

have additional requirements.¹⁸ Once permitted, each diesel generator's operation is bound by strict regulations. Operators typically may run generators for only a limited number of hours per year for routine maintenance and inspection purposes.

Although it varies by facility, generators at data centers are typically used far less than these rules dictate. Generators' brief monthly operation to ensure proper functioning is comparable to running a pump system that's been inactive for an extended period—regular checks prevent potential issues that accompany prolonged inactivity, such as seized components or degraded lubricants.

Greener alternatives to diesel are in various stages of development, but none has been proved at scale yet.

Water sustainability

Cooling accounts for almost 40 percent of the total energy consumed by data centers, McKinsey and Company estimates.¹⁹ Several factors determine the type of cooling that is most sustainable yet still suitable for the job.

Air cooling can be more efficient at lower load percentages and smaller equipment capacities. It can also be sustainable at any scale when the data center is located in an area with a high percentage of renewable sources in the energy grid, including ones generated on site.

When cooling processes require water, nonpotable water sources can be used so as not to reduce the local drinking water supply. Nonpotable water is treated—either at a local plant or, in some cases, on site—to remove contaminants, solids, and impurities. Then recycled water is then distributed in plum-colored pipes, which accounts for the nickname the **purple pipe system**. To pursue it, companies often consider access to recycled wastewater an important factor in the early stages of site selection.

Hyperscalers have even helped AHJs finance such projects, though that's not always viable, which makes proximity to existing treatment facilities a key consideration. In 2012, Google funded the construction of the Sweetwater Creek Sidestream Plant in Douglas County, Georgia, which we explore further in [the appendix](#).

Electrical utility transmission and distribution

When developers vet a site for a data center, they consider whether there are adequate transmission lines. At the local level, there can be pushback against the building of new transmission lines, inside and outside a data center context. Local pushback against transmission lines increased by 57 percent from 2022 to 2023, according to Columbia Law School research.²⁰

This challenge exists not just for data centers but also for the clean energy transition. One truism says that the transition can't happen without transmission. Here's why: as more sectors such as transportation go electric, overall power demand is likely to increase, requiring greater transmission capacity. Grids in the U.S. are not connected, which is a problem because such clean energy sources as solar and wind are often located far from urban centers, where electricity is most needed. Connecting grids across the country requires a plethora of new transmission lines.

"By the 2030s, we need to build so many new lines that they would reach to the moon if they were strung together," says Bill Gates, cofounder of Microsoft, in a video on his YouTube channel. "And by 2050, we'll need to more than double the size of the grid, while replacing most of the existing wires."

Most transmission lines, built between the 1950s and the 1970s, are now outdated.²¹

How did we get here? For a long time, electricity generation was centralized, and there was no need for a connected grid. Large coal-powered plants and nuclear power plants produced massive amounts of electricity in specific locations. This electricity was then distributed widely to homes, businesses, and industries throughout a large area. Power flowed primarily in one direction: from centralized plants to distributed end users.

As we transition to clean grid sources, however, we need a less centralized, more distributed system. Unlike fossil fuel plants, renewable energy sources are often geographically dispersed, variable in output, and located far from major consumption centers. They require a shift to an interconnected grid with diverse, distributed sources, one that's more resilient to outages and increasingly frequent extreme weather events caused by climate change. This shift requires more cross-regional transmission or inter-regional transmission. It requires . . . transmission lines.

18 U.S. Environmental Protection Agency, "Regulations for Emissions from Heavy Equipment with Compression-Ignition Engines," <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-heavy-equipment-compression>.

19 Srinii Bangalore et al., "Investing in the Rising Data Center Economy," McKinsey & Company, January 17, 2023, <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/investing-in-the-rising-data-center-economy>.

20 "Opposition to Renewable Energy Facilities in the United States," Sabin Center for Climate Change Law, Columbia Law School, May 2023, https://scholarship.law.columbia.edu/sabin_climate_change/200/.

21 Bill Gates, "The Surprising Key to a Clean Energy Future," Gates Notes, January 24, 2023, <https://www.gatesnotes.com/Transmission>.