenterdynamics.com). That figure was roughly four to seven times higher than the 12 to 20 million liters per year that Microsoft and the local municipality had previously projected the mature facility would need (Source: www.datacenterdynamics.com). Microsoft subsequently clarified that most of the 2021 figure reflected water used during construction of the facility's next phase rather than steady-state operations, and noted that 36 million of the 84 million liters withdrawn were discharged back to the region's water supply, bringing net consumption closer to 48 million liters (Source: www.datacenterdynamics.com). The municipality of Hollands Kroon separately disclosed that all data centers across North Holland, including facilities operated by both Microsoft and Google in the region, together used 550 million liters of drinking water that year, about 0.5% of the region's total drinking water supply of 112 billion liters (Source: www.datacenterdynamics.com). The episode illustrates how construction-phase water use, often excluded from steady-state operational estimates published before a facility opens, can distort local public understanding of a data center's true water footprint in its first years.

## Memphis: xAI's Colossus Supercomputer and an $80 Million Wastewater Plant

When Elon Musk's xAI company selected a former Electrolux manufacturing site in southwest Memphis, Tennessee, for its Colossus AI supercomputer in 2024, water activists raised concerns the company would draw from the aquifer beneath the city, which contains some of the purest drinking water in the country (Source: time.com). Instead, xAI began construction on an **$80 million** wastewater treatment plant that treats sewer water and repurposes it for cooling, with the Tennessee Valley Authority and Nucor Steel also agreeing to draw from the treated supply once it comes online, taking additional pressure off the aquifer (Source: time.com). Sarah Houston, executive director of the nonprofit Protect Our Aquifer, called the treatment plant "a huge step in the right direction," while cautioning about the facility's long-term ownership if xAI's business changes course ("If xAI folds and leaves, how do we ensure this facility continues to operate?") (Source: time.com). Separately, xAI's power generation for Colossus has drawn scrutiny of its own: the Southern Environmental Law Center alleged the company installed dozens of methane gas turbines without proper Clean Air Act permits, a controversy distinct from but adjacent to the facility's water footprint given how tightly power generation and indirect water consumption are linked (Source: www.selc.org).

## Arizona: Rapid Data Center Growth Meets an Already-Stressed Desert Watershed

Arizona has emerged as one of the most closely watched U.S. states for data center water policy, precisely because it combines rapid AI-driven construction with a documented, decade-plus water shortage. A Ceres analysis focused on the Phoenix metropolitan area found that data centers active in the region during the summer of 2025 used approximately **385 million gallons** of water directly, a figure Ceres projects could grow to **3.7 to 3.8 billion gallons** annually, an increase of roughly 870%, as more facilities come online (Source: www.ceres.org). Indirect water use tied to power generation for those same facilities could grow four-fold, from about 2.9 billion gallons to over **14.5 billion gallons** annually, enough to supply the entire city of Scottsdale for more than two years, and Ceres warns this growth "could increase water stress in already strained basins by up to 17% annually" (Source: www.ceres.org). Even in the report's worst-case scenario, however, data center usage would remain equivalent to roughly 1% of the region's total residential water consumption (Source: www.preventionweb.net), underscoring the recurring tension between small statewide shares and large local impacts. Local response has varied by city: Mesa, Avondale, and Phoenix have passed ordinances capping industrial water use and requiring developers to supply supplemental water above those caps, while sustained resident opposition led the Tucson city council to reject a proposed facility called Project Blue, whose developer subsequently committed to a zero-water cooling system for a revised proposal elsewhere (Source: www.preventionweb.net). Not every Arizona locality has resisted growth: Buckeye, a fast-growing Phoenix suburb, welcomed a $20 billion, 2,000-acre data center complex, with Mayor Eric Orsborn telling Grist, "This wasn't really a controversial issue for us... The water is really on them to bring, and the trick now isn't water, the trick now is getting enough power" (Source: www.preventionweb.net).

## Implications and Future Directions

Three trends are likely to define data center water use over the next several years. First, cooling technology is shifting decisively toward liquid and direct-to-chip designs, driven primarily by the thermal density of AI accelerator racks rather than by water policy per se. Nvidia's Rubin architecture, described by the company as the industry's first 100% liquid-cooled AI infrastructure platform, uses closed liquid loops operating at up to 45°C (113°F) and can reduce facility cooling water consumption from roughly 2.6 million gallons per megawatt annually for conventional cooling-tower systems to near zero, a reduction Nvidia's director of data center cooling and infrastructure, Ali Heydari, describes as having "eliminated massive amounts of power usage and pretty much all water usage" (Source: blogs.nvidia.com). Because these systems still rely on dry coolers rather than evaporation for roughly 99% of the year, ITIF characterizes the shift as making "close-to-zero water consumption" achievable, though at higher upfront capital cost than evaporative systems (Source: itif.org).

Second, indirect water consumption, embedded in electricity generation, will remain the harder problem to solve, because it is a function of a region's power grid mix rather than any individual data center operator's cooling design choices. ITIF frames water for power generation as "the real elephant in the pool," noting that gas and nuclear plants and hydroelectric reservoir evaporation drive most indirect consumption, and that this variable is largely outside a data center operator's direct control once a site's grid interconnection is fixed (Source: itif.org). This is precisely why Meta's decision to disclose an indirect water intensity figure, and why the Wall Street Journal singled Meta out as the only major operator doing so, matters for the field's future transparency norms: as more capacity is added on gas-fired or renewable grids specifically procured for AI data centers, the choice of power source will increasingly determine a facility's true water footprint more than its cooling system does.

