The Ethics of AI Infrastructure: A Comparative Analysis of Northern Virginia and Metro Atlanta

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Abstract

Massive amounts of costly physical infrastructure are fueling the rapid expansion of Artificial Intelligence (AI). As data centers continue to expand worldwide at higher levels of hyperscale, the need for this expansion drives unprecedented consumption of land, electricity, and water. Supporters of Hyperscale Data Centers often argue that the benefits to the global economy and to AI technology significantly outweigh any environmental/destructive impacts on local communities, and therefore that the development of such facilities should continue unabated. The authors of this article argue that the Utilitarian framework is ethically untenable when evaluated against principles of Distributive Justice. This paper will demonstrate how the existing model of deployment creates and continues to create unequal environmental and infrastructural burdens upon host municipalities by presenting a comparative case analysis of Northern Virginia, which is a well-developed data center market with serious reliability issues with its grid, and Metro Atlanta, which is an emerging data center siting market that is experiencing tremendous amounts of land conversion and depletion of freshwater resources. To redress these inequities, and to ensure compliance with the ethical principle of "least harm," the authors propose a new regulatory structure entitled "Siting Criteria Matrix," which will require that regional ecological capacity take precedence over the need for network latency; create a requirement for the use of closed-loop cooling systems; create a requirement for the integration of renewable energy resources; and provide for the development and execution of an explicit Public Benefits Agreement (PBA) before the issuance of any zoning permits. Establishing a viable ethical framework for AI will ensure that the physical asset base supporting digital technologies does

not undermine the long-term resource sovereignty of the surrounding local community.

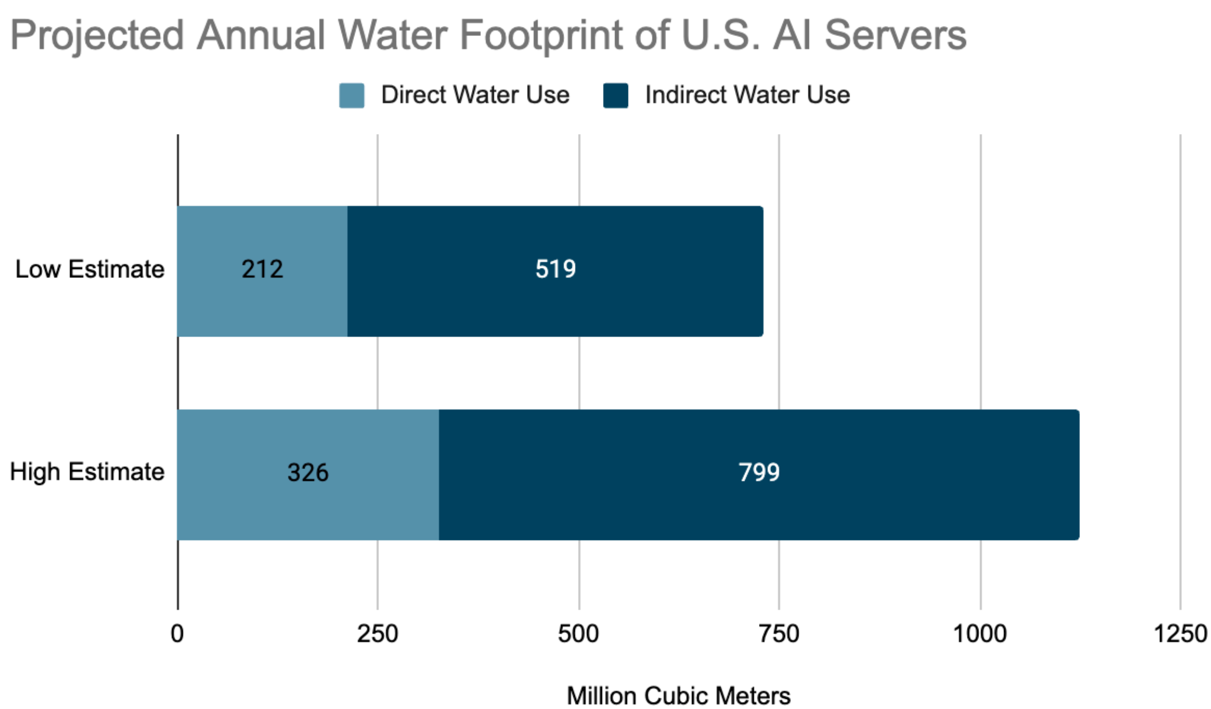
Introduction

Current dialogues surrounding Artificial Intelligence are frequently influenced by the word “cloud,” which is misleading because it suggests an almost endless, airy, weightless, and invisible infrastructure. The backbone of generative AI is fundamentally an industrial framework. The algorithms that will guide the development of the digital economy will be created in hyperscale Data Centers (HDCs). HDCs will need vast volumes of land, electricity, and water (up to 24/7/365) to avoid catastrophic thermal conditions. Thus, these physical demands are not just operational requirements; rather, they represent an inherent conflict in how global digital systems interact with their surrounding environments. They convert the natural resources available to people living in those areas into basic materials for manufacturing products that can be shipped anywhere in the world.

To demonstrate the size and scope of AI’s physical footprint, we can look to the projected water footprint of AI Server deployments in the US alone. According to Xiao et al. (2025), the total water footprint of AI server deployment in the US will exceed 1125 million cubic meters (CM) per year by 2030. (See Figure 1)

Figure 1

Projected Annual Water Footprint of U.S. AI Servers: Direct vs. Indirect Use



Note. Author-created figure using data from Xiao et al. (2025).

