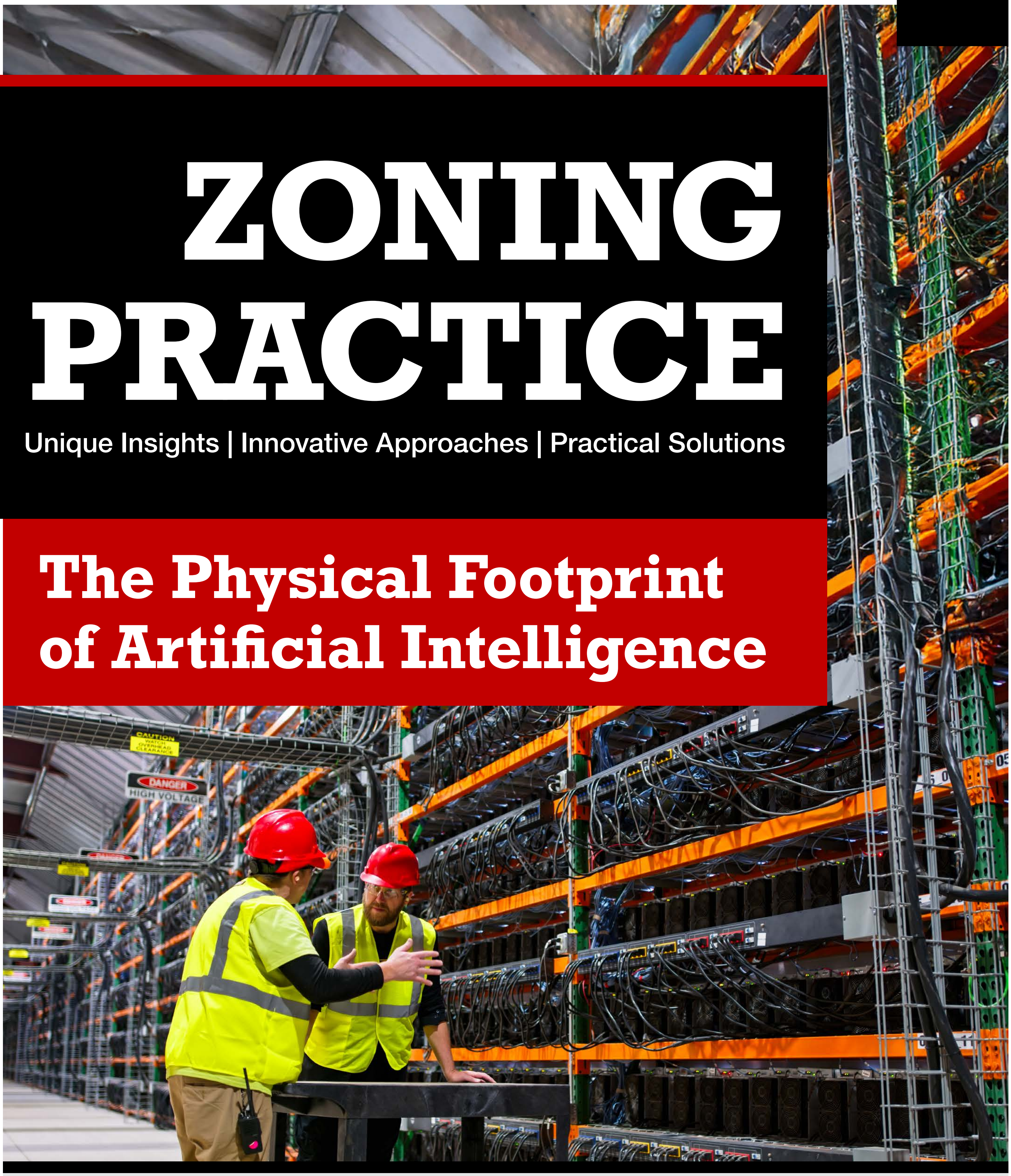
OCTOBER 2025 | VOL. 42, NO. 10

APA

ZONING PRACTICE

Unique Insights | Innovative Approaches | Practical Solutions

The Physical Footprint of Artificial Intelligence



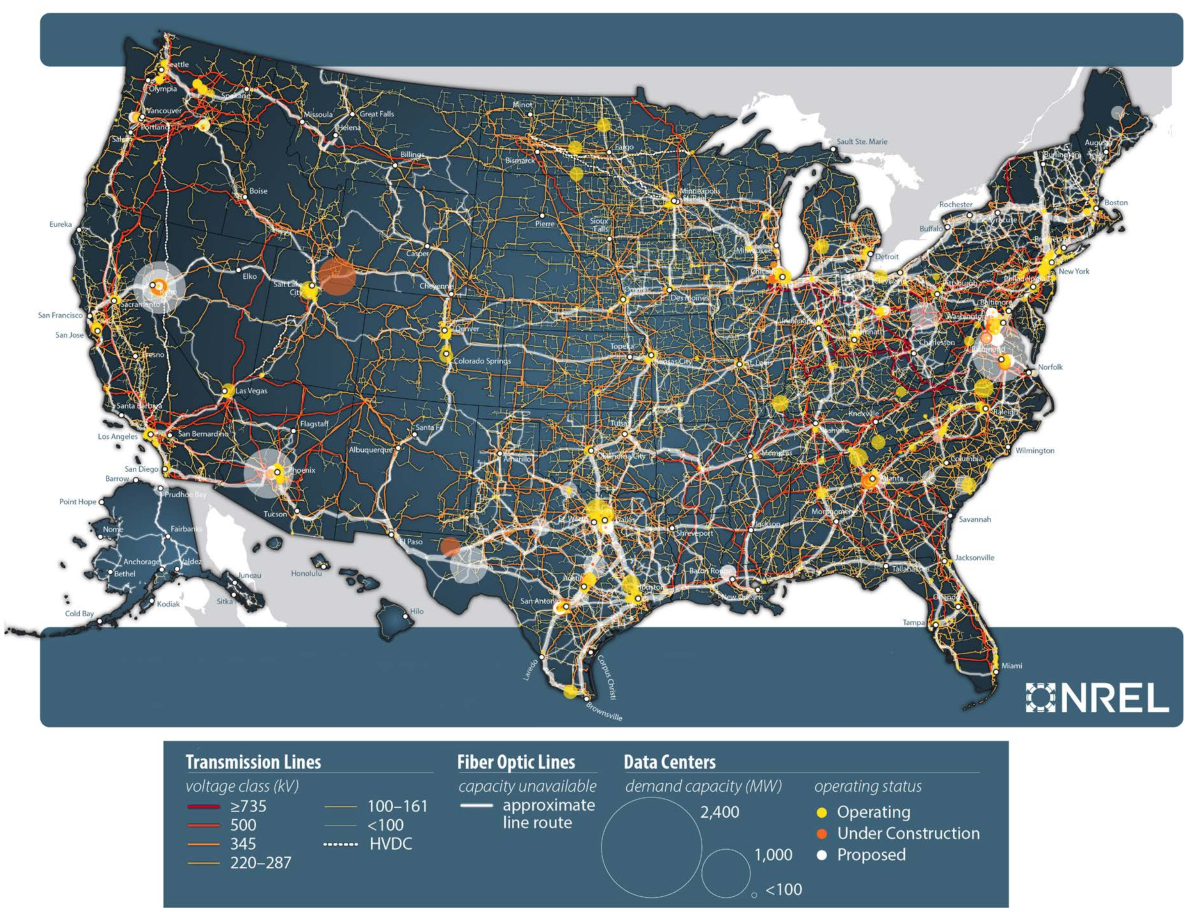
The Physical Footprint of Artificial Intelligence

By Charlie Nichols, AICP

Every time you ask ChatGPT, Gemini, or Claude a question, you are tapping into a sprawling, power-hungry network of machines. Somewhere, a data center's processors are whirring, fans are spinning, and megawatts of electricity are flowing.

Artificial intelligence (AI) may feel virtual, but its footprint is intensely physical. Behind every chatbot interaction, predictive algorithm, or autonomous system lies a vast network of data centers, power generators, and electricity transmission and distribution infrastructure. As vast as it is now, the demand for computing power is growing at an exponential rate, and local zoning is on the front lines.

This issue of *Zoning Practice* explores the physical effects of AI deployment and highlights core considerations for local planning and zoning. It begins with a summary of the land use characteristics of the system of data centers that host and serve contemporary AI models before highlighting noteworthy regulatory approaches and areas of opportunity for zoning updates and land use decision-making processes.



Data center infrastructure in the United States, 2025 (Credit: NREL)

What Are the Physical Needs of AI?

When we think about artificial intelligence, we often imagine abstract ideas or algorithms, software, or maybe a chat assistant or a robot. But AI is deeply physical. It runs on powerful hardware that lives in large buildings, draws enormous amounts of electricity, and requires robust infrastructure to keep it cool and operational. These needs are shaping land use decisions in ways many communities have never dealt with before.

AI Lives in Data Centers

The primary home of AI is the data center. These are large, sometimes windowless, buildings filled with servers, networking equipment, and backup systems. While some are sleek and high-tech, many look like simple warehouses. But inside, the technology is anything but simple.

AI workloads require far more computational power than traditional cloud computing. That means more servers packed with graphics processing units (GPUs), which are optimized for machine learning tasks. These GPUs are energy-intensive and generate a significant amount of heat (Shehabi et al. 2024; Casey 2025).

This is why the design, location, and infrastructure of data centers have become such a big deal. For example, Meta's Altoona, Iowa, data-center campus has more than five million square feet of space and is still growing (Miller 2022).

Data centers themselves fall into several distinct categories. Edge or micro facilities are the smallest, often modular container-sized enclosures ranging from a few hundred to a few thousand square feet. Enterprise data centers, typically operated by corporations or universities, can range from about 5,000 to 50,000 square feet, sometimes larger. Colocation facilities lease space to multiple tenants and often fall between 50,000 and 600,000 square feet, with many averaging around 150,000 square feet. At the largest scale are hyperscale data centers, typically built by major cloud or AI providers, which can easily reach hundreds of thousands of square feet per building and exceed one million square feet across a campus (Zhang 2023).

