UNDERSTANDING DATA CENTERS

What is a Data Center?

Data centers are facilities that provide critical infrastructure to power modern digital services. There are different types of data centers, often shaped by the primary function(s) of the facility. Most data centers house servers (connected computers) and data storage systems capable of vast numbers of calculations and computing applications. Often referred to as "the cloud," data centers provide the necessary hardware for internet connectivity, large scale software systems, and the computational demands of traditional and generative artificial intelligence (AI).

Why Talk about Data Centers?

Significant increases in the use of AI, and to a lesser extent, cloud computing and other digital services, is driving greater demand for the physical infrastructure that supports these services and technologies. Data centers are the unseen backbone of our digital economy, yet their presence and impacts, both positive and negative, are often overlooked in local governance discussions. In fact, data center facilities can provide significant benefits for communities, including tax revenue, enhanced digital connectivity and new jobs, but also present challenges such as increased energy demand, water usage and land use considerations.

Local leaders can take a proactive approach to planning data center development by addressing sustainability, zoning and infrastructure concerns to shape these facilities so that they are designed and operated to best serve community interests. This fact sheet outlines basic elements of data centers to help policymakers begin these discussions.

Types of Data Centers

Enterprise & Internal Data Centers
Privately owned and operated, these facilities manage proprietary information technology (IT). The average on-site data center typically houses between 2,000 and 5,000 servers on a site ranging from 20,000 to 100,000 square feet. They draw around 100 megawatts (MW) of power.[1]

Colocation Centers
These third-party facilities lease out space, power and cooling infrastructure to multiple organizations. Businesses use these centers to reduce infrastructure costs.[2]

Hyperscale Data Centers
Built by major technology companies such as Amazon, Google and Microsoft, these large-scale centers handle enormous computing demands, including AI and cloud services. A hyperscale data center is defined as containing at least 5,000 servers, occupying at least 10,000 square feet of physical space and having an energy draw of over 100 MW of power.[3]

Design Features of Data Centers

Data centers are typically located near necessary infrastructure like high-voltage power lines and high-speed fiber optic networks. They can also require substantial land use. This means you can often find data centers in suburban or rural areas, or industrial zones, where these needs can be met. In addition to proximity to power sources, proximity to end-users helps reduce delays in data transfer and can improve the speed of cloud and AI-powered service delivery. Climate can be another influential factor for the location of data centers. Because servers require cooling, differences in environment can increase the strain on air-conditioning or water-based cooling systems.

In terms of their appearance, data centers tend to resemble warehouses[4] — large and windowless — to support a highly controlled environment optimized for equipment performance, energy efficiency, and physical security. Flat roofs are common and necessary for housing mechanical equipment like HVAC units, but also offer opportunities for sustainability features such as solar panels or reflective coatings. While functional needs inform design choices, local leaders can consider the impact these facilities have on the character of their community.

