CASE STUDY

WHAT IS THE SOURCE OF YOUR WATER?

CONSTRUCTING AN ATMOSPHERIC WATER GENERATOR FARM
TO SUPPORT A CLOSED LOOP
DATA CENTER OR NETWORK OPERATIONS CENTER

BACKGROUND

A data center is the technological hub of modern enterprise operations. The data center provides the critical IT infrastructure needed to deliver resources and services to business employees, partners and customers around the world.

The sheer scale involved in enterprise computing demands a large, dedicated space that is carefully designed to support the space, power, cooling, management, reliability and security needs of the IT infrastructure.

- **Power.** There must be adequate power -- in watts, often as much as 100 megawatts -- to operate all the IT infrastructure. Power must be affordable, *clean* -meaning free of fluctuation or disruption and reliable. Renewable and supplemental/auxiliary power must be included.

- **Cooling.** The enormous amount of power delivered to a data center is converted into computing -- i.e., work -- and a lot of heat, which must be removed from the IT infrastructure using conventional HVAC systems (demanding massive quantities of non-potable water for cooling), as well as other unconventional cooling technologies

- **Security.** Considering the value of the data center and its critical importance to the business, the data center must include controlled access using a variety of tactics, ranging from employee badge access to video surveillance.

- **Management.** Modern data centers typically incorporate a building management system (BMS) designed to help IT and business leaders oversee the data center environment in real time, including oversight of temperature, humidity, power and cooling levels, as well as access and security logging. (by Stephen J. Bigelow, Senior Technology Editor, 18 May 2022)
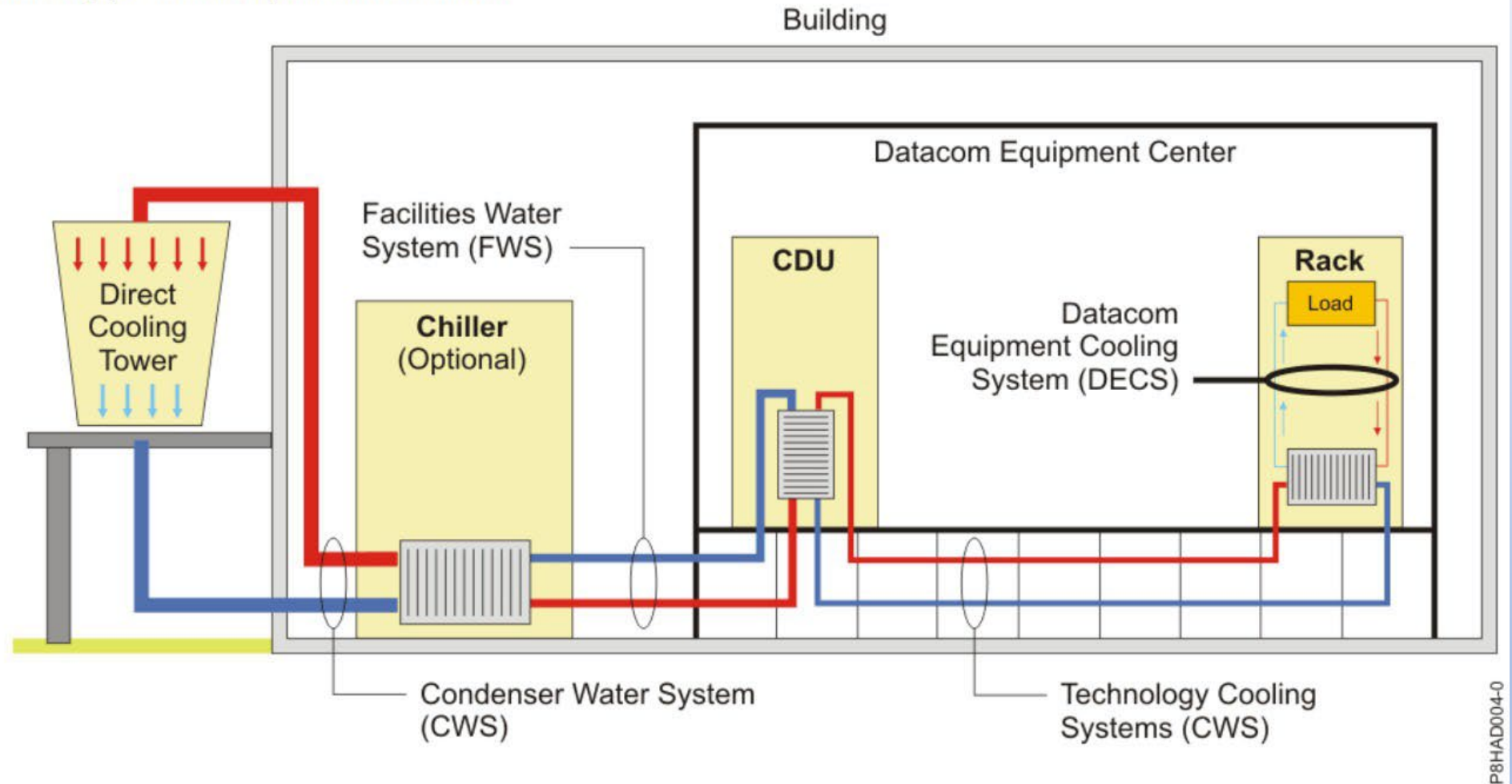
WATER REQUIREMENTS FOR COOLING