This water footprint is based on two main sources of water use: cooling servers through evaporation and powering AI servers. All this water needed for cooling and generating electricity dramatically relocates the "cloud" into the physical realm, converting an all-digital innovation into a highly localized environmental stressor. The AI infrastructure ultimately establishes a cycle in which the geographic distribution of the enormous computational advantages is far-reaching, compared to the extremely high level of geographic concentration of the harsh environmental and social impacts in a few specific host municipalities.

Frequently, utilitarian efficiency is the argument made for creating rapid, unrestricted, vast AI infrastructures for the "greater good." Placing hyperscale facilities in areas of high population density or those suffering from water shortages does not satisfy the principle of Distributive Justice. Based on ethical considerations, site selection for any facility must follow the principle of least harm; this means that facilities should be located in places that cause the least harm to all parties involved (the Planet and people), and not based solely on a profit/growth motive. Due to the inequitable distribution of environmental burdens, we recommend developing a Siting Criteria Matrix (see Table 1) as a new regulatory framework to determine where and how the physical infrastructure for AI should be sited. Whereas industry siting decisions currently prioritize network latency—the need for proximity to end-users to minimize data transmission delays—this matrix inverts that logic, prioritizing regional ecological capacity as the primary determinant of suitability.

Table 1

Proposed Siting Criteria Matrix for Ethically Placed Hyperscale Data Center Development

Criterion	**Preferred Site**	**Poor Site**
Water Source	Reclaimed / non-potable	Potable municipal supply
Grid Capacity	Renewable surplus	Congested grid
Climate	Cool / free-air cooling	Hot / water-intensive cooling
Zoning	Industrial	Residential/agricultural
Community Impact	Offset from residential areas	Near residential housing

***Note.* Author-developed framework based on distributive justice and least-harm principles.**

Factual Background: A Tale of Two Cities

As “the Data Center Capital of the World,” Loudoun County, Virginia, is arguably the best example of a predictive model that describes the extent of infrastructure friction between the pace of hyperscale development and municipalities’ capacity. Currently, Data Center Alley is home to nearly 200 operational facilities, accounting for approximately 70% of the global internet traffic, with over 100 more in the development pipeline. The concentration of data centers at this current level within the region has pushed the electrical infrastructure to its absolute physical limits.

In 2022, the regional transmission organization (PJM) and the local utility, Dominion Energy, severely underestimated the exponential demand for power, driven by the rapid emergence of AI workloads. As there are currently insufficient high-voltage transmission lines to deliver the gigawatts needed to power this growing segment safely, Dominion was forced to impose an immediate moratorium on all new data center connections to the eastern portion of Loudoun County due to the imminent threat of grid failure. In late 2025, Dominion reported staggering forecasts of more than 40 gigawatts of potential new data center load on its books, which would require several nuclear power plants to power future AI development.

To ease congestion on the electric grid and accommodate this unprecedented load, utility companies are pursuing large-scale capital improvement projects. As an example, Dominion Energy proposed creating a new 500-kilovolt transmission line (loop) between Golden and Mars that will cut through residential areas, schools, and conservation areas, requiring utility poles as tall as, or taller than, the Statue of Liberty. This proposed project has generated intense community controversy. Standard ratepayers are carrying the visual, environmental, and financial costs, estimated at over $28 billion in statewide transmission capital costs, associated with an industry that will export the majority of its benefits to the rest of the world, according to citizens and local government officials.

The Loudoun County Board of Supervisors is increasingly recognizing and responding to this disparity. The County Supervisors have recently produced several municipal white papers calling for the data center industry to move away from monopolizing the public grid and toward generating its own power through the construction of "microgrids." This location also serves as an ideal example of the core conflict of Distributive Justice: boundless digital expansion is fundamentally incompatible with finite local infrastructure.

In Metro Atlanta, particularly in Douglas County, developers are aggressively pushing southward in search of large, contiguous parcels of inexpensive land that are generally zoned for agriculture or rural use, with the potential for high returns on investment. Moreover, these regions are desirable not only for their lower land costs but also for their lower regulatory resistance, more permissive zoning, and lower political costs associated with industrial conversion. Therefore, the forces behind the expansion of data centers also stem from questions about structural power, rather than just economic considerations. Microsoft is building a 980,000-square-foot facility on 160 acres in Douglasville, scheduled to open in 2027. Even more indicative of this land tension is the new effort to construct a "Rock House Road Data Center" (Development of Regional Impact 4078) planned for unincorporated Douglas County. With the proposed development of 1.46 million square feet of data center facilities across a 134-acre site currently zoned "Residential/Agricultural," this represents an ongoing evolution in data center siting, from traditional urban/industrial environments to less-populated rural and suburban locations.

A core infrastructure gap exacerbating this expansion is the lack of municipal "grey water" (reclaimed wastewater) pipelines to support the new southern zone data center development. Google financed a custom plant in Douglas County in 2012 to provide recycled water as a cooling agent for its servers. However, the Douglasville-Douglas County Water and Sewer Authority has confirmed to reporters that this was a one-time arrangement, and that there is no existing municipal network supporting a treatment plant that provides reclaimed water to the many new data centers moving into the region.