While many forecasts focus on power demand rather than square footage, it is possible to translate one into the other. Deloitte estimates that AI-driven data centers could require up to 123 gigawatts (GW) of capacity in the U.S. by 2035, compared to roughly 4 GW today (Stansbury et al. 2025). Real-world projects suggest that every megawatt of IT load requires between 5,000 and 12,000 square feet of total building area. Applying that ratio to 123 GW implies a national buildout of 615 million to 1.48 billion square feet of data center space, equivalent to about 22 to 53 square miles. Land use estimates point in a similar direction, with recent projects averaging 0.5 to 1.5 acres per MW, which would translate to roughly 96 to 288 square miles of U.S. land devoted to AI-related data center campuses by 2035 (Stansbury et al. 2025).

A proposed 612-acre hyperscale data center campus in Cedar Rapids, Iowa (Credit: QTS)

AI Needs Lots of Electricity

Power demand is one of the most critical limiting factors in scaling AI. The U.S. Department of Energy's Secretary of Energy Advisory Board notes that legacy hyperscale data centers have typically connected at 20–50 megawatts (MW), but utilities are now receiving AI-driven connection requests for single campuses of 300–1,000 MW (2024). To put the low end of that new range in context, a 300 MW facility running around the clock would consume about 2.6 terawatt-hours a year—roughly the annual electricity use of 250,000 U.S. homes (calculated with the U.S. EIA average of 10,500 kWh per household). These unprecedented loads are forcing planners, utilities, and regulators to rethink siting, transmission capacity, and community-impact mitigation.

This demand is driving data centers to locate near existing transmission infrastructure, substations, or power plants. In some cases, new substations or transmission lines are being proposed just to support AI infrastructure. Local planners are being asked to approve not just buildings, but energy projects with regional impacts.

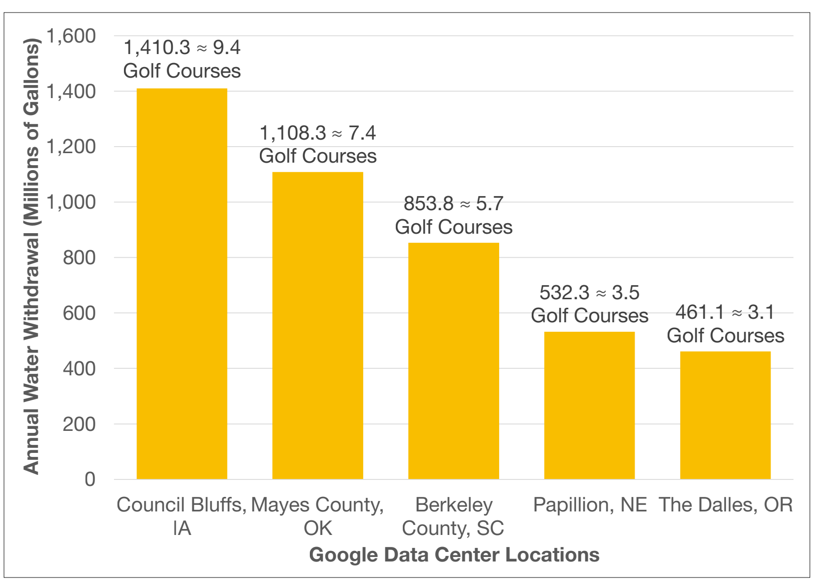
There is also growing concern about the climate impacts of AI. Researchers estimate that the cumulative carbon emissions from AI models could reach 3.66 to 8.72 million tons in the U.S. alone—the equivalent of driving an average gasoline-powered car nine to 22 billion miles (Ding et al. 2025; USEPA 2024). This has led to pressure for data centers to run on renewable energy, adding another layer of land use complexity as solar or wind farms are proposed nearby or colocated together with data centers.

AI Needs Water and Cooling

All that power generates heat, and that heat has to go somewhere. Most data centers use a combination of air- and watercooling systems. Some of the largest AIfocused facilities can consume hundreds of thousands of gallons of water per day for evaporative cooling (Lei et al. 2025; Shehabi et al. 2024; Selsky 2022). That's raising concerns in water-scarce regions or places where water infrastructure is already stretched thin.

For example, in The Dalles, Oregon, a dispute between Google and the city over water use became national news when the city council approved a water agreement to support Google's data center expansion, despite local concerns about long-term water availability (Selsky 2022).

Water and cooling infrastructure also raise siting questions. Should data centers be allowed in areas with limited water supply? What happens when a tech company becomes one of the largest users of municipal water? These questions are starting to reach planning commissions and city councils.



Top-five U.S. Google data centers by annual water withdrawals, 2024 (Credit: Google's 2025 Environmental Report)

AI Needs Fiber and Connectivity

Finally, AI infrastructure depends on high-speed fiberoptic connections. Training models and delivering AI services both require fast, reliable data transmission. This can drive the need for new fiber lines, telecom infrastructure, or even small-cell installations in rural or suburban areas (RVA LLC 2025; Walker 2024).

It's not just big cities seeing these investments. Some rural areas are gaining interest from AI developers because they offer space, lower land costs, and cooperative local governments—provided they can offer fiber access and a willing utility partner.