Third, state-level regulation is moving faster than federal policy and will likely remain the primary lever shaping where and how new capacity is built. ITIF's policy recommendations, drawing on Minnesota's pioneering 2025 pre-application watershed review process and Illinois's mandatory annual reporting statute, call for standardized disclosure requirements, watershed-tiered performance standards rather than blanket technology mandates, and joint water-energy regulatory review, while explicitly cautioning against a single national water standard given how dramatically water stress varies by basin (Source: itif.org). Transparency gaps extend beyond water-specific reporting: researchers at the University of Mary Washington who surveyed 31 Virginia communities with existing, approved, or proposed data centers found that 25 of them "had nondisclosure agreements with local officials," often obscuring water and power usage plans from public view until projects were already finalized, according to Consumer Reports (Source: www.consumerreports.org). Given that more than $130 billion in projects were already delayed or abandoned in the first quarter of 2026 amid this regulatory ferment, operators that proactively adopt low-water cooling designs and publish comprehensive, audited water data are likely to face materially fewer siting and permitting delays than those that do not.

## Conclusion

Data centers use a genuinely large and rapidly growing volume of water in absolute terms, tens of billions of gallons annually across the largest operators, even as that volume remains a small fraction of national water budgets in the United States and most other developed economies. Both statements are true simultaneously, and conflating them, either by minimizing the issue as statistically trivial or by treating a single chatbot query as environmentally catastrophic, misrepresents the evidence gathered across corporate disclosures, federal research, and independent journalism reviewed in this report. The more defensible framing is that data center water use is a genuinely local and highly variable phenomenon: a facility's impact depends far more on its specific watershed, its cooling technology, and its electricity source than on any single global average. Uruguay, Chile, the Netherlands, Memphis, and Arizona each illustrate a different facet of that variability, from drought-driven protest to court-ordered redesign to construction-phase measurement confusion to power-plant permitting disputes.

The trajectory of the underlying technology favors reduced direct water intensity even as absolute consumption climbs, because the same AI-driven demand that is inflating water headlines is also forcing the industry toward liquid and immersion cooling designs that use dramatically less water per unit of computing delivered than the evaporative systems they are replacing. Whether that efficiency gain keeps pace with the sheer scale of new capacity being built, an open question given LBNL's projection that hyperscale direct water consumption alone could reach 124 billion liters by 2028, will likely determine whether public concern about data center water use recedes or intensifies over the remainder of the decade. What is not in serious dispute, based on the evidence assembled here, is that transparency remains the binding constraint: the companies, regulators, and researchers who can measure this problem accurately are far better positioned to solve it than those relying on viral approximations in either direction.

## Frequently Asked Questions (FAQs)

**How much water do data centers use overall?** U.S. data centers directly consumed about 66 billion liters (17.4 billion gallons) of water in 2023, according to LBNL, with indirect water use from electricity generation adding nearly 800 billion liters more (Source: eta-publications.lbl.gov). Globally, the IEA puts total data center water consumption at 560 billion liters in 2023 (Source: pmc.ncbi.nlm.nih.gov).

**Does AI use a lot of water?** A single AI chatbot query uses very little water directly, on the order of a fraction of a milliliter to a few milliliters, according to both Google's own methodology (0.26 mL median per Gemini prompt) and independent recalculations of the "bottle of water" claim (roughly 2.2 mL onsite) (Source: cloud.google.com) (Source: blog.andymasley.com). Aggregated across billions of daily queries and the electricity and construction needed to build AI infrastructure at scale, however, the totals are large and growing rapidly, as Google's own 34% year-over-year water consumption increase in 2025 demonstrates (Source: axios.com).

**How much water does data center cooling use compared to other cooling methods?** It depends entirely on the cooling technology deployed. Evaporative water-cooled chillers have the highest water intensity of common designs, while air-cooled chillers use no on-site water but more electricity, and the newest direct-to-chip and immersion liquid-cooling systems can approach zero on-site water use (Source: eta-publications.lbl.gov).

**What are Google's and Microsoft's data center water usage figures?** Google reported total water consumption of 10.9 billion gallons for 2025, up 34% year over year (Source: axios.com). Microsoft withdrew approximately 2.7 billion gallons in fiscal year 2024 and reported a WUE of 0.27 L/kWh for fiscal year 2025 (Source: trellis.net).

**Does data center water use worsen drought conditions?** The effect is highly localized. Nationally, data centers account for well under 1% of total U.S. water consumption (Source: itif.org), but individual facilities sited in already water-stressed basins, such as Uruguay's Canelones region, Chile's Santiago aquifer, or Arizona's Phoenix metro area, can materially strain local supply during drought years even while remaining a small share of the national total (Source: www.ceres.org).

**Can liquid cooling eliminate data center water use entirely?** Direct, on-site water use can approach zero with closed-loop liquid cooling designs such as Nvidia's Rubin architecture and Microsoft's newest AI data centers (Source: blogs.nvidia.com) (Source: cdn-dynmedia-1.microsoft.com). Indirect water use from electricity generation cannot be eliminated by cooling technology alone; it depends on the power source supplying the facility's grid connection (Source: itif.org).

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Tags: data center water use, ai water consumption, data center cooling, water usage effectiveness, data center water footprint, google microsoft data center water, liquid cooling data centers, data center drought

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