ETH Zurich Department of Architecture
ARCHITECTURE OF TERRITORY
Chair of Architecture
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Professor Milica Topalović

The Production of Cloud
Spring 2026

Atlas

Northern Virginia, US

Leonardo Mühlestein, Vithursan Manoharan, and Alberto Früh

Northern Virginia accounts for approximately 35% of the world's data center facilities. The region hosts over 275 facilities with a power demand of 2,600 megawatts. This transformation began in 1991, when the small farming community of Farmwell evolved into the tech hub now known as Ashburn. Major corporations like Amazon and Microsoft were drawn to the area by favorable tax incentives, a stable climate, and proximity to Washington D.C.

However, this rapid expansion has placed immense strain on the local power grid. Some new projects request twice the capacity of a standard local power plant, triggering a rare bipartisan "backlash." While Republicans express concern over rising electricity costs, Democrats emphasize the environmental impact and heavy water consumption. Consequently, roughly $64 billion in new projects are currently stalled or delayed across the United States.

The physical presence of these "cloud" buildings is equally controversial; maps show massive, windowless structures standing directly adjacent to residential neighborhoods and public schools. Furthermore, the offer of millions of dollars to farmers for their ancestral land has created significant emotional stress within the community. For Northern Virginia to sustain its growth, it must find a way to reconcile technological demands with the needs of its residents and the environment.

The $33-Million-Knock



Ida Huddleston (left) and her daughter Delsia Bare. Photograph: Janet Garrison.

Ida Huddleston is 82 years old, and her roots in Mason County, Kentucky, run deeper than the crops she tends. Her familys story is the story of American resilience: her grandfather harvested tobacco when the Civil War erupted, her father plowed wheat through the First World War and the lean years of the Great Depression. Ida and her five siblings were raised on the beans, broccoli, and potatoes pulled from soil once seared by the Dust Bowl. In her family, no one went to college. The land was their education and their life.

But last May, the centuries-old rhythm of the Huddleston farm was interrupted. Two men arrived at Ida’s door with a contract worth $33 million.



The Huddleston farm in Mason county, Kentucky. Photograph: Janet Garrison.

The offer was for her 650-acre farm, but the details were shrouded in secrecy. The men represented an unnamed “Fortune 100 company” seeking land for an unspecified industrial development. To learn anything more, Ida would have to sign a non-disclosure agreement. She wasn’t alone; more than a dozen neighbors received the same mysterious knock.

The community went searching for answers in public records. What they found was staggering: a new customer had applied for a 2.2 gigawatt project from the local power plant, nearly double the plants entire annual generation capacity. The “industrial development” finally had a name: a data centre.



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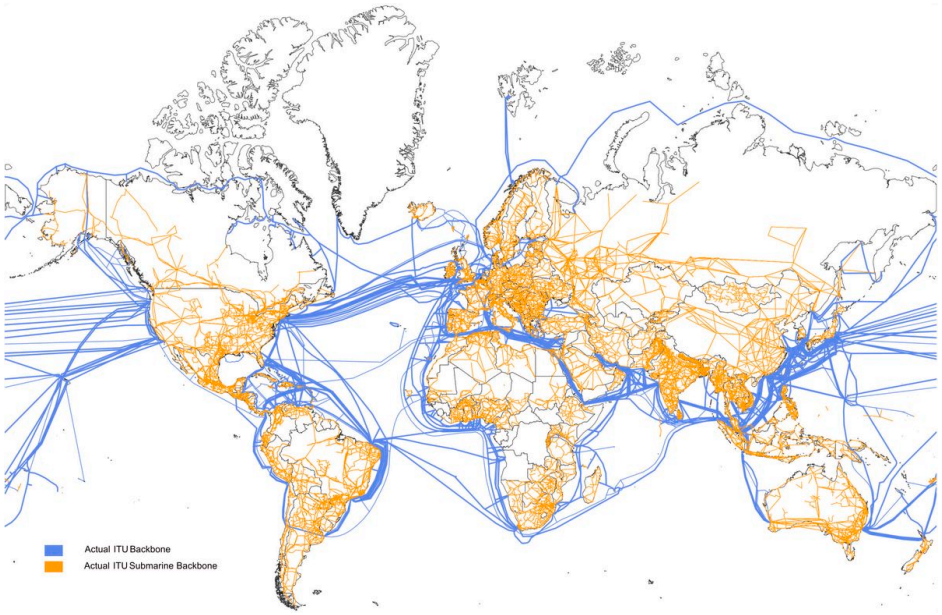
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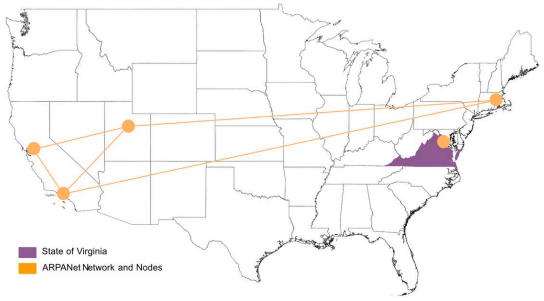
Path Dependency or New Logic?