How Is AI Infrastructure Regulated (or Not)?

If your city or county does not already have a data center, just wait. The odds are increasing that a tech company, or the utility that serves them, will soon come knocking. Yet most local governments are not fully prepared to regulate AI infrastructure. In many places, the regulatory framework is either nonexistent or built for a different era of technology.

Zoning Codes Rarely Mention AI or Data Centers

Many zoning codes still make no explicit reference to "artificial intelligence" or even to "data centers." Where definitions are absent, planners may choose to slot these facilities into broad buckets such as warehousing, light-industrial, or public-utility uses, even though the buildings may be packed wall-to-wall with servers instead of pallets.

Yet these facilities behave very differently from the categories they're often shoehorned into, and there are many reasons why local governments may want to specifically define data center uses (Morley 2022). Their continuous operation demands megawatts of electricity and, in many climates, hundreds of thousands of gallons of cooling water per day; the equipment generates heat and noise; and the employment footprint is minimal. When such impacts are overlooked, communities can be blindsided—as happened in Prince William County, Virginia, where approval of a massive datacenter corridor sparked backlash over noise, power delivery, and land use compatibility.

Recognizing this mismatch, an increasing number of jurisdictions have begun to write data-center-specific rules. Loudoun County, Virginia, imposes façade, screening, lighting, and pedestrian-connectivity standards on by-right data centers to blunt visual impacts while leveraging their tax base (§4.06.02). Prince William County uses a Data Center Opportunity Zone Overlay to funnel projects to infrastructure-served parcels and require design review (§32-509). Missoula County, Montana, offers a different model. The county's ordinance, crafted for cryptocurrency mines, confines those operations to industrial zones and requires them to offset 100 percent of their electricity use with renewable energy (§5.10). Because cryptocurrency mines and large-scale data centers both run continuously, draw high-density power, and employ few on-site workers, planners can adapt the same toolkit—clear land use definitions, targeted overlay districts, and energy-focused performance standards—to data centers when communities want comparable safeguards.

Looking ahead, AI training clusters dwarf the loads discussed in 2022, with utilities now fielding single-campus interconnection requests of 300 MW and more. The zoning fundamentals remain the same, but the stakes are higher. Without proactive definitions, locational criteria, and impact standards, local governments risk conceding critical decisions about land, water, and grid capacity to developers' timetables rather than community goals.

Data Center Alley in Loudoun County, Virginia (Credit: Gerville/iStock/Getty Images Plus)

Many AI Facilities Are Allowed by Right

In areas that do allow data centers by right, local officials often have little authority to influence their design or siting (Morley 2022). Developers may be able to build massive facilities with only administrative approval. If the project complies with the basic zoning and building code, it can move forward, even if it brings significant impacts to neighboring properties or the local infrastructure system.

This hands-off, by-right approach can leave neighbors in the dark when a campus that draws 100 MW or more of power is permitted the same way a warehouse is. Such facilities may also require hundreds of thousands of gallons of cooling water per day and generate continuous low-frequency noise from chillers, pumps, and backup generators (Van Geet and Sickinger 2024). Without a public-hearing trigger, residents may not learn what is coming until the bulldozers roll.

That said, relying on discretionary use permits alone is not a perfect fix. Case-by-case approvals can introduce uncertainty, increase timelines, and duplicate reviews that utilities already perform when they decide whether to supply the necessary electricity and water. A more balanced strategy is to embed objective, use-specific standards (e.g., caps on sound at the property line, requirements for renewable-energy procurement, and water-recycling targets) directly into the zoning code. Guidance from the Urban Land Institute shows how clear definitions, overlay districts, and measurable performance thresholds can give developers predictability while still protecting community interests (Miet 2024). By pairing these standards with early coordination among planners, utilities, and residents, communities can address local impacts without resorting to duplicative or open-ended discretionary reviews.

Infrastructure Approvals May Be Handled Separately

Adding to the complexity, the infrastructure needed to support AI such as transmission lines, substations, power generation facilities, battery energy storage. and fiber installations is often regulated under different frameworks. Utilities may have their own review and siting authority at the state level, which can bypass local land use processes entirely.

Large solar or wind projects, for example, are pre-empted from local control in more than 20 U.S. states, leaving local governments to vet the data-center building, while the power generation facility that feeds it is debated elsewhere (Gomez and Morley 2023; Morley 2025). Fragmented approvals make it hard for planners to tally cumulative effects such as substations, access roads, or groundwater withdrawals.

Battery-energy-storage systems (BESS) create another layer of complexity, and a clear trend of data centers colocating BESS on-site is accelerating (ZincFive 2024). Some states exempt utility-scale BESS that are colocated with generation assets, while others treat them as industrial equipment needing only an electrical permit. Where local authority does apply, recent guidance recommends clear definitions, district regulations, and objective safety standards, thermal-runaway monitoring, minimum setbacks, and emergency-response plans to avoid ad-hoc hearings (Ross and Vadali 2024).