IBM specifications for water cooling systems: The datacom equipment cooling system (DECS) is a water loop in which the water comes in contact with the components to be cooled. There are cases where the DECS water is supplied by an in-rack CDU or can be supplied by an external CDU that service multiple racks. For details of potential liquid cooling systems and loops within a data center and the terminology that is used, (see Figure 1).

The water quality standards that are specified pertain only to the DECS water loop that comes into contact with computer components. The ongoing monitoring and maintenance procedures are also described.

The cooling loop hardware consists mainly of corrosion resistant alloys, such as copper alloys and stainless steels. EPDM rubber must form the inner lining of all the hoses in the system. The chemistry of the cooling water must be properly maintained to avoid system disruption or shutdown due to any of the four common water-related problems of corrosion, microbiological growth, scale formation, and fouling.

The details of the water treatment depend on whether the local municipality allows the disposal of water that contains some cleaning chemicals down a sanitary drain. If the local municipality does not allow the disposal of contaminated water down a sanitary drain, a deionizing bypass can be included in the water-cooling loop to allow the cleaning of the water to purity levels corresponding to resistivity > 0.1 MΩ.cm (conductivity < 10 µS/cm) before pouring the water down the drain. You are responsible for verifying the local regulations before you dispose any water.

Figure 1. Example of liquid cooling systems and loops within a data center

Water quality requirements
Use the following requirements to plan for the water quality in your system:

- *The water that is required to initially fill the system side cooling loop must be reasonably clean, bacteria-free water (less than 100 CFU/ml), such as demineralized water, reverse osmosis water, deionized water, or distilled water.*
- *The water must be filtered with an in-line 50 µm filter.*

ENVIRONMENTAL IMPACT OF RELIANCE ON GROUNDWATER

"Given the predicted growth of the technology sector, however, it is perhaps particularly important for this industry (data centers) to consider its water footprint and see what changes could be made to reduce it.
Some 29.3 billion devices are expected to be online by the year 2030 and these will need to be supported and backed up by data centres all over the world, providing power for millions of servers, as well as cooling and internet access." t.ly/DS5d

"Google Data Centers' Secret Cost: Billions of Gallons of Water

To meet surging demand for online information, internet giant taps public water supplies that are already straining from overuse."

Drought-stricken communities push back against data centers - NBC News June 19, 2021, 5:00 AM CDT By Olivia Solon

As cash-strapped cities welcome Big Tech to build hundreds of million-dollar data centers in their backyards, critics question the environmental cost.

