Grundfos Whitepaper | Data Center Policies

Building America's Digital Economy

How smart policies can balance economic growth, resource conservation, and community well-being

Introduction

As digital services become foundational to nearly every aspect of American life — from business operations and public services to education, healthcare, and national security — the infrastructure that supports this digital ecosystem grows increasingly critical. At the core of this infrastructure are data centers: highly specialized facilities that store, process, and manage the massive volumes of data that drive today's economy and society.

The United States currently leads the world in data center capacity, with more than 5,400 facilities nationwide, a figure that will continue to grow as artificial intelligence, machine learning, and cloud computing become more deeply embedded across industries.[1] Valued at over $121 billion in 2024, the U.S. data center market is projected to nearly triple over the next decade, bringing with it a wealth of economic opportunity for states and communities.[2] Data center development brings skilled jobs, expands the tax base, and spurs technological advancement; all positive benefits that many host communities are now experiencing.

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Possibility in every drop

- In Loudoun County, Virginia, data centers contributed **$890 million in local tax revenue**
- They are projected to **add** over **$9 billion** to the **state's annual GDP[3]**

In Oregon, Amazon's data center **revenue has supported[4]:**

- **Fire departments**
- **Housing programs**
- **Schools**

President Donald Trump has underscored the sector's importance with his Administration's formation of an AI Action Plan, which backs major data center initiatives and accelerates permitting for data centers and related infrastructure, aiming to reduce delays while safeguarding national security. The AI Action Plan provides non-binding policy guidance, while "Stargate" represents an administration-backed public-private initiative. Together, they are shaping federal grants, research priorities, and strategic partnerships, demonstrating the unprecedented scale of government attention now focused on this sector. These initiatives also open significant investment opportunities, including $20 billion in foreign capital to build U.S. data centers and up to $500 billion in private-sector funding through "Stargate."[5] With the continued expansion of digital services across public and private sectors, demand for data centers will only intensify, presenting both economic opportunity and policy urgency.

While advantageous in many ways, the rapid growth of data centers also presents complex challenges. These facilities, particularly hyperscale data centers, are significant consumers of electricity and water, and are often developed in water-scarce regions. This competition for local resources can place severe strain on local utilities and ecosystems.

Compounding these resource challenges is a fragmented policy environment. While there are established federal energy efficiency regulations and some emerging state-level sustainability initiatives, there are no cohesive national standards for water conservation, leaving gaps in oversight, transparency and reporting.

Policymakers have a unique opportunity to help their states and communities attract developers and reap the benefits of this burgeoning sector, while simultaneously championing their citizens' needs for vital and precious resources. Smart, proactive policies, guidelines and incentives can shape data center development in ways that maximize community benefits while minimizing burdens. From federal tax credits and permitting reforms to state-level water use standards and local zoning strategies, the policy decisions made today will define how equitably and sustainably this sector grows in the years ahead.

This paper aims to equip readers with a clear understanding of the opportunities and risks presented by the data center boom. It outlines emerging trends, identifies key challenges, and offers actionable policy insights to ensure that data centers contribute to long-term economic growth, environmental responsibility, and community well-being.

Data Center Cheat Sheet

The Rise of Data Centers

- **A digital powerhouse**
  Data centers power AI, cloud, healthcare, and national security; the U.S. leads with **5,400+ facilities.**[1]

- **Massive growth**
  $121B industry in 2024, projected to hit **$357.9B by 2034.** The accompanying data center construction industry is projected to grow to **$69.56B to $128.14B by 2034.**[6]

- **Economic gains**
  Local tax revenue, jobs, and infrastructure investment (e.g., **$890-895M in tax revenue** from Loudoun County, VA).[3]

Key Challenges

- **High resource use**
  4.4% of U.S. electricity in 2023
  → 12% by 2028.[7]
  5.6B gallons of water used in 2014
  → 17.4B in 2023.[8]

- **Cooling is the driver**
  Accounts for ~38% of energy use; can use **5M gallons of water per day** in hyperscale facilities.[9]

- **Water vs. power tradeoff**
  Efficiency gains in one area can worsen impact in the other — the **water-energy nexus.**

- **Increasing efficiency**
  The heart of the system, pump equipment, plays a critical role in **increasing cooling system efficiencies, ultimately impacting power and water use (PUE & WUE).**