INFRASTRUCTURAL GENESIS: FROM MILITARY SEED TO GLOBAL BACKBONES

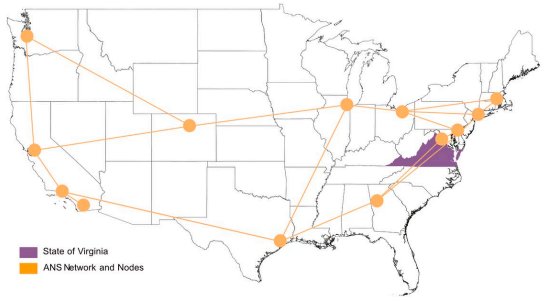


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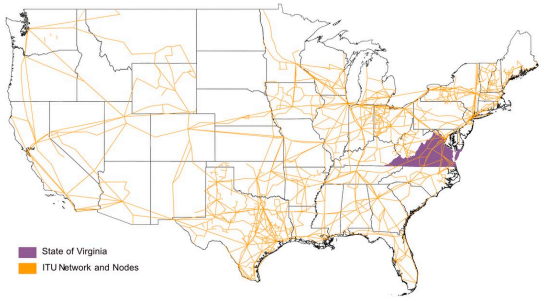
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Advanced Research Projects Agency Network (ARPANet) backbone as the first layer in the 1960s in North America. Map: the authors. Source: ARPANet Network [https://www.junglekey.fr/search.php?query=Arpanet&type=image&lang=fr&region=fr&img=1&adv=1&code=302&dc=1].



ANS (Advanced Network and Services) backbone as the start of a commercial network in the 1990s in North America. Map: the authors. Source: ANS Network [https://cs.stanford.edu/people/eroberts/courses/soco/projects/2003-04/internet-2/architecture.html].



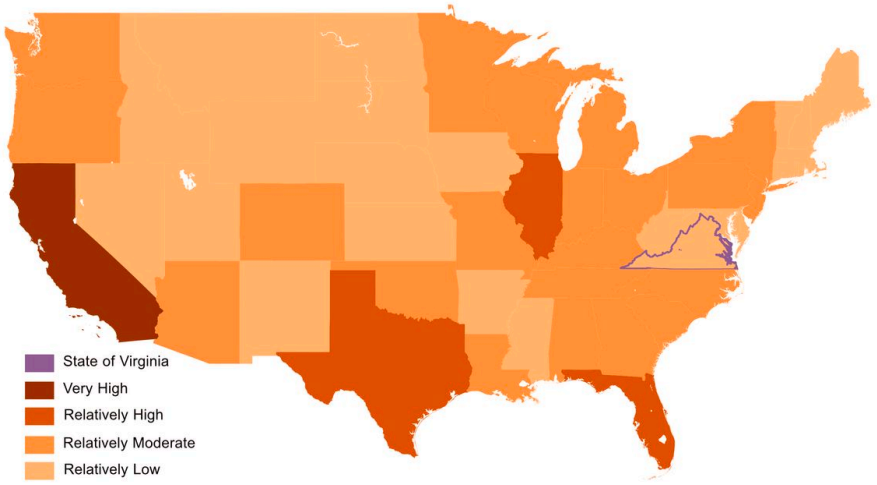
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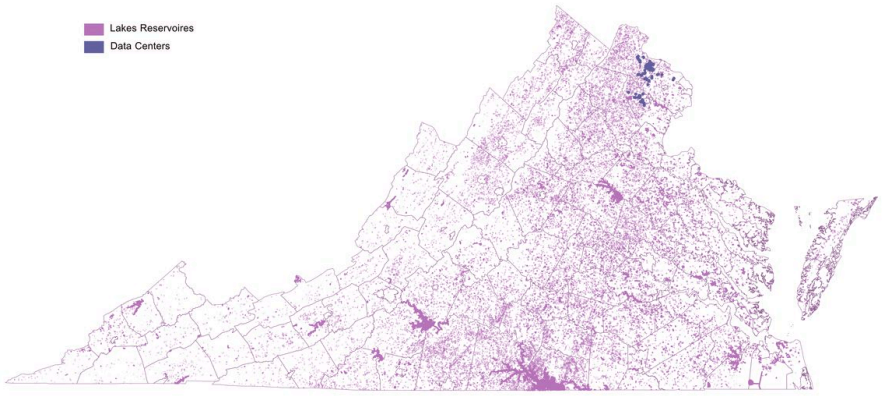
The territory’s definitive hegemony was cemented during the dot-com bubble (1997–2002). As companies collapsed, they left thousands of kilometers of unused underground fibre, known as Dark Fiber, across Virginia. By acquiring this infrastructure at minimal cost, future giants like Amazon Web Services (AWS), Google, and Microsoft laid the foundations for today’s hyperscale era. Now, the dominance of AWS and other tech leaders in the region is fully consolidated.