Without a regional grey water network in place, new data centers must use evaporative cooling systems that draw directly from the municipal potable water supply. Consequently, data centers will compete directly with residents for potable water, and water authorities will be forced to make significant plans for new reservoirs, such as the DDCWSA's newly announced $390 million Dog River Reservoir expansion, to keep pace with water shortages and provide for the industrial needs of the data transfer industry. The cumulative effect of all facilities in Georgia is severe; as stated in a report by Science for Georgia, Water Use in Georgia (2025), 27 billion gallons of water are used each year by both existing and planned facilities across the State of Georgia. As shown in Figure 2, existing and planned Georgia facilities may require substantial water and power resources.

Figure 2

Estimated Impact of Data Centers in Georgia

	Current Data Centers	**Planned Data Centers**	**Total**
Total Power Usage, announced (MW)	6515 MW (from 68)	2215 MW (from 9)	8730 MW
Total Power Usage, estimate (MW)	6610 MW (from 64)	1781 MW (from 8)	8391 MW
Total Water Usage, low estimate (Million Gal/yr)	13,219 M Gal/yr (from 64)	3,562 M Gal/yr	16,781 M Gal/yr
Total Water Usage, high estimate (Million Gal/yr)	27,536 M Gal/yr (from 64)	7,421 M Gal/yr	34,957 M Gal/yr

Note. Adapted from Science for Georgia (2025). Estimates are based on reported power usage and square footage for 97 active and 10 announced or in-progress Georgia data centers. Water demand is presented as low and high annual estimates.

These projects reinforce the argument that Metro Atlanta's expansion is not simply a local zoning issue, but a broader infrastructure governance challenge involving finite water and grid capacity. The Coweta County Project Sail Facility requested an average daily withdrawal of 6 million gallons, of which 4 million gallons will evaporate into the atmosphere. Because of this direct evaporation, there is a permanent loss of water from the watershed (Chattahoochee Riverkeeper, 2025).

Table 2

Comparative Infrastructure Pressures: Loudoun County, Virginia vs. Metro Atlanta, Georgia

Metric	**Loudoun County, VA**	**Metro Atlanta, GA**

Development State	Mature hyperscale cluster	Rapid expansion / emerging southern growth corridor
Operational Facilities	Nearly 200 operational facilities	Multiple facilities exist + major pipeline growth
Pipeline Growth	100+ additional facilities proposed	New projects in Douglas, Coweta, and South Fulton counties, BeltLine debates
Global Significance	~70% of global internet traffic is routed through the region	Major Southeast growth hub for new AI Infrastructure
Grid Stress	Severe moratorium on eastern Loudoun connections	Rising demand requires new utility planning
Forecasted New Load	40+ GW potential new data center load	Significant but fragmented regional expansion
Water Stress	Moderate concern; power-linked water use	Severe potable water competition concerns
Land Use Conflict	Transmission corridors near homes, schools, and conservation areas	Agricultural/residential land converted to industrial use
Example Project	Dominion 500-kV transmission loop	Rock House Road (1.46M sq ft on 134 acres)
Public Opposition	High and organized	Increasing local resistance/zoning restrictions
Policy Response	Microgrid proposals, county white papers	BeltLine restrictions, zoning amendments, and reservoir expansion

Note. Table created by authors using data from Loudoun County Government (2024), Atlanta Region Commission (2024), Science for Georgia (2025), and other sources cited in this paper.

Ethical Framework Analysis

When defending their huge and expanding infrastructure, the artificial intelligence and data center industries frequently utilize a Utilitarian model to defend what they consider “global

AI efficiency" and "economic growth," as well as dominating the international "AI arms race," far outweighing any unintentional disruptions that may occur at the local level. Industry leaders have defined hyperscale data centers as both profitable businesses and a vital part of the nation's infrastructure, necessary for driving future digital innovations and economic growth. The proponents of expanding the scope of the business and technology industry have a reasonable basis for their arguments based on the potential utility provided by increasing the availability of technology: maintaining a competitive position as a country; accelerating the rate of downstream innovations in medicine and other related areas; creating and retaining jobs and contributing to the generation of tax revenue for the local community; and allowing for the continued advancement of technology to benefit future generations. By using this strategy, these businesses justify the extreme pressure they are placing on host communities by saying, "We are creating global technological dominance." Nevertheless, this rationalization is critically flawed because the aggregate global benefit becomes morally unstable when it arises from hidden or concentrated harm to the local community, which is not the primary beneficiary. As noted by Tavani (2016), when considering cybertechnology, though Utilitarian theories based on consequences may provide the greatest benefit to society as a whole, in practice, Utilitarian models will almost undoubtedly violate the rights of many marginalized or minority groups.

The Utilitarian Defense in Context: National Competitiveness and the AI Arms Race

Advocates of unlimited development of hyperscale data centers do not argue from a corporate expedience or regulatory-escape perspective, but from a strong utilitarian calculus grounded in a national-interest/global-welfare framework. This rationale is advanced by several trade associations and is reflected in discussions of federal policies and regulations. It is predicated on the reality that the U.S. is currently engaged in an intense game of geopolitical competition to achieve supremacy in artificial intelligence ("AI"). Many believe AI will lay the groundwork for economic and military power in the 21st century. According to this argument, restrictive local zoning ordinances, moratoria on adding new connections to the electrical grid, or comprehensive environmental regulations (even when well-intentioned) create barriers to realizing the potential of artificial intelligence; they constitute an impediment to the deployment of data centers and other digital infrastructure needed to support the growth of AI. This impediment reduces the pace at which digital infrastructure can be constructed, and in turn, elevates the degree to which countries such as China, which have a state-directed approach to the creation of AI, have a competitive advantage given that they need to negotiate significantly fewer regulatory hurdles than do companies based in the U.S. Viewed from this perspective, the environmental and social challenges experienced by individual communities such as those located in Northern Virginia and Metro Atlanta are unfortunate; however, they are considered to be a necessary result of a national strategy to establish U.S. dominance in AI development. For the overall good of the United States, maintaining technological leadership, continuing economic expansion, and creating downstream economic opportunities for all companies involved in research and development in a wide variety of industries, including healthcare, climate science, and much more, is far more important than the slight inconvenience to a few communities. Putting the needs of Loudoun County's residents first is a poorly conceived, short-sighted approach to creating a national plan to achieve global dominance in artificial intelligence.