On May 17, the City Council of Mesa, Arizona, approved the $800 million development of an enormous data center -- a warehouse filled with computers storing all of the photos, documents and other information we store "in the cloud" -- on an arid plot of land in the eastern part of the city.

But keeping the rows of powerful computers inside the data center from overheating will require up to 1.25 million gallons of water each day, a price that Vice Mayor Jenn Duff believes is too high. "This has been the driest 12 months in 126 years," she said, citing data from the National Oceanic and Atmospheric Administration. *"We are on red alert, and I think data centers are an irresponsible use of our water."*

More data centers are being built every day by some of America's largest technology companies, including Amazon, Microsoft and Google and used by millions of customers. According to the Synergy Research Group, there were about 600 "hyperscale" data centers, massive operations designed and operated by a single company that then rents access to cloud services, globally by the end of 2020.

That's double the number there were in 2015. Almost 40 percent of them are in the United States, and Amazon, Google and Microsoft account for more than half of the total.

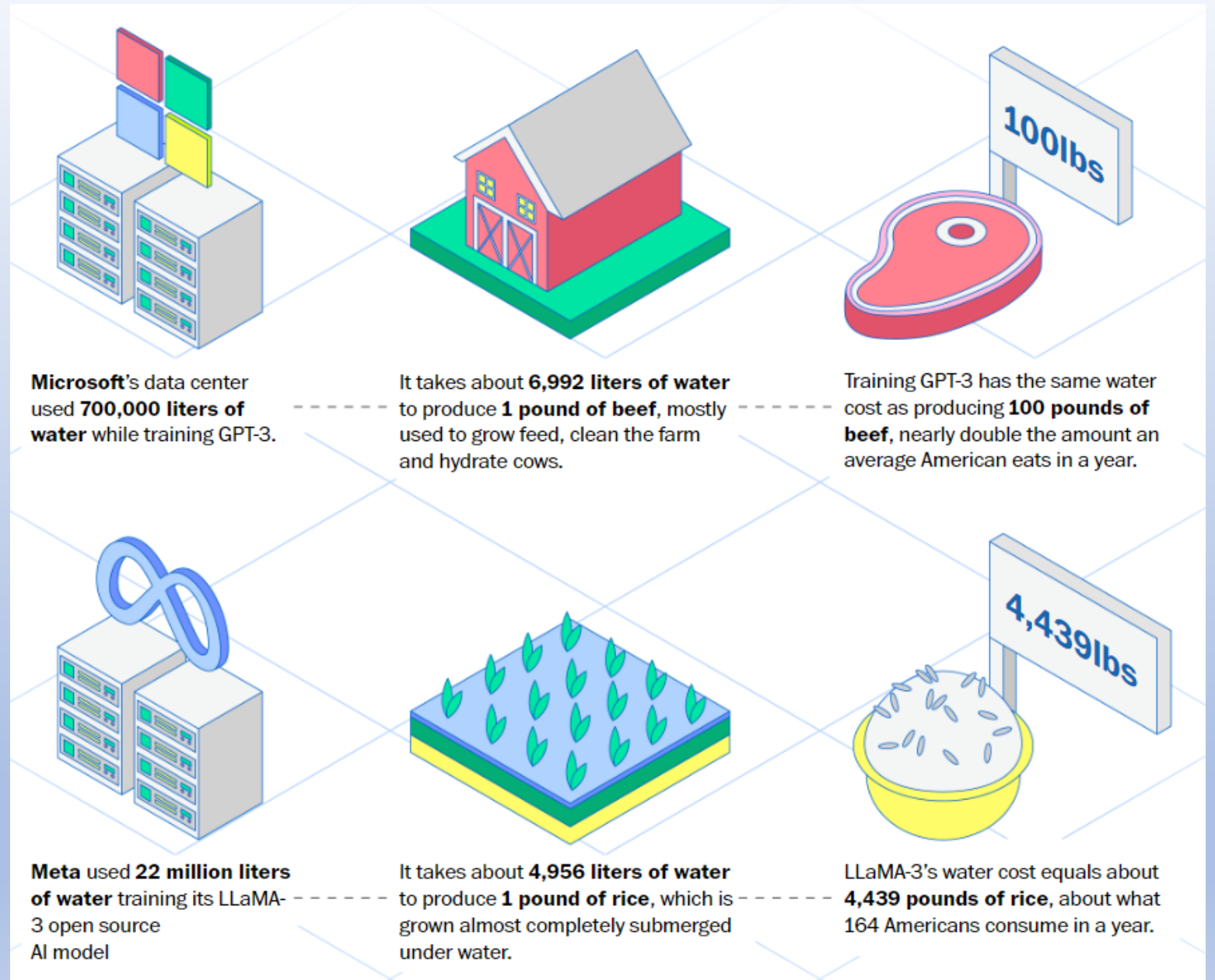The system used to cool servers inside the Apple Data Center in Mesa, Ariz.