ENVIRONMENTAL AND STRATEGIC LOGIC:
NATURAL RESILIENCE AND POLITICAL PROXIMITY



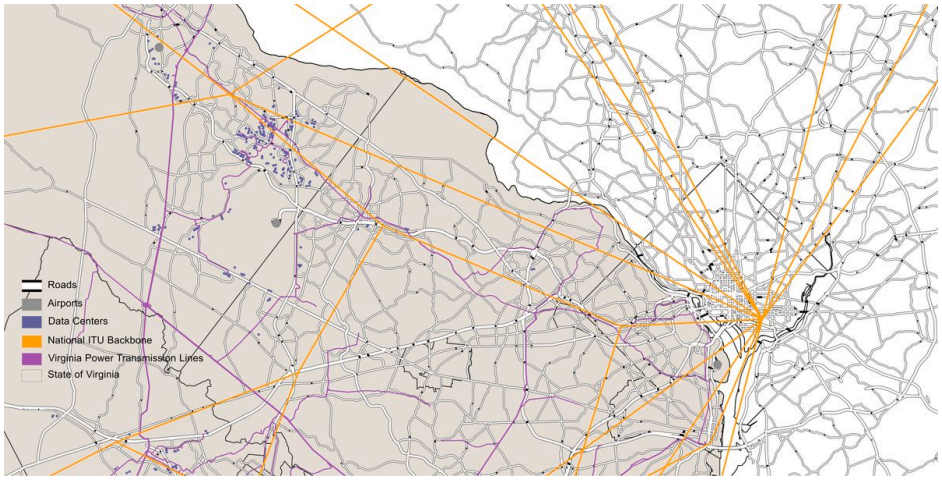
National risk index based on expected annual losses for each state of North America. Map: the authors. Source: National Risk Index [https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_methodology-hazards-overview.pdf].

The stability of a data centre is threatened by climatic hazards, as every extreme natural event poses a danger to operational continuity and the physical integrity of data. Northern Virginia has a relatively low overall risk profile. Minimising hazards means eliminating the variables that cause power outages, flood damage, or other issues. In this context, the territory is not only a physical support, but also acts as an environmental shield that lowers insurance costs and protects investments, making geological safety an economic asset.



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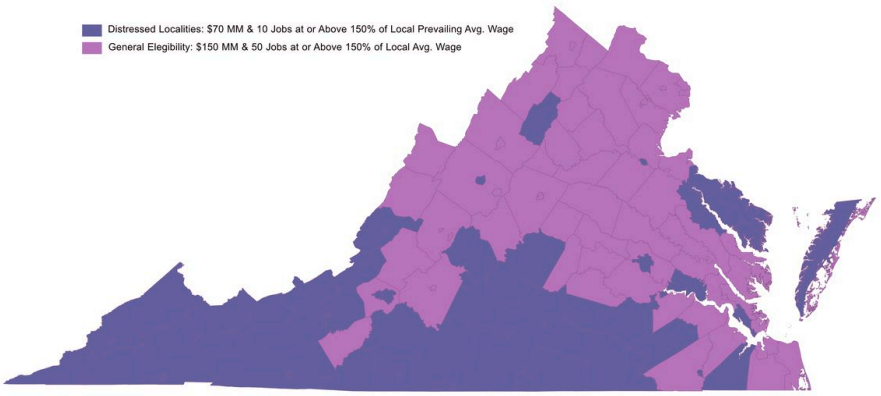
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REGULATORY ACCELERATION: JURISDICTIONAL ADVANTAGE AND SPEED

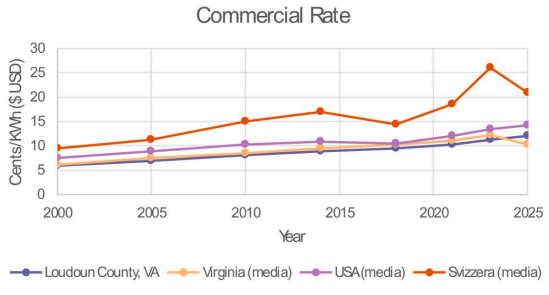


Data centre tax incentive zones in Virginia. Map: the authors. Source: Tax Incentive [https://www.vedp.org/incentive/data-center-retail-sales-use-tax-exemption].

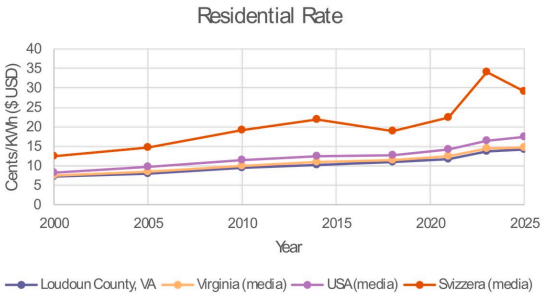
Virginia's fiscal policy acts as a spatial orientation device for capital, modulating incentive thresholds to effectively govern the density of data centre clusters. In Northern Virginia, access to tax exemptions requires a substantial $150 million investment and the creation of 50 jobs, whereas in distressed localities, these requirements are lowered to $70 million and 10 jobs. This tiered system strategically attracts hyperscalers to the north, securing massive, long-term revenues and a stable industrial fabric for the state. By demanding such significant capital, the policy limits industrial fragmentation and favors the development of permanent, large-scale infrastructure.

