FACT SHEET

Toxic Mixture: Data Centers Turn to PFAS For Cooling

Data centers' rapidly expanding land, water, and electricity footprints are fueling growing backlash, with as many as seven in ten Americans saying they wouldn't want a data center in their community.[1] In response to this intense public opposition, many data centers have promised technological fixes in the form of novel liquid cooling systems.[2] While liquid cooling systems may reduce—but not eliminate—data center water use, they often rely on dangerous per- and polyfluoroalkyl substances (PFAS), which are highly toxic, lab-made chemicals that persist in the environment and harm many systems of the human body.[3] Data centers are poised to increase the use of these "forever chemicals" just as some other industries are phasing them out.[4] The data center industry already relies on PFAS and similar compounds for chip manufacturing and is now turning to the same industry that produced fracking fluids to cool its data centers.[5]

The Chemical Industry's Pivot from Fracking Cocktails to Data Center Cooling

In late 2025, the infamous oilfield supplier and contractor Halliburton announced a pivot to serving data centers amid slowing global interest in fracking.[6] Other oilfield corporations including Baker Hughes and Liberty Energy have also moved into supplying data centers.[7] These linkages between the chemical, fracking, and data center industries are not new; major chemical manufacturers like Chemours and 3M already supply both the oil and gas industry and data centers.[8] And major oil corporations themselves are getting involved; ExxonMobil and Shell have both released several new chemicals for use as data center cooling liquids.[9]

No stranger to toxic chemistries, the oil and gas industry was an early adopter of PFAS.[10] PFAS are a group of over 12,000 lab-made and long-living compounds introduced by chemical corporations beginning in the 1940s.[11] They are termed "forever chemicals" since they do not readily break down in the environment.[12] The companies manufacturing PFAS long hid evidence of the compounds' toxic properties and environmental contamination.[13] These same chemical producers are now rushing to repurpose lubricants and transformer oils for the data center liquid market.[14]

The deregulatory agenda behind data center cooling is reminiscent of the loopholes that legalized fracking. Trade secrets and the "Halliburton Loophole," which exempted fracking fluids from regulation under the US Safe Drinking Water Act, have severely limited transparency and hindered efforts to quantify fracking's environmental impact.[15] Now, data centers often use non-disclosure agreements and trade secret protections to avoid publishing information about their cooling systems.[16]

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Federal oversight is not filling this void. In July 2025, President Donald Trump issued an executive order to reduce environmental regulations on data centers and use federal resources to fast-track their permits.[17] Later that fall, the US Environmental Protection Agency (EPA) announced plans to "get out of the way" of data centers, in part by expediting review of new chemicals used in data center projects.[18] The EPA has even announced plans that would allow oil and gas wastewater to be used for cooling data centers.[19]

Bring On the Fluids

Computer equipment generates heat as electricity flows through components, with central processing units and graphics processing units operating at very high temperatures.[20] Traditionally, data centers used large fans with air conditioners or chilled water loops to keep microchips cool, relying on evaporation to dissipate heat.[21] However, as the scale, heat, and footprints of data centers increase, the industry has begun to employ "liquid cooling" techniques that transfer heat from electronic components to a fluid medium.[22]

Rather than transferring heat to the air, single-phase immersion runs the electronic equipment inside of a tank filled with specialized liquid.[23] Pumps circulate the fluid though a heat exchange system to cool the components.[24] According to a 2025 study, single-phase immersion is a "widely adopted solution," and liquids that are commonly used in the process contain PFAS.[25]

Another process, known as two-phase immersion cooling, involves dipping servers in PFAS liquids, which then boil into vapor.[26] One-phase immersion sometimes uses fluorinated liquids, but according to researchers at Microsoft, "two-phase immersion fluids are PFAS."[27]

DataVolt, a Saudi Arabian developer and operator of hyperscale data centers, announced a partnership with Chemours, a US chemical company known for manufacturing Teflon™ (made from PFAS) that supplies chemicals to the oil and gas industry.[28] In a press release that hyped the endeavor as "eco-friendly," the two companies agreed to use Chemours's new two-phase immersion fluid.[29] This new chemical is part of a class known as a hydrofluoroolefins (HFOs), which degrade into the PFAS compound trifluoroacetic acid (TFA)—a persistent toxic chemical.[30] In May 2025, President Trump bragged about DataVolt's plans to invest $20 billion in US data centers.[31] DataVolt is not alone in its use of PFAS coolants; a 2025 comprehensive review of next-generation cooling technologies lists HFOs as example fluids for both types of immersion systems.[32]