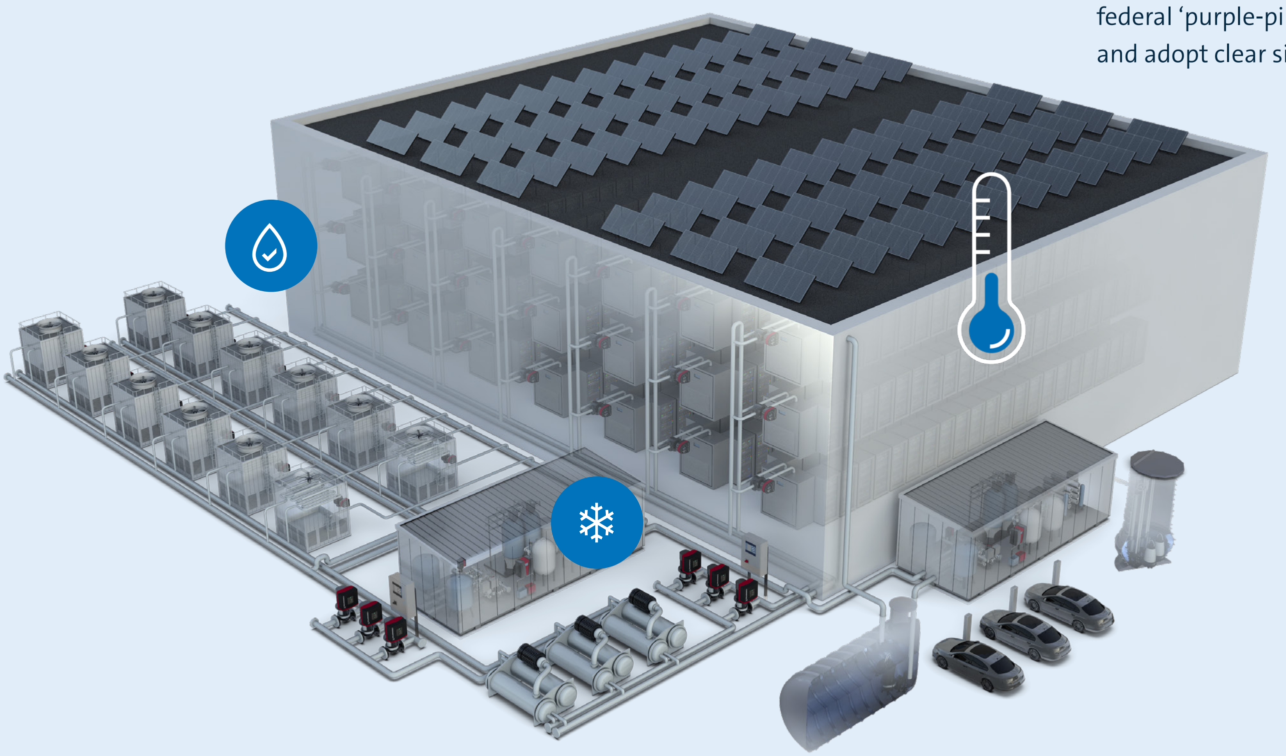
Policy Gaps and Recommendations

- **No national standards**
  for water use, Water Usage Effectiveness (WUE) reporting, or sustainable siting. Need clarification and standardization.

- **State policies**
  are emerging but inconsistent (e.g., CA, VA, AZ leading).

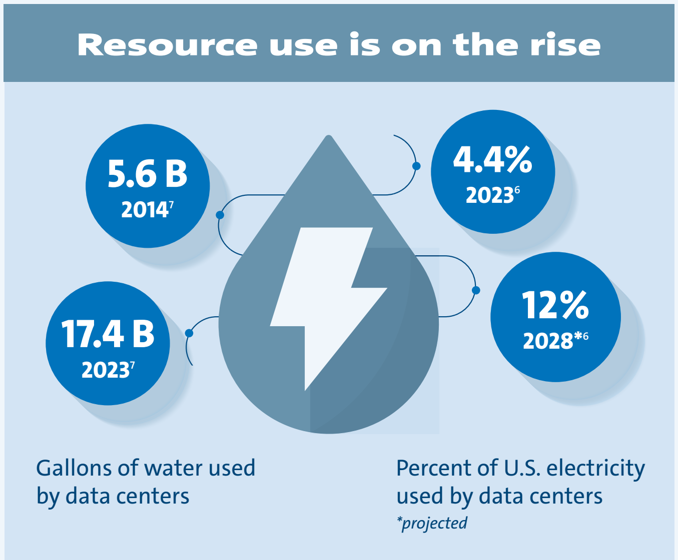
- **Smart incentives**
  are needed for sustainable cooling, resource reuse, and efficient tech (e.g., smart pumps, recycled water, heat capture).