The Utilitarian Argument for Hyperscale Data Center development offers clear, simple explanations while remaining consistent with the Political Realities of AI development. Additionally, the Utilitarian Argument for AI recognizes the high geopolitical stakes of AI development. In this sense, the Utilitarian Argument supports people's practical understanding of the decision to accept localized harm to achieve a national interest.

However, under the more thorough analysis of Distributive Justice - and, even more so, the deeper understanding of the principles of Utilitarianism - The Utilitarian Argument lacks merit.

The Distributive Justice Rebuttal: The Illegitimacy of Concentrated Sacrifice

One of the core concerns regarding the argument for national competitiveness as a signal for society to invest more in AI infrastructure is that it appears to assume that communities most likely to bear the burden of such investments are limited to a narrow set of relatively small, largely vulnerable minority communities. Tavani (2016) argues that this type of reasoning is problematic because, due to its utilitarian nature, it often overlooks the question of justice for minority communities (p. 86). Simply put, the large aggregate social welfare generated by AI infrastructure is not sufficient justification for imposing extreme, uncompensated harms on a limited, discrete population.

In Loudoun County, Douglas County, and South Fulton, citizens will serve as the members of the affected communities in this regard. They will bear the weight of 215-foot visual blight from transmission towers; they will take on the risk of stranded utility costs; they will forever lose access to their local water resources; they will no longer have control over their physical environment; and yet, the capital benefits of the AI infrastructure will flow to the rich urban centers and multinational technology hubs.

These communities are not simply collateral damage; rather, they represent a structural violation of the principle of Distributive Justice. Per Tavani, the principles of Distributive Justice apply not only to access to digital services but also to the physical deployment of information infrastructures (Tavani, 2016, p. 268). The placement of hyperscale data centers in residential and water-stressed areas without an accompanying investment in local communities and resource sovereignty represents an unjust distribution of environmental and social costs. The national interest may be legally sufficient to allow policymakers to convert certain communities into a region of sacrifice for the digital economy. Still, it does not grant them a blank cheque to do so.

The Rule Utilitarian Critique: Unsustainable Long-Term Consequences

Even if one accepts the premise that aggregate utility is the appropriate metric for ethical evaluation, the industry's defense fails on its own terms under the scrutiny of Rule Utilitarianism. Rule utilitarians, as Tavani explains, recognize that "policies that permit the unjust exploitation of the minority by the majority will also likely have overall negative social consequences and thus will not be consistent with the principal criterion of utilitarian ethical theory" (Tavani, 2016, p. 47). By allowing global technology corporations to take local water sources and overstrain municipal electrical grids, causing them to fail, while at the same time passing on the billions of dollars needed for infrastructure costs (to these companies) on to everyday people as part of their electric bills, we create an unstable base for long-term social welfare for the community. The many examples of community resistance seen throughout Northern Virginia and Metro Atlanta (from organized community opposition to the construction of transmission lines to the creation of municipal bans meant to protect vulnerable neighborhoods along the Atlanta BeltLine) provide clear evidence that the extraction model used by global corporations creates a growing amount of political and social friction. As the reliability of our electrical grids declines and water becomes increasingly hard to find, the growing costs associated with this political and social friction will continue to worsen and eventually erode the national competitiveness that is being defended through the utilitarian justification of such policies. Thus, it would appear that policies that allow the unreserved, inequitable expansion of global corporations will ultimately fail in the long term.

The "Least Harm" Alternative: Redirecting, Not Halting, AI Expansion

Importantly, the ethical critique of this work does not require an end to the development of AI infrastructure, nor does it call for the United States to cease pursuing leadership in artificial intelligence. Rather, the ethical critique emphasizes the need for the United States to develop artificial intelligence infrastructure in a manner that is consistent with the "Least Harm" Principle - that is, that all decisions made by policymakers and developers shall be made based on where to locate infrastructure with minimal disruption to the environment and community as opposed to where land and regulatory barriers are least expensive and/or when they are least restrictive.

This ethics review led to the development of a Siting Criteria Matrix based on the "Least Harm" Principle and a preference for Regional Ecosystem Capacity over Network Latency. It does not eliminate the need for physical infrastructure for AI. Still, it provides for redirection to places such as the Enterprise South Industrial Park in Chattanooga, Tennessee, which has a large supply of low-carbon energy, non-potable water, and appropriate zoning for industrial development, and is a substantial distance from where people live. This combination maximizes the utilitarian benefit of adding to the national capacity for Artificial Intelligence (AI) while minimizing Distributive Justice violations in an AI infrastructure development project as it exists today.

It also illustrates that Artificial Intelligence (AI) does not limit our choices to respect the rights of vulnerable populations or to advance AI in the U.S. Instead, there is another option: intentionally and ethically develop site selection criteria aligned with a country's goals for technological leadership, without infringing on the health, safety, or sovereignty of local communities' resources.