Beyond these tax advantages, Northern Virginia's competitive edge is defined by its remarkable bureaucratic velocity. Through the "By-Right Development" model, land already zoned for industrial or office use can bypass public hearings and council votes, as the intended use is considered a pre-approved right. This administrative acceleration compresses approval timelines to just a few months—significantly faster than in other global tech hubs. This efficiency transforms the jurisdiction into a true business accelerator, allowing the region to meet the near real-time infrastructure demands of the global cloud market.

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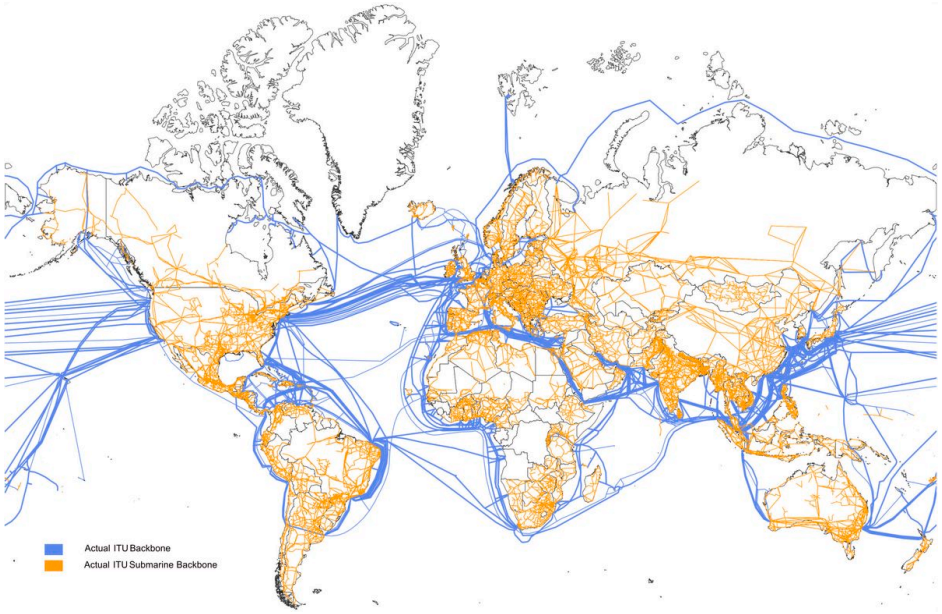
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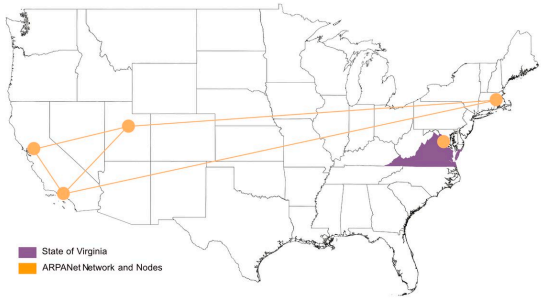
Beyond energy costs, the region's success stems from data centres acting as "ideal tenants" for local authorities, providing a massive, constant source of tax revenue with minimal public overhead. Loudoun County collects hundreds of millions of dollars annually from these facilities, covering a significant portion of its public budget. Crucially, unlike residential developments, data centres do not require schools, extensive public transport, or healthcare services. They occupy land needing only power and water, often privately funded, creating a financial surplus. This asymmetry allows authorities to keep citizen taxes low while financing high-quality public projects, creating a paradox where digital infrastructure materially subsidises local quality of life.

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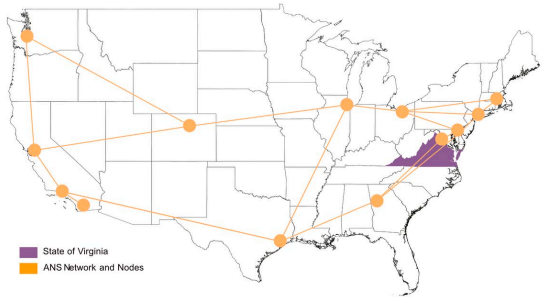