- **ARPA-E**
  A water-positive investment tax credit; urge ARPA-E to create a closed-loop thermal management funding opportunity (building on COOLERCHIPS); establish a federal 'purple-pipe' accelerator; and adopt clear siting guardrails.



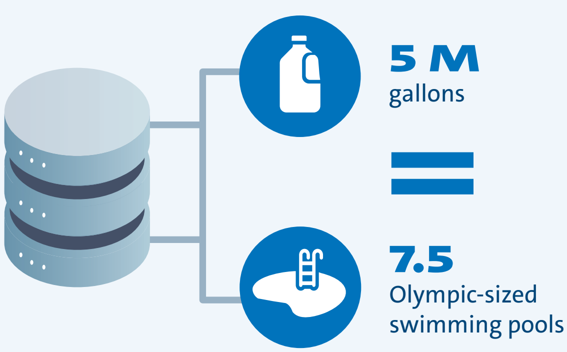
Managing the demand for energy and water

As the U.S. data center industry continues to grow at warp speed, its expanding footprint is placing unprecedented demands on two of the nation's most precious resources: electricity and water. These data centers, which serve as the backbone of our digital economy, are energy- and water-intensive by design, largely due to the critical need for uninterrupted cooling.



Why do data centers consume so much energy and water?

AI, supercomputing and large language models (LLMs) require highly specialized computer chips that are designed to process massive amounts of data and mathematical calculations. More capable AI or LLM systems require higher chip density to perform well, and higher chip density emits more heat. As the demand for faster and smarter AI systems rises, so too does chip density. This creates enormous heat output in data centers, requiring 24/7 cooling to mitigate the risk of hardware malfunction and data loss.



Reliable cooling systems are critical for data centers to operate, but these systems can be extremely high water- and energy-consumers. Cooling systems account for approximately 38% of an average data center's total energy use, and some large data centers can use between 3-5 million gallons of water per day. In fact, U.S. data center water use has more than tripled over the past decade, with hyperscale AI facilities accounting for 84% of that demand.

The importance of a holistic, regional approach

Water and energy-intensive data centers are competing with homes, farms, and small businesses for limited resources, especially in areas experiencing water stress or grid constraints. Selecting a cooling system that considers the availability of local resources is crucial to ensuring data centers aren't burdening resource-strained communities. For example, cooling strategies that are appropriate in more temperate climates may be environmentally damaging in arid regions.

Holistic site assessments should become standard practice in project permitting, incorporating local environmental and community considerations from the start. Policymakers can play a direct role in shaping this practice by aligning regulatory incentives, streamlining permitting for sustainable designs, and implementing clear efficiency benchmarks.

WUE, PUE and the water-power nexus

To improve data center accountability and performance, the industry uses two key metrics — Power Usage Effectiveness (PUE) and Water Usage Effectiveness (WUE). PUE measures how efficiently a data center uses energy, while WUE assesses water consumption in relation to IT output. Together, these metrics help quantify a facility's environmental footprint.

Data center cooling systems demonstrate the interdependent relationship between energy and water consumption, known as the water-energy nexus. For example, evaporative cooling methods improve energy efficiency but increase water use, while air cooling reduces water consumption but increases the power demand. This dynamic underscores the need to evaluate WUE and PUE together, taking a balanced approach that ensures improvements in one area do not create new burdens elsewhere.

Unlike PUE standards, which have been well-established at the national level for some time, WUE standards have historically been vague and inconsistently applied, with operators differing in how they define "water use." While this lack of standardization has made it difficult to compare performance across operations or geographies, the international standard ISO/IEC 30134-9:2022 now provides a formal framework and methodology for quantifying and reporting WUE in data centers. Adoption and enforcement of this ISO standard, however, is still relatively limited. In order to encourage progress, clear definitions, standardized reporting and regulatory alignment are still needed, especially at the state and federal levels.

