



AI and data centers are essential to modern life, yet they consume tremendous amounts of energy and water. Approached from a systems perspective, data centers of the future can be reimagined as community assets, operating as partners in prosperity and climate resilience.

Designing Data Centers of the Future

AI is reaching into every dimension of modern life, from communication and commerce to science and security. Behind these capabilities are over 10,000 data centers worldwide, more than half in the United States.

Data centers are essential, but their rapid expansion is straining power grids, water systems, land use, and host communities. In the United States, they used about 200 terawatt-hours of electricity last year – roughly 4% of national demand – and billions of liters of water. A single large facility can consume as much electricity as 50,000 homes, while hyperscale centers can require enough power to serve entire cities.

We envision data centers not as isolated industrial facilities but as partners in sustainable, resilient communities. Built as quiet, efficient, and clean-powered infrastructure, they can enhance energy security, reuse waste heat, and provide backup power and connectivity during emergencies. Designing data centers of the future is one of the MIT Climate Project's frontiers. By testing system designs, MIT can identify tradeoffs across energy use, emissions, cost, and reliability – enabling data centers to support grid stability and community benefit.



Support our work on sustainable data centers

We invite endowed and expendable gifts to advance our efforts to build a sustainable, resilient future for our planet.

A VISION FOR THE FUTURE

Providing electricity to power-hungry data centers is stressing grids, raising prices for consumers, and slowing the transition to clean energy. Data centers present a massive challenge to the technology and energy industries, government policymakers, and everyday consumers, and they have implications for electricity prices, grid reliability, water use, and local communities.

Data centers can be reimagined as community cornerstones rather than isolated industrial assets. They can accelerate the expansion of clean-energy infrastructure, enhancing grid security. Efficient, quiet, and employing advanced water-free cooling, they can also return value through heat reuse and can provide backup power and connectivity during emergencies.

The Role for MIT

MIT expertise spans the entire arc of computing and infrastructure, from chip and system design to energy supply, buildings, and community impact. MIT researchers are advancing breakthrough approaches across the full computing and energy stack – spanning areas such as photonic processors that dramatically reduce the energy required for AI computation to system-level analyses that show how flexible data centers can lower costs while delivering climate benefits that depend on local grid conditions.

Rather than addressing these challenges in isolation, MIT approaches computing infrastructure as an integrated system. MIT's distinctive contribution is the ability to rethink the full computing stack as a system, linking breakthroughs in hardware and software with power delivery, thermal management, buildings, and market structures.

Areas for innovation include partnering to expand access to carbon-free electricity; developing short- and long-term energy storage technologies; advancing semiconductor processing, chip architectures, interconnects, and algorithms; and designing smaller, distributed data centers that can serve as test beds for new technologies, such as advanced cooling and flexible energy consumption.

DATA CENTER REALITIES



9%

of total US electricity could be consumed by data centers in 2030



50,000

homes could be powered by the electricity used by one large data center



200+ TWh

of electricity were consumed by US data centers in 2024 – already more than 4% of national demand



Hundreds of millions of tons

of CO₂e could be avoided by 2035 with next-generation data centers



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