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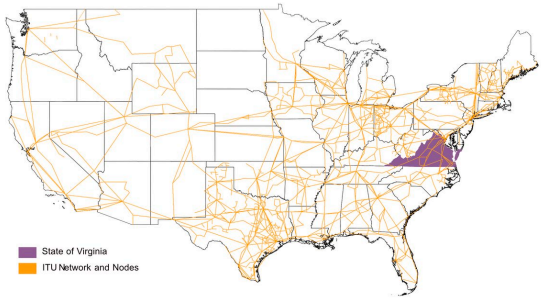
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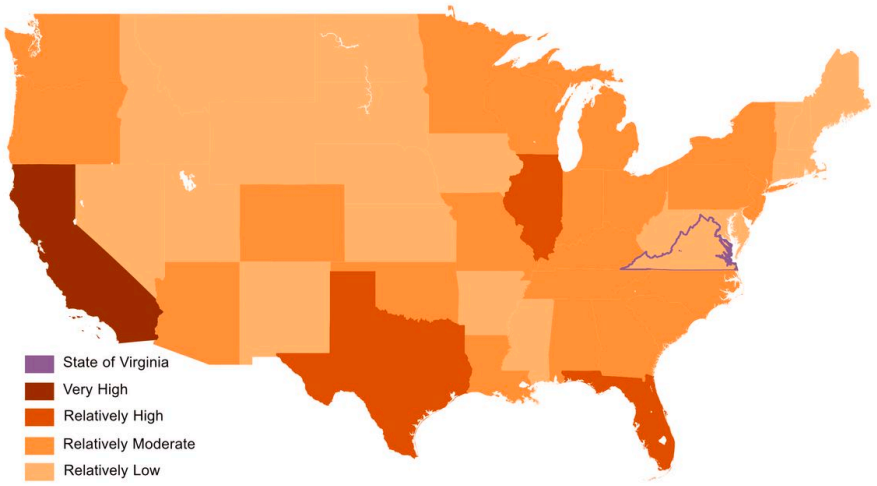
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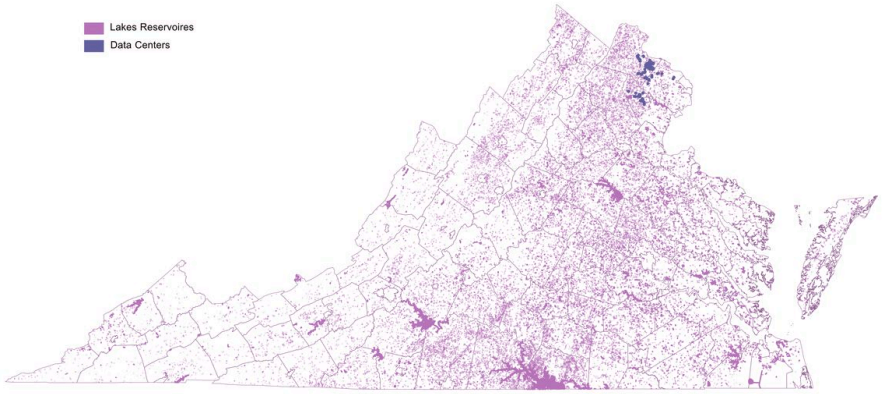
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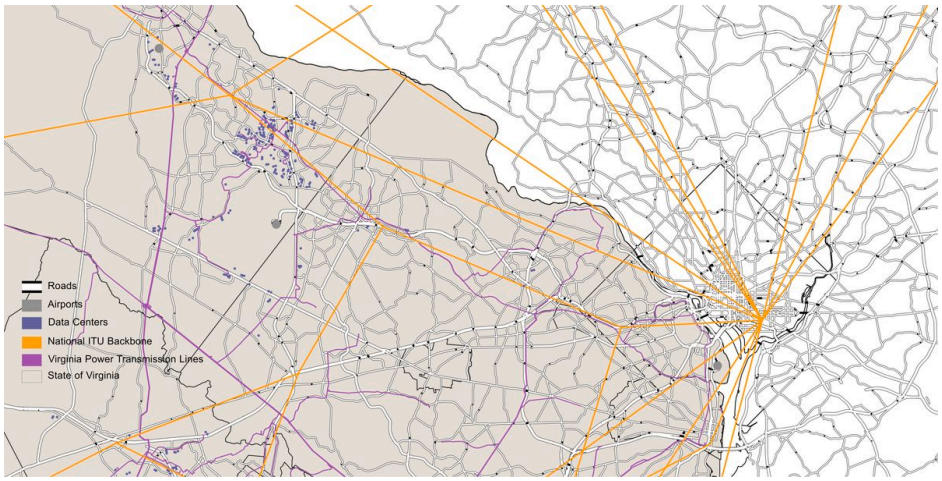
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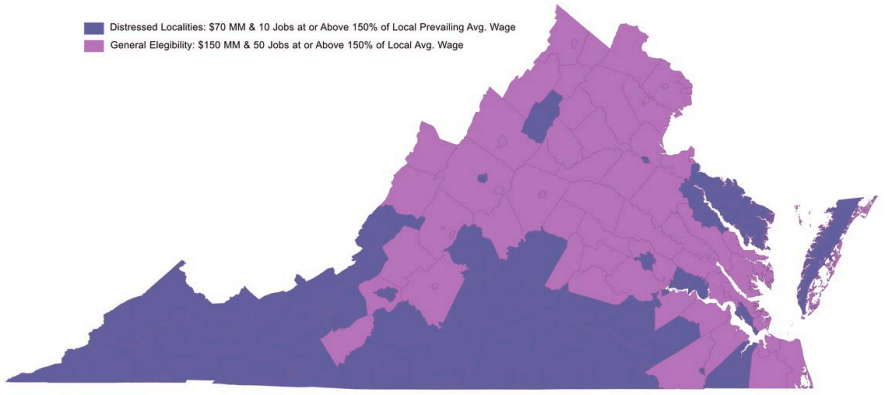
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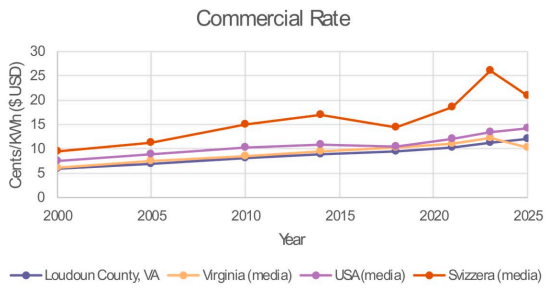