Sustainability is a license to operate

In a resource-constrained world, sustainability is quickly becoming a prerequisite for data center development. Communities are increasingly skeptical of projects that extract local resources without giving back. Facilities that demonstrate strong environmental stewardship, especially those that minimize impact on public water and energy systems, are more likely to earn community support and regulatory approval. Incentivizing such practices through favorable permitting, tax breaks, or expedited reviews can accelerate the transition to a more responsible and resilient digital infrastructure.

It all boils down to smarter cooling

As data centers become more powerful and chip density increases, the efficiency and sustainability of their cooling systems become critical. To remain competitive and future-ready, data centers must transition to smarter, more resource-efficient cooling technologies that positively move the needle on their WUE and PUE.

Which cooling method is best — air, liquid, or hybrid?

Air, liquid and hybrid are the three main cooling systems used in data centers. Air cooling has long been the standard; and while it's relatively simple and low maintenance in low-density environments, it struggles to meet the thermal demands of modern high-density workloads, such as AI and supercomputing.

Offering a balance between water and energy use, hybrid cooling systems are quickly replacing air cooling systems as the new standard with rack density dictating the need for these data center designs.

However, as supercomputing and AI (and therefore chip density) continue to grow, liquid cooling has emerged as the scalable solution for high-performance infrastructure. It offers superior thermal conductivity, enabling efficient heat dissipation directly at the source. This shift is being driven by rising server rack densities and the heat output of new, more powerful GPUs (Graphics Processing Units) and CPUs (Central Processing Units) being used in AI.

The table below compares key cooling methods in terms of efficiency, complexity, and sustainability:

Cooling Type	Description	Best For	Efficiency	Water Use
Air Cooling	Chilled air absorbs heat and is expelled via fans or evaporative systems	Low-density racks, dry climates	Moderate (PUE)	High (if evaporative)
Rear-Door Heat Exchanger	Liquid-cooled panels mounted on back of racks cool air passively or actively	Mid-to high-density racks	High	Low to moderate
Direct-to-Chip	Liquid delivered directly to CPUs/GPUs via cold plates	High-density, AI and HPC* servers	Higher	Low
Immersion Cooling	Servers submerged in dielectric fluid, often using phase-change cooling	Ultra-high-density, AI, supercomputing	Highest	Lowest

**High performance computing*

Smarter operational strategies to improve sustainability

Beyond selecting the right cooling technology, facilities can evaluate other operational practices to find water and energy efficiencies. For example, increasing the temperature and humidity set points, which are often lower than necessary, can save both water and energy. Two operational strategies with a lot of potential are the use of recycled or non-potable water and heat capture and reuse.

Recycled and non-potable water

With the right water treatment equipment, data centers can recycle their wastewater back through their facilities time and again, significantly reducing, or even eliminating, their reliance on fresh water. Some data centers are turning to other non-potable water sources, like lakes, rivers and oceans, to meet their water needs. Cologix and Equinix have facilities that draw on the naturally chilly waters of Lake Ontario to cool their facilities.[10] Google has one facility in Finland, with a second forthcoming, that primarily uses seawater for cooling, virtually eliminating its reliance on fresh water[10]

Heat capture and reuse

Another sustainable practice gaining a significant amount of attention is heat capture and reuse, which captures the heat waste byproduct from data centers and funnels it into thermal energy networks (TENs) that supply local buildings with clean heat.

Because data centers operate 24/7, their heat waste can become a valuable and constant resource that helps decarbonize local communities. It's an innovative strategy that is poised to grow significantly as more communities integrate TENs and more data centers look to offset their carbon footprint.

What kind of water is it?