To reinforce this, Tavani points out that Utilitarian models have an inherent "Blind Spot" with respect to the rights of these groups. He emphasizes this as follows: "[Utilitarian] models fail to consider concerns of justice for the minority population" (Tavani, 2016, p. 86). As such, Utilitarianism cannot ethically be invoked to justify the use of "global AI efficiency" unless that efficiency can be attained without unjustly exploiting resource-strained local municipalities. Noting the work of van den Hoven and Rooksby, Tavani states that concepts of Distributive Justice must apply not only to access to the digital realm, but to the actual deployment of "information infrastructures" (Tavani, 2016, p. 268). This clearly illustrates that issues such as local zoning battles, excessive water use, and the degradation of local power grids are not solely municipal or environmental concerns, but represent a fundamental failure in maintaining Distributive Justice. Draining a resource-stressed community's water supply to power the cloud fails the test of Rule Utilitarianism because it entails negative long-term social ramifications, including policies that allow majority populations to exploit minority populations (Tavani, 2016, p. 47).

While some may view AI industry leaders such as Sam Altman, Jensen Huang, Mark Zuckerberg, or Elon Musk as acting with malice to harm their local communities, it is unfair to accuse them of doing so. The executives in the AI industry are not intentionally causing harm; rather, they are systemically unaware of the localized impacts caused by their rapid data center expansion.

Haidt (2012) indicates that secular, Western moral systems tend to be "cuisines" that activate one or two receptors (concern for harm/suffering or concern for fairness/injustice). Since the technology industry relies almost exclusively on a unilateral moral point of reference (utilitarian efficiency), it remains completely unaware of the potential impact of its activities on the municipality's economic distribution of wealth.

Governance failures stemming from utilitarian moral blindness, especially at the national and municipal levels, are immensely damaging. The technology industry nationally is currently engaged in a reckless arms race to build hyperscale data centers, with companies investing billions of dollars towards the rapid expansion of these facilities. Local governments often view these facilities as financially lucrative sources of revenue to support both school districts and city budgets.

Unfortunately, local governments often get caught up in the hype surrounding the use of artificial intelligence (AI) and fail to see that the expected fiscal benefits to the municipalities might be completely offset by the additional financial burdens placed on residents who ultimately pay for the additional costs of using electricity, water, and gas due to the presence of these hyperscale facilities. Municipal planners have been overwhelmed by the hyper-competitive data center market, which has hampered their ability to develop risk-averse zoning and regulatory strategies for power grids and water tables in areas adjacent to these facilities. As noted by Danielewicz and Thomas (2024), "The market forces motivating the deployment of AI have not permitted the development of reasonable and systematic approaches" (p. 115).

This failure of governance is demonstrated by the fact that many municipalities have now been forced to retroactively rewrite their data center development policies, long after the construction and establishment of the data centers, resulting in a situation in which the municipality's residents subsidize the excessive resource consumption of hyperscale data center facilities.

As such, in correcting this failure of governance, policymakers need to acknowledge that, pursuant to UNESCO's Global Principles, the definition of Genuine AI Ethics encompasses the duty to actively safeguard the physical environment. Danielewicz and Thomas (2024) expand on this duty, stating, "Ultimately, there should be adequate oversight, impact assessments and audits, and due diligence undertaken to prevent a conflict with human rights and a threat to environmental safety" (p. 113). Ultimately, to be classified as an ethical AI system, the physical infrastructure supporting it must not degrade the local environment of the host municipality.

Governance Failure and Strategic Recommendations

Due to the lack of regulation on establishing high-density ("hyperscale") data centers, as well as political incentives to do so, the recent increase in the number and density of these data centers is occurring at an unprecedented, uncontrolled pace. Therefore, it can be concluded that the rapid, unregulated growth of high-density (hyperscale) Data Centers is due in part to failures occurring within the systems themselves. Specifically, this failure is structural: existing zoning, reporting, utility planning, and permitting systems were not designed to assess AI infrastructure as a cumulative industrial burden, leading them to systematically underestimate its long-term impacts. Governance failures occur at many levels (e.g., zoning, reporting, and strategic planning) and create environments that are not conducive to regulating industrial cloud computing operations associated with AI Infrastructure. To correct these inequities and bring growth into line with Distributive Justice principles will take a fundamental change in the way sites are selected, transitioning from a “resource extraction” model to one of “resource symbiosis”.

The Zoning and Reporting Loophole

A major problem with how municipalities control Hyperscale Data Centers (HDCs) stems from an outdated interpretation of HDCs within local government zoning codes. HDCs generate large amounts of electrical energy, consume large amounts of water, occupy large amounts of physical space, and are therefore typically classified within zoning codes as “warehousing” or “light industrial”. The zoning classification mistake documented in the American Planning Association Zoning Practice Report (2025) is one way developers can avoid the extensive environmental and community impact reviews that would otherwise be required for “heavy industrial” operations, such as power plants/manufacturing. By assigning HDCs to the wrong zoning designation, municipalities deprive themselves of the regulatory power to require advanced mitigation measures and view HDCs as passive storage units rather than energy-hungry industrial operations.