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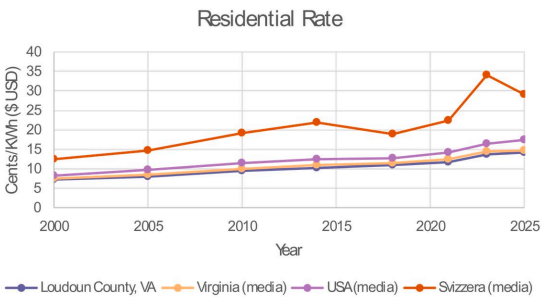
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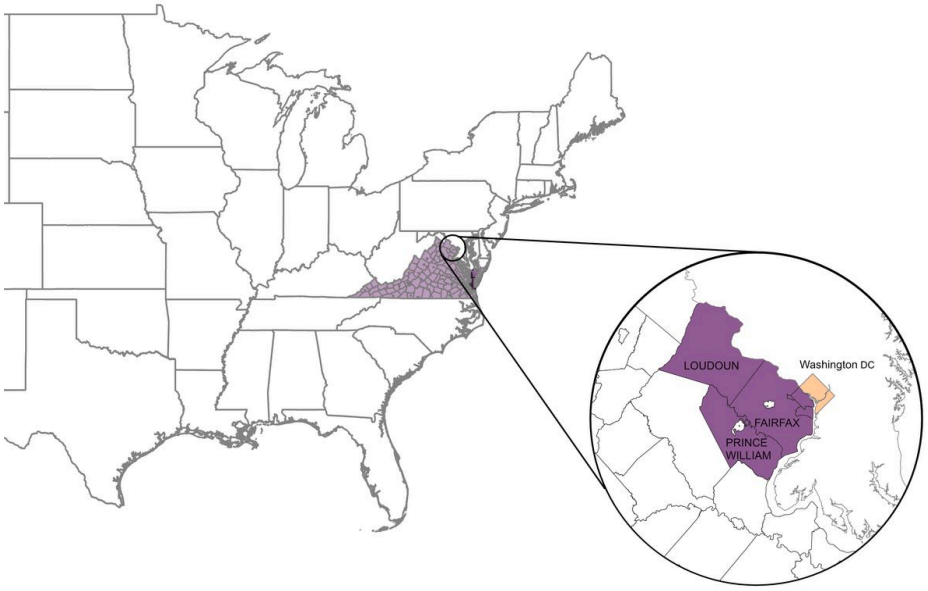
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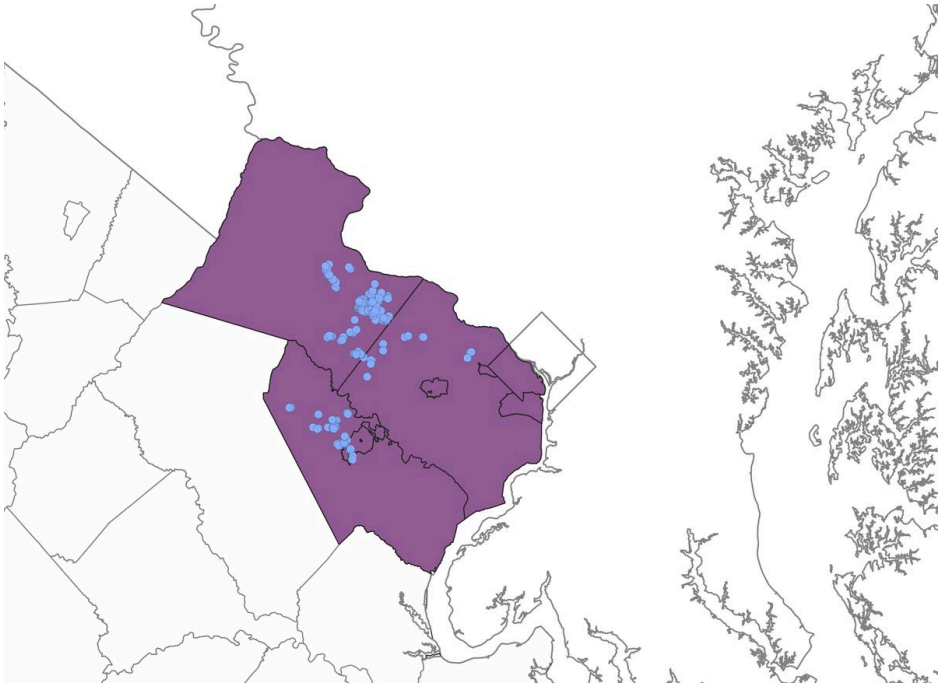
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Anatomy of the World's Largest Data Centre Cluster



Location of the Northern Virginia data centre cluster near Washington, D.C.