Potable
Water safe for human consumption, meeting regulatory drinking water standards

Recycled/reused and non-potable
Water unsuitable for drinking but acceptable for cooling and industrial applications

Reclaimed
Water leaving data center boundaries for alternative non-data center use

Choosing the right equipment for the job

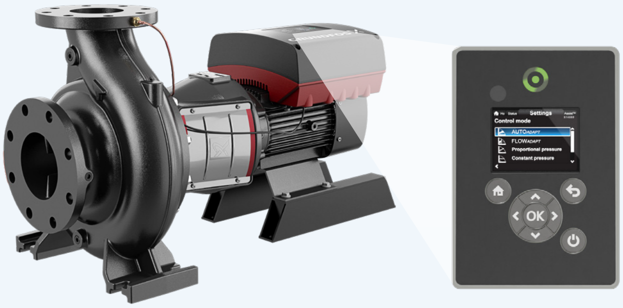
As data centers move toward more efficient cooling strategies, pump systems play a pivotal role. Pumps, controls, sensors and monitoring software form the backbone of HVAC, liquid-based and hybrid cooling systems, directly influencing both energy and water consumption, and ultimately PUE and WUE.

Modern electronically controlled pumps, or smart pumps, use motors with integrated variable frequency drives (VFDs) and built-in sensors to respond dynamically to changing cooling loads. Unlike traditional systems that rely on throttling valves, which cause energy waste, smart pumps automatically adjust flow and pressure to match real-time demand. This precise control minimizes energy use, improves cooling efficiency, and reduces strain on mechanical systems. Integrating smart pumps with data center infrastructure management (DCIM) systems further enhances performance through live monitoring and predictive maintenance.

Smart Pumps & Controls Benefits

- **Up to 40% energy savings** vs. fixed-speed pumps
- **Optimized PUE and WUE** through better flow control and lower water use
- **Compact footprint** with built-in VFDs and PID controllers
- **Seamless integration** with building management systems using industry-standard open protocols
- **High reliability**, critical for the highest tier uptime requirements (Tier 4), which allow for just 26 minutes of downtime annually

Smart pumps enable true on-demand pumping, eliminating system overcapacity, reducing the need for additional mechanical equipment, and ensuring more of the energy used is dedicated to actual cooling, not system losses. As cooling needs evolve, choosing the right pump equipment will be central to meeting both performance and sustainability goals.



Tier 1	Tier 2	Tier 3	Tier 4
99.671% Uptime Redundancy none	**99.741% Uptime** Partial power and cooling redundancy	**99.982% Uptime** Redundancy N+1 fault tolerance	**99.995% Uptime** Redundancy 2N or 2N+1

Did you know?

There's an additional way to unlock energy savings in pumps equipped with permanent magnet motors. By over-speeding the pump/motor, the data center is able to use a smaller motor, and sometimes even a smaller pump, to do the same work as a larger one while using substantially less energy. Bonus: Over-speeding can help save space and does not add any wear and tear to the pump or motor.

Grundfos is a global leader in pumping solutions and is at the forefront of water and energy conservation in data centers. Read more about how sustainable pumping solutions are currently being used in the data center industry: **grundfos.us/datacenters**

Current policies, regulations and incentives

As data center development accelerates to meet surging demand, concerns over the strain on natural resources are rising. While energy efficiency in this sector has benefited from clear national standards and well-established programs, water-related policies remain fragmented.

1. Federal strategic direction

Recent federal actions reflect growing urgency to expand digital infrastructure, but they largely focus on permitting and energy, not water.

- **Permitting Executive Policy (July 2025):** Streamlines federal approvals for new data centers and AI infrastructure, aiming to reduce delays and support workforce development.[11]
- **Biden Executive Order (2024):** Mandates the use of clean energy and domestically sourced semiconductors in federal data center facilities, emphasizing energy security and supply chain resilience.[12]

2. State and local policies and regulations

Most governance around data center water use takes place at the state and local level, but policies and regulations differ widely by location. States and municipalities must carefully evaluate a complicated slew of factors when shaping the policies that will inform how data centers develop and operate within their jurisdictions. It's important for policymakers to balance sustainability efforts with the desire to attract investments that can spur economic growth and technological advancement.

Local permitting and utility coordination

Cities and counties typically require:

- Water and wastewater permits, including projected and actual usage[14]
- Compliance with conservation ordinances[13]
- Infrastructure adequacy reviews (e.g., York County, VA)[14]

State-level policies

Policies differ from state to state, and are greatly impacted by geographic location and the varying degree of urgency around the environmental challenges they face.