Components of Data Centers

Data centers consist of several critical components that ensure efficient operation and reliability.
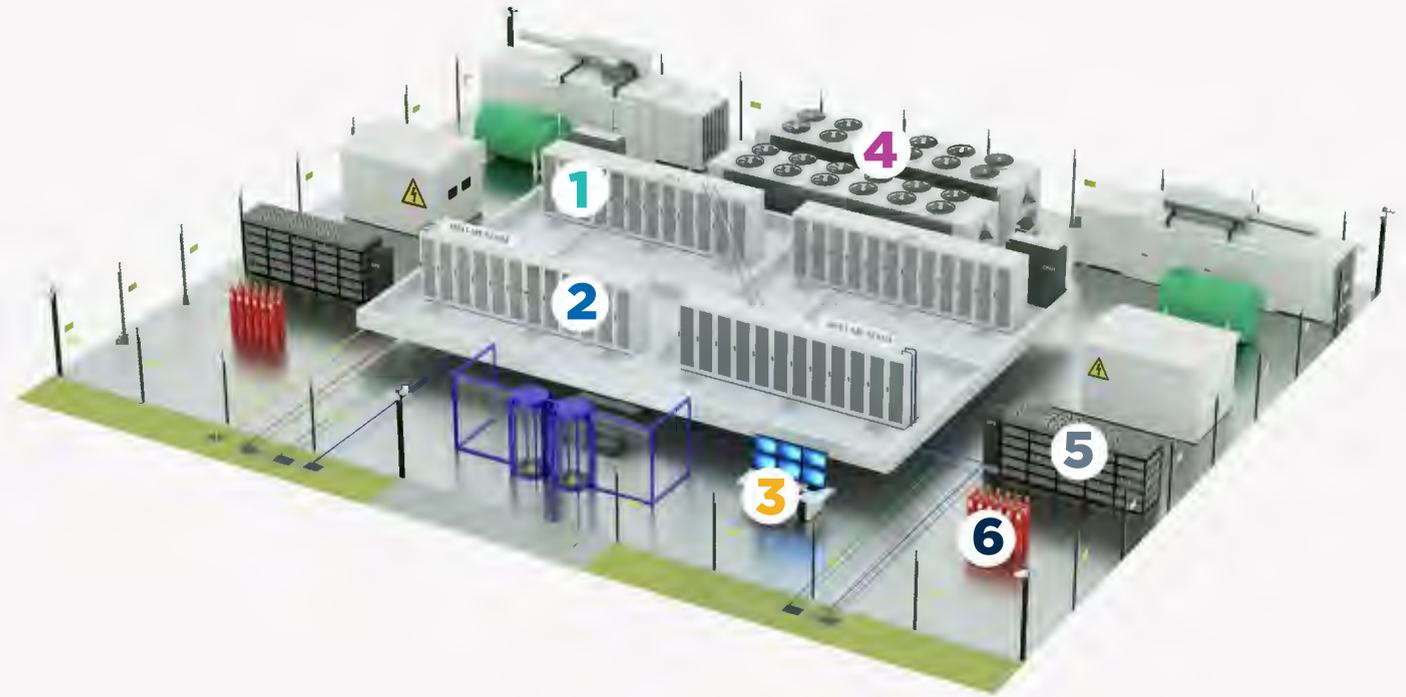
Source: https://datacenteruniversity.be/whats-inside-a-data-center. To view this interactive graphic visit the Data Center University website.

1 Servers
The backbone of data processing and storage, servers are computers connected together to run applications and computing tasks.

2 Storage Systems
Data centers house vast amounts of digital information, stored on solid-state drives or hard disk drives.

3 Networking Equipment
Includes routers, switches and firewalls that manage data traffic and security.

4 Cooling Systems
Prevent overheating by using air or liquid cooling methods to maintain optimal operating temperatures for computers.

5 Power Infrastructure
Includes backup generators and uninterruptible power supplies to ensure continuous operation.

6 Security Systems
Physical and cyber security measures such as biometric access controls, surveillance cameras and fire suppression systems.

Growth and Impact of Data Centers

USA Data Centers

Source: https://www.datacentermap.com/usa. To view the interactive map, visit the USA Data Center website.

Global demand for data center capacity is expected to surge, driven largely by the rapid growth of AI workloads. Demand for AI-capable data centers — which need more computing power and energy — is expected to rise sharply. Demand could grow by 22 percent annually, potentially reaching an energy demand of 219 gigawatts (GW) in 2030 compared to 60 GW in 2024. By 2030, 70 percent of all data center needs could be tied to supporting advanced AI applications and use cases.[5] Innovation in cooling technologies, energy efficiency, AI algorithms and semiconductor design could alter current projects.