Tom Tingle / The Republic / USA Today Network

"**The typical data center uses about 3-5 million gallons of water per day -- the same amount of water as a city of 30,000-50,000 people,**" said Venkatesh Uddameri, professor and director of the Water Resources Center at Texas Tech University."

Roughly a quarter of Americans have used ChatGPT since the chatbot's 2022 release, according to the Pew Research Center — and every query exacts a cost. Chatbots use an immense amount of power to respond to user questions, and simply keeping the bot's servers cool enough to function in data centers takes a toll on the environment. While the exact burden is nearly impossible to quantify, The Washington Post worked with researchers at the University of California, Riverside to understand how much water and power OpenAI's ChatGPT, using the GPT-4 language model released in March 2023, consumes to write the average 100-word email.

Let's look first at water.

(source Washington Post "**A bottle of water per email: the hidden environmental costs of using AI chatbots**" By Pranshu Verma and Shelly Tan September 18, 2024)

Microsoft's data center used **700,000 liters of water** while training GPT-3.

It takes about **6,992 liters of water** to produce **1 pound of beef**, mostly used to grow feed, clean the farm and hydrate cows.

Training GPT-3 has the same water cost as producing **100 pounds of beef**, nearly double the amount an average American eats in a year.

100lbs

Meta used **22 million liters of water** training its LLaMA-3 open source AI model

It takes about **4,956 liters of water** to produce **1 pound of rice**, which is grown almost completely submerged under water.

LLaMA-3's water cost equals about **4,439 pounds of rice**, about what 164 Americans consume in a year.

4,439lbs

Amazon Water Sustainability & Water Stewardship

==**"Water Positive by 2030:**== **In 2022, we announced Water+, our commitment to being water positive by 2030. That means we'll return more water to communities and the environment than we use in our data center operations.**

To do this, we're increasing the use of sustainable water sources, improving water use efficiency across our operations, reusing water as much as possible, and supporting water replenishment projects for communities and the environment around the world." (source Amazon Sustainability website t.ly/Sa1i)

Comment: Amazon's response is a bit disingenuous as it has not addressed the current issue; ==What is the source of their water for current operations?== What is the current impact on the environment? What effect of their drawing existing water resources for the next eight years until they achieve their goal? Reads like hyperbole and an attempt to garner positive press.

THE CASE FOR CONSIDERING ALTERNATIVE POINT OF USE DELIVERY OF WATER FROM THE AIR PRODUCED BY ATMOSPHERIC WATER GENERATORS THAT HAVE ZERO IMPACT ON THE ENVIRONMENT AND ARE 100% INDEPENDENT OF EXISTING GROUNDWATER RESOURCES

Atmospheric Water Generator Farms constructed in tandem with data centers provides a long-term solution relieves the burden of current dependence on existing and diminishing water supplies. AWGs provide a sustainable solution relying upon the billions of water particles present in moisture in the atmosphere, free from pollutants, that can be moved through a multi-stage filtration process to produce fresh drinking water quality water that meets or exceeds World Health Organization Standards, fully in compliance with the IBM water purity standards noted above that will not be harmful to sensitive electronic equipment.