- **California:** Assembly Bill 93 (pending Senate approval) would require water use reporting, promote closed-loop or non-potable cooling systems, and establish statewide best practices by 2028.[15]
- **Virginia:** HB 2377 (effective July 2025) directs localities to evaluate cooling alternatives and water impact in comprehensive plans. Loudoun County's purple pipe system already enables reclaimed water use for cooling, reducing potable demand by up to 90%.[16]
- **Arizona:** Phoenix enforces performance standards that restrict water-intensive cooling in response to long-term drought conditions.[17]
- **Washington, Oregon, New York:** These states are in early stages of developing legislation aimed at transparency, water metering, and efficiency standards for industrial users.[18]

3. Sustainability Incentives

Although no federal policies directly target data center water use, several programs encourage technologies and systems that reduce water demand.

Federal programs and standards

- **Federal Data Center Enhancement Act (2023):** Requires federal data centers to conduct comprehensive energy and efficiency assessments, including water management.[19, 20]
- **U.S. Department of Energy R&D Grants:** In 2023, $40M in competitive funding supported next-generation cooling technologies with lower energy and water footprints.[21]
- **Section 179D Deduction:** Provides up to ~$5/sq ft in tax incentives for energy-efficient upgrades, including HVAC and cooling systems.[21]
- **Fuel Cell Tax Credit:** Offers a 30% investment tax credit, which can help offset energy loads and reduce associated water use.[22]

State and utility incentives

- **New York:** Con Edison and the New York State Energy Research & Development Authority (NYSERDA) have a joint Data Center Efficiency Program that offers up to $5M/project for verifiable energy savings, including from water-efficient cooling systems.[23]
- **Other States:** Indiana, Iowa, Minnesota, South Carolina, and Washington offer sales and use tax exemptions tied to infrastructure investments and job creation, including cooling technologies.[24]

Voluntary certifications

- **Green Globes:** Recognizes sustainable building design, including water use performance in data centers.[25]
- **LEED:** The Leadership in Energy and Environmental Design (LEED) certification, developed by the U.S. Green Building Council (USGBC) promotes environmentally responsible and resource-efficient building practices.[26]
- **BOMA 360 Performance Program:** This program, from the Building Owners and Managers Association (BOMA), recognizes buildings for excellence in sustainability.[27]
- **BREEAM:** The Building Research Establishment and Environmental Assessment Method (BREEAM) offers comprehensive sustainability assessments and certifications for sustainable design and operational practices.[28]

The argument for greater transparency

The fragmented and decentralized policy landscape underscores the urgent need for greater transparency in data center water use. Without uniform federal requirements for operators to track and report water consumption, it's next-to-impossible to accurately assess and manage local water stress, which is critical to making informed decisions. Transparency reporting, including public disclosure of water use, is a promising policy tool that can help regulators better understand and mitigate the risks posed by data centers.[29]

How tech is leading the way

Largely driven by public pressure, consumer demand, and the necessity of sustainability in a world of diminishing natural resources, many large tech companies are proactively implementing more environmentally and socially responsible corporate policies and practices. Tech companies are inherently innovative, and the sustainability strategies they pursue are no exception. Many have set aggressive net-zero by 2030 water and energy targets for their data centers, and are quickly working to meet, or even exceed, them. Policymakers can look to big tech companies for ideas that can help shape the data center policies of the future.

Tech Company Water and Sustainability Commitments

Company	Water Goal	Progress and Highlights	Additional Sustainability Initiatives
Amazon (AWS)[30]	Water Positive by 2030	• 53% progress as of 2024 • Recycled water used at 120+ U.S. data centers • Expected to save 530M gallons of drinking water annually • Up to 85% water savings vs. traditional cooling	• Focus on community water reuse • Investments in water replenishment projects
Microsoft[31]	Water Positive by 2030	• Zero-water AI-optimized data center cooling • Saves ~125,000 m^3 per facility annually • High server reuse and recycling rates (>90%)	• Carbon negative & zero waste by 2030 • Emissions up 23.4% since 2020 due to AI scale-up
Google[32]	Replenish 120% of freshwater use by 2030	• 8.1B gallons of water used in 2024 • 72% from low-risk sources • 4.5B gallons replenished in 2024	• 24/7 carbon-free energy goal • 12% emissions reduction despite 27% electricity use increase • Investing in geothermal & modular nuclear
Meta[33,37]	Water Positive by 2030	• Restored over 1.5B gallons in 2023 • Aiming for 1.9B gallons annually • 25+ restoration projects • Dry cooling in new AI data centers • Transparent water reporting	• Net-zero emissions target • LEED Gold certified efficient data centers
Apple[34,38]	100% replenishment in fresh water in water-stressed areas by 2030	• 40% of goal reached as of Mar 2025 • Nearly 9B gallons projected in water benefits via partnerships	• Focus on localized water replenishment • Strong integration of sustainability into supply chain
Equinix[35,36]	No explicit water-positive goal	• Highlights efficient cooling tech • Prioritizes LEED & sustainable design	• 100% renewable energy target • Net zero carbon by 2030 • Carbon offsets and renewable procurement