The global data center industry is projected to grow from $269 billion in 2025 to more than $580 billion by 2032, with an annual growth rate of 11.7 percent.[6] There are more than 3,000 data centers in the U.S. It is estimated that of the roughly 1,100 hyperscale data centers globally, over half are located in the U.S. as of late 2024.[7]

There is a growing strain on infrastructure as AI-driven demand accelerates. Within the U.S., states like Virginia and Texas are seeing the fastest growth in data center construction. These same states are also experiencing some of the sharpest increases in commercial energy consumption.[8]

Preparing for the Future

As digital infrastructure continues to expand to accommodate demand, city leaders are increasingly likely to encounter proposals for new data center development. Local leaders may need to coordinate with state regulators, utilities and tech companies when considering data center development. Additional considerations for city leaders include looking at the environmental impacts of data centers, as well as zoning, permitting and integration into community development plans.

Endnotes

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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.
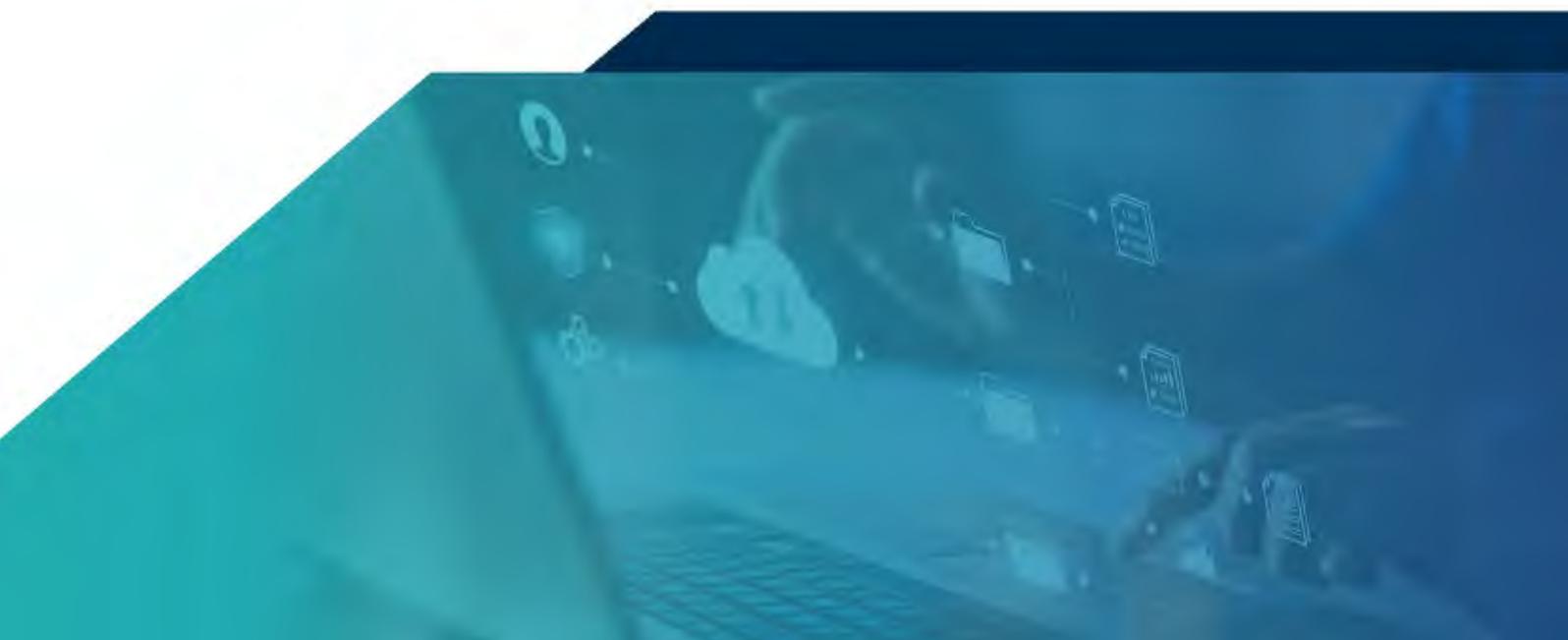
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Community Strategies to Address Data Center Development and Operation

Overview

This fact sheet explores how local governments can manage land use and the community impacts of data center development and operation. Building on insights about energy and environmental considerations, it highlights zoning ordinances, permitting strategies and policy tools that help cities, towns and villages guide data center siting while aligning with economic, sustainability and community development goals.