Developers are now bundling data centers with on-site renewables and storage in microgrid “energy parks,” aiming to bypass long interconnection queues and control energy costs. Recent projects in Texas and Virginia pair hundreds of megawatts of generation and storage with adjacent server halls, creating hybrid campuses that straddle state energy-facility review, regional transmission rules, and local zoning (DiGangi 2025). To keep pace, planners can identify jurisdictional triggers early, embed measurable performance standards (e.g., noise caps, screening, or renewable-energy sourcing) in their codes,

The Eland Solar-plus-Storage Center in Kern County, California (Credit: The Desert Photo/iStock/Getty Images Plus)

and coordinate with utilities so local and state reviews proceed on aligned timelines.

Environmental Review Is Inconsistent

Environmental review of AI infrastructure also varies widely. In states that require environmental impact statements (EIS), large-scale data centers may undergo detailed scrutiny. But in states without EIS laws, or for smaller projects, there may be minimal analysis of water use, energy consumption, or greenhouse gas emissions (Morris 2024).

Even where review is required, the focus may be on the building itself, rather than the full ecosystem of impacts. For example, if a local code does not require review of off-site power infrastructure or supporting utility upgrades, critical issues related to energy delivery, environmental impact, or long-term capacity may fall through the cracks.

Local Governments Are Starting to Catch Up

Local governments are no longer standing still while hyperscale campuses spring up at the edge of town. Since 2023, a wave of city councils, county boards, and planning commissions have begun moving data centers out of catch-all industrial categories and into their own, better-defined regulatory boxes. Some jurisdictions, such as Atlanta, now require special-use permits tied to energy, water, and noise studies (Ordinance 25-O-1063). Others, such as Cedar Rapids, Iowa, leverage community-benefit agreements to ensure local reinvestment when a project wins approval (Pratt 2025).

Approaches vary, but the trend is unmistakable: Communities are adopting objective, use-specific standards rather than relying solely on ad-hoc discretionary permits. Some ordinances steer projects into infrastructure-served corridors, others set caps on sound and water use, and a growing number link approvals to renewable energy procurement or on-site battery storage. Table 1 highlights seven recent examples illustrating the breadth of new zoning language, overlay districts, and design guidelines that together show local governments are indeed catching up.

Table 1. Examples of Recent Local Regulatory Updates for Data Centers

Jurisdiction	How it regulates data-center impacts
Atlanta, GA	Requires a special-use permit for every new data center and empowers the city council to review water-consumption, energy-efficiency, and noise-mitigation plans (Ordinance 25O1063, 2024)
Brainerd, MN	Prohibits data centers unless the planning commission approves a conditional-use permit that addresses cooling noise and utility demand (Ordinance No. 1581, 2025)
Chandler, AZ	Adds a data center use category; limits the use to Planned Area Development zones and sets size, generator-testing and water-recycling standards (Ordinance No. 5033, 2022)
Tempe, AZ	Requires a water use plan and enhanced setbacks next to homes and schools, and “innovation hubs” (Ordinance No. O2025-23, 2025)
Phoenix, AZ	Defines “data center,” restricts locations, and introduces design standards such as façade articulation and noise studies (Ordinance G-7396, 2025)
Sugar Grove, IL	Creates a dedicated district with height limits, façade screening, and a master-utility-plan requirement (Ordinance No. 2022-1206B, 2022)
Frederick County, MD	Establishes an overlay zone that limits where data centers can be built (Bill No. 25-05, 2025)

What Should Planners Be Thinking About?

Artificial intelligence may sound futuristic, but the decisions that shape its physical footprint are being made today. Local governments that wait too long to prepare may find themselves reacting to projects rather than guiding them. So what should planners be thinking about now?

Think About Scale

AI infrastructure often hides in plain sight until its true footprint emerges. What looks like a single “warehouse” can blossom into a portfolio buildout—multiple server halls, two substations, a battery yard, and a 30-inch water main, all staged over a decade (USDOE SEAB 2024). To avoid approving these megaprojects one slice at a time, some jurisdictions now demand a phased master plan up front. For example, Loudoun County, Virginia, requires every data-center rezoning to include a "Data Center Development Plan" showing the full buildout of power feeds, cooling infrastructure, and utility corridors before the first site plan is approved (2025).

Regional utilities are following suit by running scenario-based load models to test whether transmission and groundwater supplies can keep up. A 2024 white paper by Energy + Environmental Economics describes how such models informed Portland (Oregon) General Electric's latest integrated-resource plan and helped local planners identify future right-of-way corridors for two new 230-kV lines (Riu et al. 2024). By asking for phased utility exhibits and participating in utility load-growth scenarios, planners can make sure each new server hall fits into a system-wide picture rather than becoming an isolated surprise.

Many comprehensive plans still treat "technology infrastructure" as an afterthought, yet data center proposals are now shaping decisions on land supply, energy policy, water allocation, and broadband.

Think About Alignment With Your Plans

Many comprehensive plans still treat "technology infrastructure" as an afterthought, yet data-center proposals are now shaping decisions on land supply, energy policy, water allocation, and broadband. Start by inventorying where AI-related facilities touch existing plan elements—utilities, environmental stewardship, economic development—and flag the gaps.