Northern Virginia has emerged as the largest data centre cluster in the world. Located at the intersection of major fibre corridors and within close proximity to Washington D.C., the region concentrates a critical share of the infrastructure that supports global cloud services, digital platforms, and financial networks. Over the past two decades, this accumulation of digital infrastructure has transformed the suburban landscape into a strategic node of the global internet.



Data centre concentration across Loudoun, Fairfax, and Prince William Counties.

Data centres in Northern Virginia are not evenly distributed but concentrated within three counties: Loudoun, Fairfax, and Prince William. This spatial clustering reflects the presence of fibre network corridors, available land for large-scale campuses, and direct proximity to Washington, D.C. As a result, suburban landscapes have been progressively transformed into specialised zones of digital infrastructure, forming the core of what is commonly referred to as “Data Center Alley.”

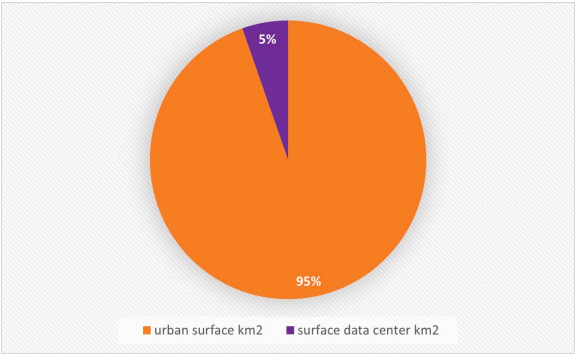
County / Region	# of Data Centers	Data Center Area (km^2)
Loudoun County	115	2.51
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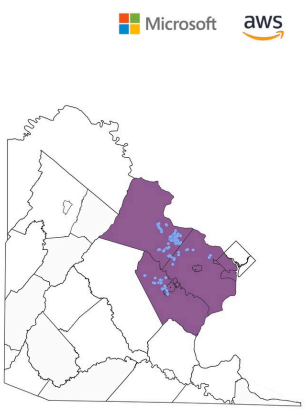


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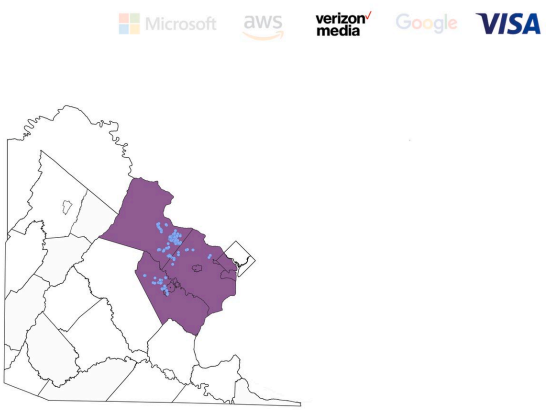


Percentage of land used by data centres in Ashburn.

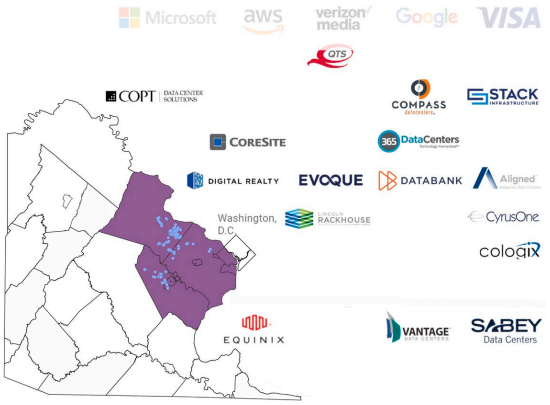
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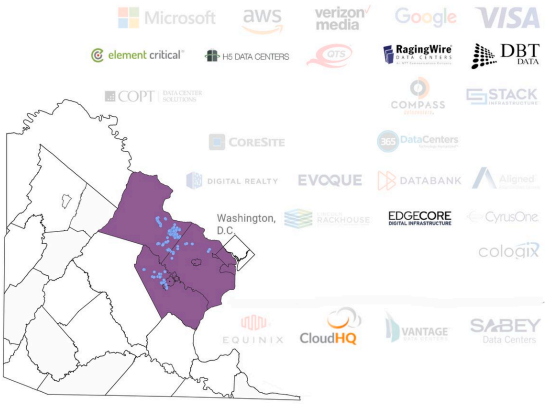
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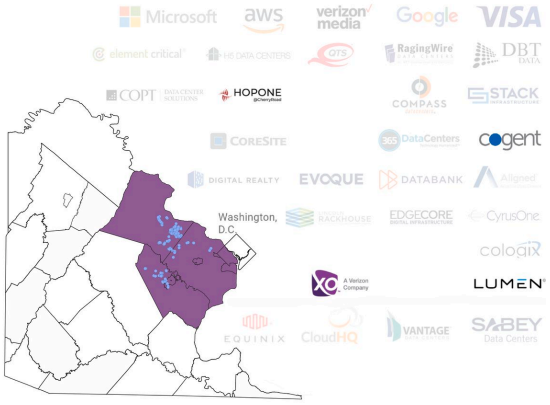
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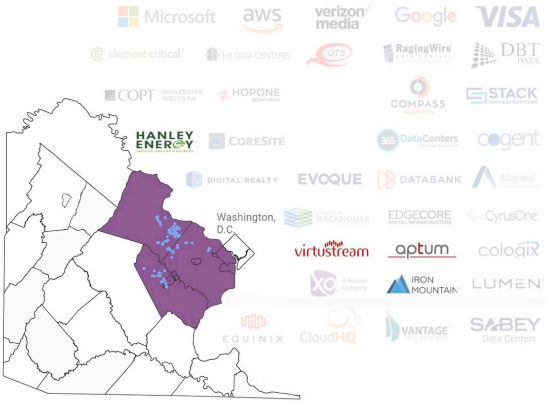
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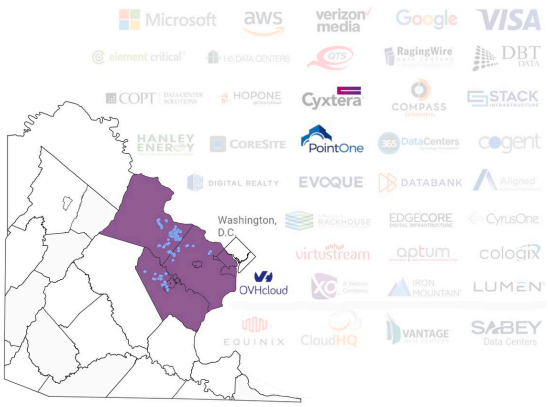
HYPERSCALE DEVELOPERS