Policy recommendations

The United States is racing to meet the current and future demand for AI and supercomputing, building new data centers all across the nation. With demand ever-increasing, it's imperative to put policies and frameworks in place that ensure the responsible development of data centers while protecting the best interests of communities and resources.

The following policy recommendations were prepared by the Grundfos Public Affairs Team with support from the Trade Council in North America, which is a governmental export and investment promotion organization under the Ministry of Foreign Affairs of Denmark.

How to Accelerate Best Practice Adoption through Policy		
Lever	**Recommendation**	**Why it matters**
National WUE and PUE standard	Direct DOE/EPA to adopt a tiered national Water-Usage-Effectiveness standard starting at 1.0 L kWh-1 in 2027 and converging to ≤0.25 L kWh-1 by 2035 (aligned with ISO/IEC 30134-9 & EN 50600-4), paired with a PUE cap of 1.2.	Turns a fragmented, state-by-state maze into a single rulebook, cutting water risk where it's rising fastest and giving investors comparable metrics that exist in Europe.
H.R. 2940 "The Advancing Water Reuse Act"	Advocate for the adoption of H.R. 2940, to incentivize private investment in industrial water reuse infrastructure. The bill provides a 30% investment tax credit to help manufacturers, data centers, energy producers, and other industrial operation scale up their use of recycled water.	This legislation helps ensure that businesses have long-term, reliable water supplies and that community water resources are protected.
"Report-or-Reduce" transparency rule	Require quarterly public disclosure of site-level PUE, WUE, ERF and source-water type on a single DOE portal; model language on California AB 93 and Virginia HB 2377.	Unlocks peer pressure, enables communities to gauge local water stress before new builds.
Water-positive investment tax credit (ITC-W+)	Expand §179D so projects that achieve WUE ≤ 0.4 and offset 110% of on-site withdrawals via reuse or replenishment receive a bonus 30 % credit.	Complements the existing 179D energy deduction; flips the business case in arid regions.
ARPA-E "Closed-Loop Now" grant stream	Reserve at least 25 % of the existing $40 M ARPA-E cooling program for field deployment of zero-evaporative or closed-loop liquid-cooling pilots.	Speeds commercialization of projects already seeded by DOE funding.
Federal purple-pipe accelerator	Provide low-interest WIFIA loans and fast-track Clean Water Act permits for utilities that build reclaimed-water mains to data center clusters (Loudoun model).	Slashes potable withdrawals and cuts operator water bills in half.
AI-infrastructure siting guard-rails	Tie any federal AI Action-Plan incentives to proof of WUE compliance, grid interactive demand-response, and 100% non-potable cooling in water-stressed basins.	Ensures the forthcoming AI buildout does not worsen power-water conflicts.

Conclusion

The U.S. data center market is projected to nearly triple in the next decade, bringing with it major opportunities for economic growth, job creation, and technological advancement in communities nationwide. Data centers are already driving billions in local tax revenue, funding schools, infrastructure, and essential public services while accelerating America's digital economy.

But this growth also places unprecedented demands on limited water and energy resources. Policymakers at all levels of government have a pivotal role to play in ensuring this sector expands responsibly. By aligning sustainability, innovation, and policy, the United States can set a global standard for responsibly scaling digital infrastructure, while driving economic competitiveness and protecting the resources communities depend on. The policy choices made today will shape the digital economy's future, and its environmental and social legacy for decades to come.

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