The illicit opportunity for developers created by this zoning classification is exacerbated by another critical governance failure: the way local governments report environmental impacts. Usually, the reports used to evaluate the potential environmental impacts of a project, called Environmental Impact Statements (EIS), do little to explain the multiple and cumulative sources of damage to the ecosystem that AI infrastructure will cause. Slimani et al. (2025) note that AI represents a tremendous energy demand (due in part to the large-scale training of models, the continuous operation of data centers, and the need for new hardware) and results in increasingly excessive electricity and cooling water consumption. Traditional project-by-project EIS assessments cannot combine these energy requirements into a single total footprint. An Environmental Impact Statement (EIS) evaluates a facility's direct water use. However, it does not account for the 71% of indirect water use associated with the electricity generated in off-site power plants (Xiao et al., 2025). In many instances, an EIS does not account for the additive effects of multiple facilities drawing water from the same aquifer. Without reporting on both the direct and indirect cumulative impacts, local governments allow HDC development to continue under a façade of regulatory compliance. The Siting Criteria Matrix outlined in this article addresses the missing link of assessing both the on-site water consumption and the indirect water footprint associated with the proposed facility. By doing so, a true measure of the hydrological impact will be determined before any zoning approvals are given.

Proposed Solution

A Siting Criteria Matrix. To address the Governance Gaps created by HDCs, we are introducing a new regulatory framework, the Siting Criteria Matrix. This Matrix will emphasize the long-term environmental sustainability of an area over industry standards, which typically prioritize low network latency as the primary factor in determining where the physical component of AI should be located.

The Siting Criteria Matrix consists of three non-negotiable core criteria: Climate & Grid Mix - Locations for HDCs must have a cold climate to support "Free Air Cooling" and, consequently, minimize reliance on the energy- and water-intensive Mechanical Cooling systems (Xiao et al., 2025). Furthermore, to ensure that the incremental energy demand of AI supports the transition to clean energy, new HDCs should be required to locate in areas with a strong grid capable of supporting renewable energy sources, thereby avoiding extending the life of fossil fuel generation facilities. Water Source and Management - As metropolitan areas like Atlanta currently experience high levels of Water Stress, it is critical that the Siting Criteria Matrix prohibits the use of potable water for cooling processes. Developers must be required to implement Closed-Loop Systems and Non-Potable Water Sources, including Greywater and/or Treated Effluent. Without these mandates, a violation of Distributive Justice occurs, creating a condition in which local communities must compete with Industry for access to a Fundamental Human Right. Community Benefit & Grid Impact - In addition to Environmental Standards, the Siting Criteria Matrix must require a “Net Positive” Resource Model. Public Benefit Agreements (PBAs) shall mandate that Developers financially support the utility infrastructure upgrades needed to accommodate their business models, and additionally invest funds in their host community’s water infrastructure as well as establish tangible benefits to the Local Community (e.g., Broadband Expansion, Workforce Development) and thereby enable Host Communities to share in the Value generated from locating HDCs in their Communities.

Trade-Off Analysis and an Ethical Model

Implementing such a matrix requires a realistic trade-off analysis that clearly distinguishes among the many phases of AI operations. Of all the functions of AI, modeling training represents the highest resource demand, yet also has the greatest tolerance for delays. Model training can consume many megawatt-hours of energy and literally hundreds of gallons of water over weeks of energy-intensive operation.

Model training typically occurs in one or more areas/location types during this period, based on which sites or locations meet the Matrix's needs and the resources available for that workload, given the long-term operational requirements for these workloads (Luo & Feng, 2024). Model inference is performed in real time and must occur at a site/location close to end users to ensure minimal latency. This “policy split” allows for the concentration of less resource-intensive inference workloads near urban centers, while ethically isolating the most damaging, resource-heavy “training” phase to remote areas with the highest environmental capacity.

The Framework points to a potential future location for developing Sustainable AI Infrastructure. The proposed location is the Enterprise South Industrial Park (ESIP) located in Chattanooga, Tennessee, which can serve as a replicable ethical model for other locales. The ESIP contains a unique collection of resources, namely: (1) a low-carbon, high-capacity hydroelectric grid managed by the Tennessee Valley Authority (TVA); (2) The Gig, the fastest municipal-based fiber internet service in the United States (U.S.); and (3) designated heavy industrial zoning that is situated far from multi-family housing and single-family housing.

Therefore, these residents will benefit from a robust, clean-energy-operating, heavy-industrial-zoned area of the city where their operational resources will be concentrated, without sacrificing any of their own rights or well-being. Thus, the ESIP represents a tangible approach to developing sustainable AI Infrastructure without sacrificing the residents of the city of Chattanooga (and its region), as is currently seen in Northern Virginia, Metro Atlanta, etc.

Evaluating System Safety and the Digital Divide

The physical robustness of municipal grid(s) hosting AI systems directly impacts their safety and reliability, and, beyond software alignment and algorithmic outputs, their safety should also include evaluating risks associated with hardware failures. The U.S. Department of Energy (DOE) projected in a July 2025 report that AI-driven hyperscale data center electricity demand will increase regional outage risks by a factor of 100 in 2030. The operators of Data Center Alley in Northern Virginia have documented many “near misses” stemming from the clustering of multiple data centers in the same geographic area, where extreme load fluctuations nearly caused power outages that could have cascaded through the interconnected regional network.

As hyperscale facilities place tremendous demand on the electrical grid to the point of collapse, or rapidly draw from local reservoirs required for fire suppression, agriculture, and public health, they endanger the municipality’s safety. For an AI system to be truly reliable and safe, it must be engineered and sited with consideration for not infringing on the host municipality’s survival infrastructure.