Zoning and Permitting

With the growth of artificial intelligence (AI) and the need for more data centers, a common challenge facing local governments is that older zoning codes do not explicitly address data centers. These facilities often fall between classifications. This ambiguity can result in case-by-case determinations and ad hoc review processes. Zoning code typically allows for specified development types through the following: by right, by conditional use, or by special exception.

TABLE 1: ZONING CATEGORIES

ZONING APPROACH	FEATURES
By Right	Projects that meet all zoning requirements are allowed to proceed without discretionary review or public hearings. Streamlined and predictable process.
By Condition Use	Projects may be allowed if they meet specific conditions set by the zoning ordinance. Typically requires a public hearing and approval from a zoning board or commission.
By Special Exception	Projects not normally permitted under current zoning may be approved if they meet certain criteria and do not adversely impact the surrounding area. Usually involves a public hearing and discretionary review.

Some local governments are adopting zoning amendments to specifically address data centers. For example, in Fairfax County, VA, officials have updated their zoning ordinance to define data centers and permit them by-right in select industrial and commercial zones, while introducing buffers, size thresholds, and location restrictions to guide development away from transit-oriented areas. Harrisonburg, VA took a different approach by removing by-right permissions and requiring special use permits for data centers in industrial zones, enabling more discretion in site selection and public engagement.

Loudoun County, VA is considering shifting from by-right permissions to a special exception model for new data centers. Proposed comprehensive plan changes would also limit future data center development in designated urban centers near transit.

Several local governments have used **overlays**, which provide additional rules on top of existing zoning regulations. Overlays can allow local governments to exercise greater control over where and how data centers are built. These mechanisms often include supplemental requirements related to noise, aesthetics, setbacks and environmental impact. Prince William County, VA created multiple overlay zones between 2016 and 2023, including the "Digital Gateway" district. These zones impose specific criteria, including 24-hour noise limits and landscaping requirements, while also enabling large-scale rezoning for data center parks. Limerick Township, PA created a data center overlay that requires compliance with detailed standards for noise, woodland preservation, water use and emergency access.

In Chandler, AZ, all new data centers must now go through a public hearing process and are restricted to specific districts. The city's ordinance requires detailed noise mitigation studies and regulates generator testing schedules to reduce disruptions.

Policy Tools and Local Incentives

Beyond zoning, local governments are experimenting with policy tools to shape the environmental footprint and community contributions of large building projects.

Some cities have adopted or explored **energy and water benchmarking requirements**. In 2023, Detroit, MI enacted an ordinance requiring large commercial buildings to report annual energy and water use. Similar policies exist in Chicago, IL and Atlanta, GA forming part of a broader trend toward transparency in high-resource-use sectors.

Several jurisdictions have explored **renewable energy and water efficiency incentives** tailored to data centers. While some operators voluntarily co-locate renewable energy, local governments have begun facilitating this through streamlined permitting and flexible zoning for on-site generation.

In New Albany, OH, a large **tax abatement was paired with community benefits** in a development agreement for a data center. In return for a 15-year, 100 percent property tax abatement, the developer committed to stormwater mitigation, scholarships for local students and cultural programs.

Community Engagement and Placemaking

Community engagement should begin early, before zoning changes are proposed or negotiations with data center developers take place. Proactive outreach to residents and community-based organizations builds trust, surfaces local priorities and creates opportunities to align development with community goals.

Creative placemaking offers a useful framework for engaging the public in data center planning and ensuring these projects contribute positively to the built environment. For example:

◆ Transforming required buffer zones into **public green spaces** or **walking trails** that benefit nearby neighborhoods.

◆ Using **community-led design processes** to shape screening, signage or building facades so they reflect local identity or cultural themes.

◆ Developing **public benefit agreements** tied to local education, job training or public Wi-Fi access, co-designed with community stakeholders.