In addition to immersion, there is a third process known as direct-to-chip or cold plate cooling. This process transfers heat to a specialized cooling liquid that runs through a pipe below the chip.[33] Direct-to-chip systems often use similar cooling fluids as two-phase immersion systems,[34] including HFO-based coolants.[35] Some researchers have also tested nanoparticles in mineral oil as a direct-to-chip cooling fluid.[36] Because of their size, nanoparticles are challenging to contain, and they present unique and under-studied health dangers due to their ability to cross cell membranes.[37]

Data Center Accidents Create PFAS Contamination Risks

These specialized cooling liquids can leak.[38] Small leaks are so common that data center corporations refer to the oil blooms and residues that contaminate nearby surfaces and tank exteriors as a regular maintenance hazard.[39] According to a data center cooling company, "Every time an immersion bath is opened for maintenance or otherwise, large amounts of PFAS can quickly evaporate into the data center and eventually the atmosphere."[40]

Even when fluid isn't lost to leakage, prolonged exposure to immersion fluids can cause servers to degrade, contaminating the fluid and necessitating its disposal.[41] That probably means incineration of the fluid, but information is limited because, as one study says, "EOL [end of life] impacts were modelled by the manufacturer and remain confidential."[42] Rather than neutralizing PFAS, incineration releases many PFAS compounds into the air or leaves them behind in post-combustion ash that is sent to landfills.[43]

US Department of Defense testing of two-phase immersion using a 3M liquid (NOVEC 649) reported frequent maintenance issues, as well as the inability to locate vapor or liquid leaks because the vapor is invisible.[44] These complex liquids may also introduce the need for other dangerous materials; to prevent corrosion, one company recommends the use of Teflon™ for gaskets.[45]

High energy use and back-up power systems at data centers pose significant fire risks, potentially resulting in the release of toxic vapors.[46] Data centers may rely on artificial intelligence for fire risk assessment or use automated management, delaying emergency response if the systems fail.[47] Because of the electrical equipment, water is a less effective and more expensive fire suppression tool, and PFAS are very likely to be part of the facility's fire suppression system.[48] Use of PFAS to fight industrial fires has been shown to raise PFAS levels in nearby waterways, and PFAS compounds can break through firefighter safety gear, exposing firefighters to elevated PFAS blood serum levels and associated cancer risk.[49]

Despite claims made by many PFAS manufacturers that a new generation of PFAS has fewer risks,[50] as the number of PFAS compounds has increased, so too have the links between PFAS and numerous human health effects. PFAS can accumulate in the body[51] and impede neurological functions and behaviors,[52] increase the risk of type 2 diabetes,[53] and decrease bone health and density.[54] PFAS have also been demonstrated to cause reproductive harm as well as fetal growth restriction and lower birth weights.[55] Childhood exposure is associated with asthma, the development of hyperthyroidism, and delayed-onset puberty.[56] Additionally, the EPA has classified two PFAS—PFOA and PFOS—as likely carcinogens.[57]

Demand from Data Centers Is Reviving PFAS Manufacturing

In addition to the potential on-site use of PFAS for the cooling of data center equipment, microchip production is impossible without PFAS.[58] While precise quantification remains challenging for the US, in 2020 in Europe, semiconductor manufacturing was already the third largest consumer of fluoropolymers (a class of PFAS), accounting for 11 percent of total use or 4.21 kilotons.[59] The vast majority of PFAS used in semiconductor manufacturing is either incinerated or ends up in wastewater, while a small percentage stays on the chip.[60] Data centers also coat pipes, cables, and other electronic equipment with PFAS, which, due to the high equipment turnover rate at data centers, ultimately ends up in landfills.[61]

Chemours has proposed scaling up PFAS production at factories in Fayetteville, North Carolina, and Parkersburg, West Virginia, to meet demand for producing data center chips.[62] These facilities have a long and significant history of environmental contamination.[63] Permits for these expansions highlight the possibility of resulting higher levels of PFAS air emissions.[64] Even industry research finds that these plants emit PFAS in their wastewater.[65]

Conclusion

There is no quick fix to data centers' water woes. Moreover, promises of new "environmentally friendly" technological solutions are being promoted by the same corporations behind fracking, eager to sell yet another chemical cocktail. Despite a lack of transparency, the use of PFAS appears to be becoming more common and widespread at data centers. To stop potentially irreversible environmental contamination, we need a moratorium on data center development.

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