In addition to the challenges posed by the physical deployment of AI, that deployment can exacerbate the digital divide between urban and rural regions. As developers move into new, emerging suburban and rural areas (such as Douglas and Coweta counties) in search of lower-cost land, water, and power, host communities are bearing the environmental and infrastructure burdens associated with hosting large, energy- and water-intensive facilities. The massive computational and economic benefits produced by AI facilities are primarily flowing out of those communities and concentrating in global technology hubs and affluent cities, a phenomenon Guo et al. (2025) identify as the “Spatial Siphon Effect”. To help rectify this disparity and provide equitable access to AI technologies, local government entities will have to create new integration strategies (e.g., Public Benefit Agreements) to legally bind AI developers to fund the local extension of fiber-optic broadband and invest in regional digital literacy and cybersecurity training pipelines, as well as subsidize the local computing capacity of public institutions and community schools. Only through mandatory structural reinvestment can the digital divide be closed, enabling the communities powered by AI to have equitable access to the digital dividends they create.

Conclusion

Advocates within the data center sector tend to rationalize expansions of hyperscale DCs on utilitarian grounds (i.e., the concept that actions are morally justified when they result in greater total utility for individuals). Supporters of this view contend that, even though hyperscale DCs have a disruptive effect on their host communities in the short term, the long-term impact will be positive because they will ultimately enhance the development of AI and other advanced technologies and create economic benefits for the communities in which these facilities are situated. In contrast, our research shows that the industry's rationale for constructing AI-based data centers is not valid when examined at the municipal level. When dealing with limited local resources, such as Douglas County's potable water supply or Dominion Energy's grid capacity, AI companies exploit these resources without regard for the harm caused by transferring digital benefits to a global marketplace. The result of this injustice is a violation of the principles of Distributive Justice. It therefore negates the argument that utilitarianism justifies the current expansion of AI data centers in residential neighborhoods.

The presence of structural inequities inherent in the AI-based Infrastructure Industry warrants the removal of the industry's default "social license". Municipalities must reject speculative promises of digital innovation when they result in the degradation of local physical resource sovereignty. As we look to the future, municipalities must implement a "Net-Positive" Resource Model that requires AI center developers to adhere to strict environmental standards, as determined by the Local Zoning Board and the Public Utility Commission, before obtaining a Special Use Permit. This model mandates that AI developers build closed-loop or waterless cooling systems, fund municipal grey water systems, and pay for the cost of any energy grid improvements. Until the AI Infrastructure Industry provides proof that it replenishes the local environmental resources used by the host community, it should be denied entry into any residential neighborhood or resource-stressed municipality. The ethical deployment of AI does not require the complete cessation of infrastructure development; it requires a commitment to the principle of least harm—siting facilities where they can operate without degrading the fundamental capabilities of the communities that host them. By shifting the governance paradigm from resource extraction to ecological accountability, the Siting Criteria Matrix offers a pathway toward an AI future that is both innovative and just.

Issues Purposely Not Addressed and Unanswered Questions

The purpose of this research is to explore municipal resource allocation and public infrastructure through the lens of Distributive Justice. To achieve this goal, this paper has defined certain adjacent areas or components of AI Ethics. These components are equally important to those discussed in this paper; however, they will not be included in the analysis. The reason for this exclusion is that adding them to the analysis would diminish the clarity and specificity of the research topic on governance and local resource sovereignty of AI technology.

Economic Viability of Retrofitting Existing Infrastructure.

The proposed Siting Criteria Matrix is forward-looking; it establishes standards for new hyperscale developments. This paper does not address the financial or engineering feasibility of retrofitting the nearly 200 existing data centers in Loudoun County or the legacy facilities in

Metro Atlanta to meet these new environmental standards. The capital expenditures required to retrofit evaporative cooling systems with closed-loop systems or to integrate renewable microgrids into operational facilities represent a distinct policy challenge involving utility rate cases, stranded asset valuation, and corporate accounting—issues beyond the scope of this ethical and regulatory analysis.

Global Supply Chain and Hardware Lifecycle.

The operational energy and water use documented in this paper represent only one aspect of the overall costs associated with data centers. The costs of producing servers, GPUs, and networking devices must also be considered. This includes extracting valuable rare earth elements, reducing carbon emissions from semiconductor production, and addressing the growing e-waste crisis driven by rapid hardware obsolescence in the AI industry. A different lens is needed when addressing the lifecycle of a product from production to end-of-life (EOL), as it falls outside the scope of 'local' governance covered in this paper and should be viewed through the lens of international trade, supply chain transparency, and related concepts.

Algorithmic Bias Versus Physical Bias.

In discussions regarding "AI Ethics," one prevalent issue is how algorithms can reflect a fair and equitable society, as well as the necessity of appropriately collecting and disclosing the data on which automated decisions are based and of using unbiased sources for training datasets. However, this paper will not address these ethical challenges relating exclusively to software. Instead, this paper focuses on another, often overlooked, aspect of the relationship between AI and society: the way and the location in which AI hardware is constructed contribute to existing inequalities between communities. An AI system cannot be considered ethical simply because its algorithmic results appear equally accessible across racial/ethnic groups; rather, as this paper argues, an AI system's reliance on degraded environment(s) within the community in which the hardware that supports it exists indicates failure to meet ethical standards. By identifying this additional ethical component of AI development, this paper presents an original view of infrastructure within a broader ethical framework for AI, complementing existing research on algorithm accountability.