In addition to public engagement, **collaboration with utilities and regional partners is essential**.

◆ Work with energy and water utilities early in the planning process to assess infrastructure capacity and coordinate long-term investments.

◆ Coordinate regionally with other municipalities and public utility commissions (PUCs) to address cumulative grid impacts, resource availability and shared development pressures.

By embedding engagement and collaboration into the planning process, cities, towns and villages can ensure data center development is more responsive to local needs and contributes to long-term community well-being.
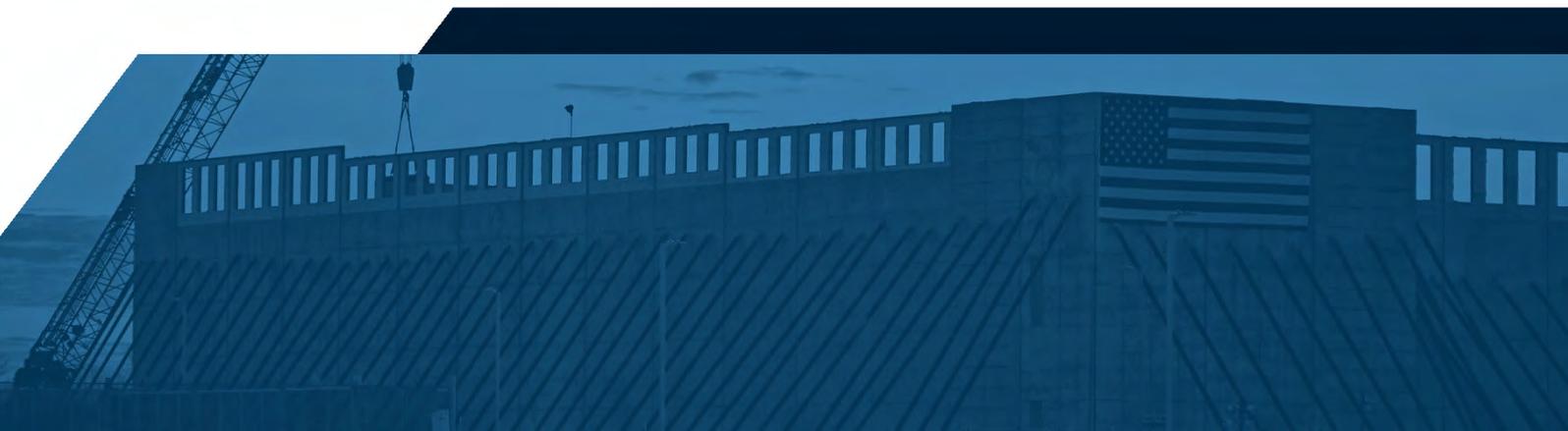
TABLE 2: HOW LOCAL GOVERNMENT'S ADDRESS DATA CENTERS

JURISDICTION	ZONING APPROACH	KEY FEATURES
Fairfax County, VA	By-right in high-intensity zones with thresholds and restrictions	Triggers special review above 40,000 sq ft (commercial) or 80,000 sq ft (industrial); prohibited within 1 mile of Metro stations; performance standards for cooling and noise.
Harrisonburg, VA	Shifted from by-right to special use permitting	Requires public hearings and city council approval for data centers in industrial zones.
Prince William County, VA	Data center overlay zones	Includes Digital Gateway; applies 24-hour noise limits, architectural screening, and buffer standards.
Loudoun County, VA	Data center overlay zones	Would require discretionary review for all new facilities; restricts development in transit zones.
Chandler, AZ	Data center overlay zones	Requires public hearings, noise mitigation studies, and generator use restrictions.
Mesa, AZ	Data center overlay zones	Encourages clustering in advanced manufacturing zone; requires infrastructure capacity review and often includes design or noise provisions in development agreements.

Additional Resources

◆ Urban Land Institute, Local Guidelines for Data Centers

◆ American Planning Association, Data Center primer for planners