One emerging best practice is to link data-center approvals directly to community climate goals. Embedding such benchmarks in comprehensive plans or codes gives planners clear decision criteria and ensures that new AI infrastructure advances, rather than conflicts with, local resiliency objectives.

Plans can also weave data-center growth into broadband and workforce strategies. The U.S. Department of Energy's 2024 report on AI infrastructure recommends that local governments coordinate land-use designations with state broadband-expansion maps so that fiber corridors serving data centers double as backbone routes for underserved neighborhoods (USDOE SEAB 2024). Aligning these layers up front helps planners negotiate public-benefit clauses—such as dark-fiber setasides or training programs, rather than scrambling for concessions late in the process.

Updating your plan first and then adopting measurable standards that flow from it gives applicants clarity, while ensuring projects advance the community's long-term vision.

Think About Infrastructure Capacity

AI campuses can overwhelm local utilities faster than many other land uses. Virginia's Joint Legislative Audit and Review Commission estimates that data centers will require 11 gigawatts (GW) of new electric generation and transmission in that state alone by 2035, roughly one-third of Dominion Energy's entire current system (VJLARC 2024). National modeling by Energy + Environmental Economics shows a similar surge, with some balancingareas seeing load grow 25 percent in a single decade under an "AI-high" scenario (Riu et al. 2024).

Water systems face parallel stress. At Google's complex in The Dalles, Oregon, public records show cooling demand could top one-quarter of the city's current supply, prompting a 2023 agreement that pauses future phases unless new wells come online (Selsky 2022). Quincy, Washington, responded to similar pressures by creating a special water rate class and meter fee for data centers to fund infrastructure upgrades (2025). These examples point to tools planners can

The Three Mile Island nuclear power plant in Middleton, Pennsylvania, which is coming back online to power Microsoft data centers (Credit: gsheldon/ iStock Editorial/ Getty Images Plus)

adopt: cumulative-demand studies embedded in utility master plans, tiered rate structures that recover capital costs, and permit conditions that link new construction to confirmed water-capacity projects.

Electric and water systems are only part of the picture. Broadband providers may need additional conduit banks, and public works departments often discover that construction traffic surpasses road-design volumes. Objective, use-specific standards, such as requiring a utilityinfrastructure plan that maps ultimate substations, mains, and fiber routes, plus haul-route and pavement-repair agreements, give planners leverage without duplicating state or utility reviews.

Think About Cumulative Impacts

A single 30 MW data center can feel benign, yet clusters of 10 or more along one corridor may push peak electric load past a gigawatt, double truck traffic during construction, and raise ambient sound by up to 10 dBA at nearby homes (VJLARC 2024). Project-by-project review often misses these system-level effects, so several jurisdictions now require applicants to look beyond their parcel lines.

Clustering can also amplify benefits if managed deliberately. Developers in Texas and Virginia now pair multiple server halls with a shared microgrid that combines on-site solar, wind, and battery storage—an "energy-park" model that eases interconnection delays and helps regions meet renewable-energy goals (DiGangi 2025). By mapping preferred corridors for both data centers and their supporting infrastructure, planners can steer growth to areas where capacity, compatibility, and community returns align.

Think About Equity and Community Benefits

Data-center projects promise major capital investment but generate few long-term jobs and can offload noise, truck traffic, and resource use onto nearby neighborhoods. Additionally, new cost analyses show that ordinary ratepayers are already footing most of the bill for AI's voracious appetite for electricity.

Monitoring Analytics, the independent market monitor for PJM Interconnection, the largest regional transmission organization in the U.S., calculated that between 2024 and 2025 data-center electricity demand added about $25 to the typical household's monthly bill (Biryukov 2025). PJM now projects that AI and data-center demand will double the region's energy use by 2033, whereas growth would have been only 15 percent by 2040 without new campuses (JLARC 2024).

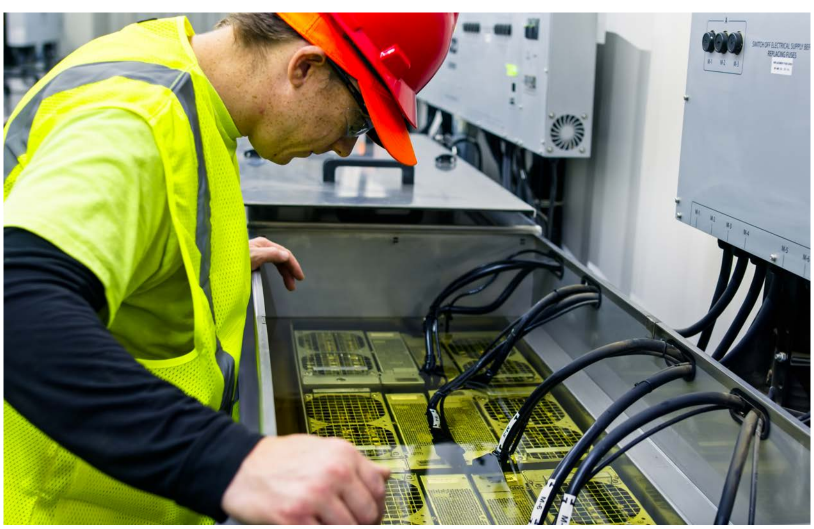
In response to this and other similar projections of effects on ratepayers, lawmakers in New Jersey (AB 5466), Oregon (HB 3546), and other states have introduced bills or tariffs to place data centers in a separate rate class or require them to "bring their own clean power," so everyday customers are not forced to subsidize the electricity needs of trillion-dollar tech companies (Levy 2025). More communities are also moving to tie approvals to arrangements that deliver measurable local benefits.