Limitations of the Research

Several constraints and limitations on the findings and recommendations in this study needed to be clearly defined. The primary limitations stemmed from the limited data available and the inherent constraints of conducting a comparative case study.

Opacity of Utility and Industry Data.

A significant constraint on this research is the proprietary nature of granular energy and water consumption data. Electric utilities such as Dominion Energy and Georgia Power routinely cite business confidentiality and critical infrastructure security to withhold precise, per-facility load profiles and real-time water withdrawal figures from public disclosure. Furthermore, the fragmented nature of local Environmental Impact Statements (EIS) creates a critical reporting loophole, frequently omitting indirect water use from off-site power generation—a factor accounting for approximately 71% of AI's total water footprint (Xiao et al., 2025). Consequently, this analysis relies on aggregated data published within state-mandated Integrated Resource Plans (IRPs), Development of Regional Impact (DRI) filings, and independent modeling conducted by organizations such as Science for Georgia and the Piedmont Environmental

Council. While these sources are credible and sufficient to establish the systemic trends identified in this paper, the absence of raw operational telemetry limits the precision of the quantitative burden assessment.

Reliance on Secondary Qualitative Evidence.

Using a variety of secondary sources, including municipal white papers such as Loudoun County Board of Supervisors reports, regional journalism, and public comments from zoning amendment proceedings, this research paper chronicles residents' concerns about potential depreciation in property values and their feelings of disenfranchisement regarding land-use planning for environmental purposes in Loudoun County. Due to time and resource constraints, original ethnographic fieldwork—such as structured interviews with residents, county planners, or industry representatives—was not conducted. Future empirical research employing primary qualitative data collection would significantly enrich the understanding of the lived experience of communities hosting hyperscale infrastructure.

Generalizability of the Comparative Model.

Using Northern Virginia and Metro Atlanta provides a strong basis for examining how established and newer types of data centers are located within the United States' Mid-Atlantic and Southeast regions. Despite using the water stress and availability framework, it is unlikely that these results will apply to other locations (i.e., geographic locations with different climates, hydrological conditions, and regulatory environments). For example, the ethics related to the placement of a data center in a dry western state, such as one experiencing shortages due to the Colorado River Compact, would differ greatly from one placed near the water-rich basins of the Chattahoochee River Basin, even though both locations have water stress issues, but to differing degrees. Similarly, the location of data centers in countries that have less developed or less effective environmental governance may present much greater opportunities for Distributive Justice violations. This paper provides a valid analytical approach to examine this issue; however, the recommended policies will likely need to be modified to reflect the local ecological and political context where the data center is to be located.

Recommendations for Future Research

The arguments advanced in this paper open several avenues for further scholarly inquiry and policy development. The following recommendations outline a research agenda that would extend and deepen the analysis presented here.

Legislative Codification of the Siting Criteria Matrix.

This paper presents the Siting Criteria Matrix as a conceptual regulatory structure. To make this regulatory structure practical, the Siting Criteria Matrix needs to be converted to model ordinance language that can be adopted by county boards of supervisors, planning commissions, and state utility regulators. To develop specific zoning text amendments that implement the core criteria of the Siting Criteria Matrix and prioritize the needs of the ecosystem, while also considering industry demands for network latency, the authors recommend future research that involves collaboration between legal scholars and municipal land-use planners. Each of the core criteria would have to be included in a legal document as either prohibitions on potable water for cooling, required use of renewable energy for cooling, or required enforceable Public Benefit Agreements. This type of research would help to bridge the gap between ethical theory and the ways that society governs itself.

Quantitative Modeling of the “Stranded Cost” and “Spatial Siphon” Burden.

This report identifies two of the most significant ways that economic injustice can be manifest: through the risk of stranded costs being transferred onto Virginia residential customers (as also projected by Dominion Energy's Integrated Resource Plan for 2025), and through the spatial siphon effect, wherein resources from peripheral communities are drained to support centralized compute hubs (Guo et al., 2025). Future work that employs econometrics may create a comprehensive AI infrastructure burden ledger that details what tax revenue is generated by each data center (to aid policymakers) compared to quantifiable costs that residents incur, such as anticipated increases in electricity rates, investment needed in expanding necessary drinking water infrastructure due to data center requirements, and losses of ecosystem services as a result of converting land to computing center use. The ledger would provide policymakers with an evidence-based, objective basis for determining the total net value or net cost of locating hyperscale data centers in Virginia.

Developing a Capabilities Deprivation Index for Host Communities.

Based on the Capability Approach developed by Amartya Sen and Martha Nussbaum, Hyperscale Data Centers put at risk a person's Fundamental Human Capabilities - health of the physical body and control of the surrounding environment. Future research on this idea should develop a "capability-deprivation" index that assesses how expanding large-scale information infrastructure affects the communities in which it is situated. This index would evaluate how large-scale information infrastructure affects a person's ability to achieve the following four goals: (a) access to safe and reliable household water; (b) frequency and duration of grid instability events; © proximity of industrial noise and visual blight to residential zones; and (d) meaningful opportunities to participate in siting decisions. By applying the capabilities-deprivation index to longitudinal studies, the results will provide either empirical evidence for or a more complex version of the critique of Distributive Justice presented in this paper.

AI Disclosure

In accordance with course policies, Google was utilized to aid in resource browsing, brainstorming, and refining the authors' original written prose. Grammarly was used for spelling, formatting, and grammatical editing. The authors conducted all independent analyses and assume full responsibility for the research, arguments, and final content of this paper.

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