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Data Centers and Environmental Considerations

Introduction

As the use of artificial intelligence (AI), cloud computing and other digital services expand, so too does the environmental footprint of the infrastructure powering them. The data centers that power these tools require significant amounts of electricity and water, and local governments increasingly face challenges related to siting, infrastructure strain and meeting climate and sustainability goals. This fact sheet examines the links between data centers and resource use, and outlines strategies city leaders might consider when planning for data center development and operation in their communities.

Why Do Hyperscale Data Centers Use So Much Energy?

Data centers operate around the clock to meet digital demands for speed, reliability and processing power. Electricity not only powers the servers within data centers that bring digital services online, but also the systems that provide cooling and operational redundancy. Electrical systems ensure that servers remain available and able to quickly move data between users and the cloud, especially for services that support AI applications and real-time data processing.

A key driver of rising energy demand is the growing use of generative AI. Training and running large language models (LLMs) required by popular services, like ChatGPT and Claude,

Energy Consumption Trends and Impacts

In 2023, U.S. data centers consumed an estimated 176 terawatt-hours (TWh) of electricity — more than the annual consumption of the entire state of New Jersey.[1] Data centers accounted for roughly 4 percent of U.S. electricity demand, a figure projected to rise to 6 to 12 percent by 2028.[2] This demand surge is a key factor behind the projected national electricity consumption increases of 15 to 20 percent over the next decade.[3]

The environmental and infrastructure impacts of this rise in electricity demand are substantial. Hyperscale data centers operated by major tech firms and colocation data centers that provide shared spaces to house servers from multiple individual companies can strain regional power grids, raising electricity prices for ratepayers.[4] If the electricity source for the data centers is powered by fossil fuels, these facilities may contribute to climate change and air pollution, either locally or at remote generation sites. While some hyperscale operators, like Amazon and Microsoft, have committed to renewable energy and carbon neutrality, many smaller facilities lack the capital to pursue similar strategies.[5] Some communities have also raised concerns about the noise pollution from cooling fans. Also, backup generators, necessary for grid load reduction during high demand periods, can emit large amounts of nitrogen oxides and other air pollutants that can pose respiratory health risks, particularly for vulnerable populations.[6]

Cooling and Water Use

Data centers require power for both computing operations and cooling systems, as computers generate significant heat and must be cooled to function efficiently. In many facilities today, cooling accounts for over 40 percent of electricity consumption.[7] Common cooling technologies can also require water, which is used in two main ways: **evaporative cooling**, which consumes water without recovery, and **non-evaporative cooling**, which typically uses more electricity, but less water. In addition, data centers also use water indirectly for generating electricity, particularly from thermoelectric and hydropower sources.

Training and running large AI models requires substantial amounts of water. One major AI company reported consuming over 20 billion liters of water per year, for cooling servers and generating electricity on site.[8] By 2027, global AI systems could withdraw more water annually than several small countries combined.[9] Most of this water is used behind the scenes in data centers and power plants that provide electricity to data centers, and some is permanently lost through evaporation. Where and when AI models are trained matters: hotter regions and peak daytime hours increase water use.[10] Despite this, AI companies rarely report their water consumption, focusing instead on carbon emissions.

High water demand can present challenges in water stressed areas or where data centers rely on potable water for cooling. According to one major AI company, close to 80 percent of water used for on-site cooling was potable water.[11] According to Bloomberg, nearly two-thirds of new U.S. data centers since 2022 are located in high water-stress regions.[12]

Sustainability and Innovation Strategies

Proven and promising new strategies are available to mitigate the environmental impact of data centers. Closed-loop cooling systems recycle water rather than drawing it continuously, reducing the amount of "consumed" water. Immersion cooling submerges servers in fluid to improve heat transfer and energy efficiency. Moreover, data centers can be placed underground or other naturally cool environments to take advantage of ambient cooling. Companies are also testing non-potable water systems to reduce pressure on municipal drinking water supplies.

Data centers can be colocated with renewable energy sources to reduce their environmental footprint and the burden on the grid, potentially protecting neighboring customers from incurring additional electricity costs.[13]

Research and innovation in cooling technologies, energy efficiency, AI algorithms and semiconductor design could result in future data center technologies that use less energy and water.

Conclusion

Local governments can play a critical role in shaping the sustainability of data center development and operation. Especially in regions facing water scarcity or energy grid constraints, city leaders can use their authority to guide where and how data centers are built through zoning reviews, infrastructure planning, resource reporting standards and utility coordination. By setting expectations for energy and water efficiency and air pollutant emission standards, municipalities can ensure these facilities align with local priorities and long-term resilience goals.

An upcoming resource on data centers will delve further into land use and planning considerations associated with data centers. It will offer guidance on zoning challenges and how cities, towns and villages can approach data center development and operation to support local interests and protect community health and well-being.

Endnotes

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