For example, Cedar Rapids, Iowa, required QTS to sign a community benefits agreement (CBA) that will return about $18 million over 20 years for workforce training, broadband expansion, and green-infrastructure projects (Pratt 2025). Legal guidance stresses clear milestones, third-party verification, and enforcement clauses to keep such agreements credible (Eisenson 2023).

Meanwhile, Quincy, Washington, created a special water rate class for data centers in 2024, adding higher volumetric charges and meter fees earmarked for new wells and main upgrades. Targeted surcharges turn one user's high demand into system-wide resilience.

By weaving CBAs and host-community fees into zoning approvals or development agreements, planners can ensure that AI infrastructure acts as a catalyst for broader community gain rather than an enclave of private benefit.

A North Dakota data center using nonconductive fluid to cool servers rather than air or water cooling systems (Credit: halbergman/E+)



Where Can Planners Learn More?

As artificial intelligence infrastructure expands, planners have a growing need to stay informed about what these facilities are, how they function, and how to plan for them thoughtfully. The good news is that several helpful resources already exist, and more are emerging every year.

Follow the Energy

Many AI-related land use challenges stem from energy demand. That means energy planning organizations are a good place to start. Resources from the U.S. Department of Energy, National Renewable Energy Laboratory, and Lawrence Berkeley National Laboratory offer insights into data center energy use, grid impacts, and cooling technologies (Shehabi et al. 2024; USDOE SEAB 2024; Van Geet and Sickinger 2024).

State and regional energy offices are also useful partners. They can help planners understand energy trends, forecasted demand, and opportunities to align AI-related development with state energy goals.

Watch the Water

Water use is another key issue, especially in places facing drought or groundwater depletion. Reports from the U.S. Environmental Protection Agency, as well as local water utilities and watershed management agencies, can help assess water-related impacts of AI infrastructure.

Planners can also look to academic and journalistic research on water use in cooling systems, which varies significantly based on the type of cooling and climate zone (Berreby 2024).

Track Technology and Land Use Trends

For a broad view of how technology affects land use, the Lincoln Institute of Land Policy and the Urban Land Institute have both published helpful materials. These organizations explore how emerging technologies from AI to autonomous vehicles are reshaping cities, infrastructure, and land markets.

Local case studies can also be instructive. Some jurisdictions have started sharing lessons learned from planning for large-scale data centers or tech campuses. For example, Loudoun (2024; 2025) and Fairfax (2024) Counties in Virginia offer planning documents and staff reports that shed light on real-world challenges and solutions.

Build Cross-Sector Relationships

Planning for AI infrastructure requires collaboration. It touches on land use, utilities, economic development, and environmental protection. Building relationships with energy providers, water utilities, economic development groups, and regional planning agencies can help planners spot opportunities and anticipate challenges.

Conferences like the American Planning Association's National Planning Conference, Grid Forward, or Smart Cities Connect often include sessions on technology infrastructure. These events are a great way to hear from peers and industry experts.

AI infrastructure is no longer a far-off idea; it's already shaping land use decisions in communities across the country. For planners, this presents both challenges and opportunities. By understanding what AI infrastructure is, what it requires, and how it fits into broader planning goals, local governments can prepare for development that is sustainable, equitable, and forward-looking.

As with many emerging trends, the best path forward is to stay curious, build partnerships, and think holistically. AI may be powered by algorithms, but the future it creates will depend on human decisions, including the choices planners make today.

References and Resources

Berreby, David. 2024. "As Use of AI Soars, So Does the Energy and Water It Requires." *Yale Environment 360*, February 6.

Biryukov, Nikita. 2025. "Power Companies Warn Lawmakers About Their Plans to Tackle Rising Bills." *New Jersey Monitor*, April 25.

Casey, Evan. 2025. "Microsoft Built Five Data Center Campuses in This Iowa City. Here's What Wisconsin Can Expect." *Wisconsin Public Radio*, May 15.

DiGangi, Diana. 2025. "Microgrid 'Energy Parks' Could Ease Strain from Rising Power Demand, Report Says." *Utility Dive*, July 23.

Ding, Zhaohao, Jianxiao Wang, Yiyang Song, Xiaokang Zheng, Guannan He, Xiupeng Chen, Xiupeng Chen, Tiance Zhang, Wei-Jen Lee, and Jie Song. 2025. "Tracking the Carbon Footprint of Global Generative Artificial Intelligence." *The Innovation* 6(5): 100866.

Eisenson, Matthew. 2023. "Experts Identify Best Practices for Negotiating and Drafting Community Benefits Agreements." *Climate Law*, September 27.

Fairfax (Virginia) Department of Planning Development, County of. 2024. *Data Centers Report and Recommendations*.

Gomez, Alexsandra, and David Morley. 2023. *Solar@Scale: A Local Government Guidebook for Improving Large-Scale Solar Development Outcomes*. Chicago: American Planning Association; Washington, DC: International City/County Management Association.

Lei, Nuoa, Jun Lu, Arman Shehabi, and Eric Masanet. 2025. *The Water Use of Data Center Workloads: A Review and Assessment of Key Determinants*. Berkeley, CA: Lawrence Berkeley National Laboratory.

Levy, Marc. 2025. "As Electric Bills Rise, Evidence Mounts That Data Centers Share Blare. States Feel Pressure to Act." *Associated Press,* August 8.

Loudoun (Virginia), County of. 2024. "Data Center Growth and Energy Constraints." Board of Supervisors Transportation and Land Use Committee Information Item, June 20.

Loudoun (Virginia), County of. 2025. Data Center Standards & Locations.

Miet, Hannah. 2024. "Local Guidelines for Data Center Development." Washington, D.C.: Urban Land Institute.

Miller, Rich. 2022. "The New MegaCampuses: The World's Largest Data Center Projects." *Data Center Frontier*, November 1.

About the Author

Charlie Nichols, AICP, is the Director of Planning and Development for Linn County, Iowa. He leads a 15-person department and has written pioneering zoning ordinances for utility-scale solar, nuclear energy, and hyperscale data centers. Nichols received his master's degree in urban and regional planning from the University of Iowa and has been working in the field of planning for over 10 years. Outside of work, he enjoys tending to his backyard chickens and working on home renovation projects with his wife and three children.

Morley, David. 2022. "Zoning for Data Centers and Cryptocurrency Mining." *Zoning Practice*, June. American Planning Association.

Morley, David. 2025. "Wait, Who Approves Large-Scale Solar Siting?" *APA Blog*, March 3.

Morris, Jackson. 2024. "Data Centers Gobbling Up Existing Nukes Threatens Grid Decarb Goals." *National Resources Defense Council Expert Blog*, July 11.

Pratt, Richard. 2025. "Cedar Rapids Council Approves Development Agreement for QTS Data Center Project." *Corridor Business Journal*, January 30.

Prince William (Virginia) Planning Office, County of. 2022. DPA2021-0020: Data Center Opportunity Zone Overlay District Comprehensive Review.

Quincy (Washington), City of. 2025. Rate Resolution 25-709.

Riu, Isabelle, Dieter Smiley, Stephen Bessasparis, and Kushal Patel. 2024. *Load Growth Is Here to Stay, But Are Data Centers?* San Francisco: Energy + Environmental Economics.

Ross, Brian, and Monika Vadali. 2024. "Battery Energy Storage Systems." *Zoning Practice*, March.

RVA LLC. 2025. "The Underappreciated Need to Enable AI and Data Center Growth." Washington, DC: Fiber Broadband Association.

Selsky, Andrew. 2022. "Oregon City Drops Fight to Keep Google Water Use Private." *Associated Press*, December 15.

Shehabi, Arman, Sarah J. Smith, Alex Hubbard, Alex Newkirk, Nuoa Lei, Md Abu Bakar Siddik, Billie Holecek, Jonathan Koomey, Eric Masanet, and Dale Sartor. 2024. *2024 United States Data Center Energy Usage Report*. Berkeley, CA: Lawrence Berkeley National Laboratory.

Stansbury, Martin, Kelly Marchese, Kate Hardin, and Carolyn Amon. 2025. "Can U.S. infrastructure Keep Up With the AI economy?" Deloitte Insights, June 24.

U.S. Department of Energy, Secretary of Energy Advisory Board (USDOE SEAB). 2024. "Recommendations on Powering Artificial Intelligence and Data Center Infrastructure."

U.S. Energy Information Administration. 2024. Use of Energy Explained: Electricity Use in Homes.

U.S. Environmental Protection Agency (USEPA). 2024. Greenhouse Gas Equivalencies Calculator.

Virginia Joint Legislative Audit and Review Commission (VJLARC). 2024. *Virginia Data Center Study: Electric Infrastructure and Customer Rate Impacts*.

Van Geet, Otto, and David Sickinger. 2024. *Best Practices for Energy-Efficient Data Center Design*. Washington, D.C.: U.S. Department of Energy Federal Energy Management Program.

Walker, Willy. 2024. "The Future of Real Estate Is Digital: How Data Centers and 5G Are Shaping the Next Generation of Infrastructure." *Walker & Dunlop Market Trends*, October 30.

Zhang, Mary. 2023. "Types of Data Centers: Enterprise, Colocation, Hyperscale." *Dgtl Infra*, November 26.

ZincFive. 2024. "Data Center Energy Storage Industry Insights Report 2024."

American Planning Association

Creating Great Communities for All

ZONING PRACTICE OCTOBER 2025 | VOL. 42, NO. 10. Zoning Practice (ISSN 1548–0135) is a monthly publication of the American Planning Association. Joel Albizo, FASAE, CAE, Chief Executive Officer; Petra Hurtado, PHD, Chief Foresight and Knowledge Officer; David Morley, AICP, Editor. Subscriptions are available for $65 (individuals) and $120 (organizations).