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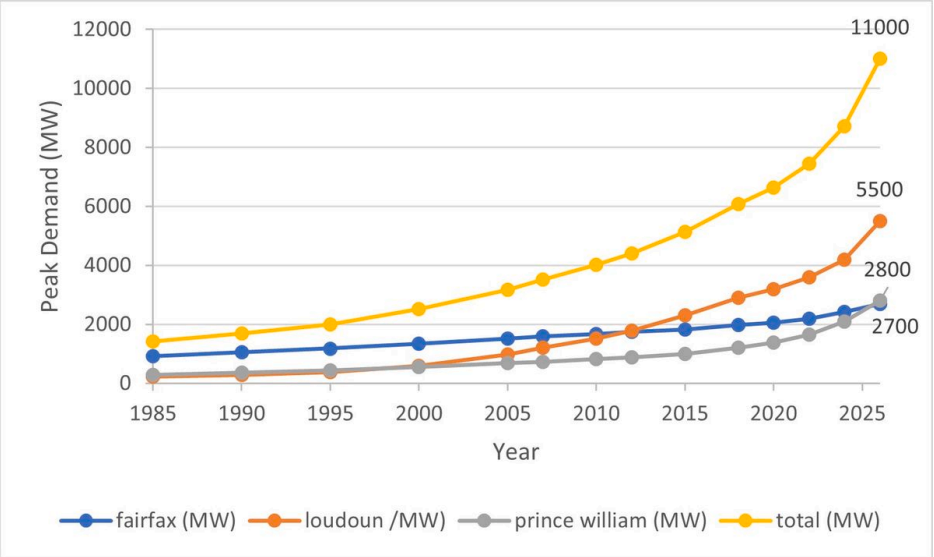
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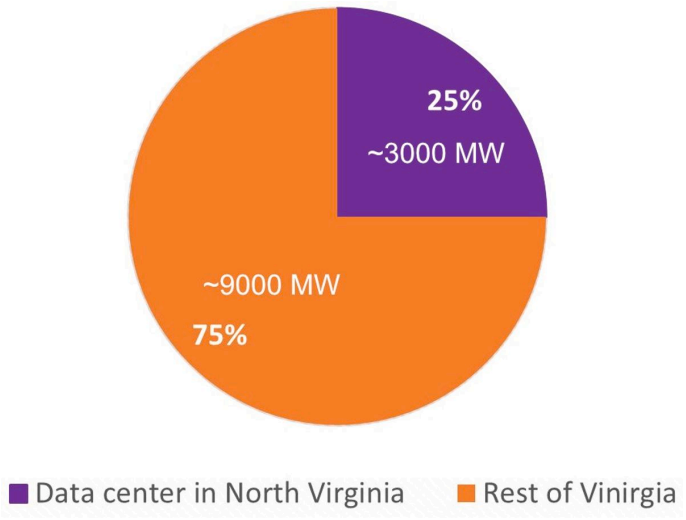
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A key role is played by colocation providers, companies that build and operate data centres and rent space, power, and cooling to customers who install and manage their own servers. Supporting the rapid expansion of cloud infrastructure are hyperscale developers, firms that specialise in developing and constructing large data centre campuses, often designed specifically for hyperscale cloud providers. Network and telecom operators are also essential, as they provide the backbone connectivity that links data centres to the global internet and ensures fast data transmission. In addition, infrastructure and IT service providers contribute engineering expertise, energy systems, and technical solutions required to build, operate, and maintain these facilities. Finally, other cloud and infrastructure platforms offer hosting and cloud services at a smaller scale, complementing the ecosystem and providing additional digital infrastructure for businesses and organisations

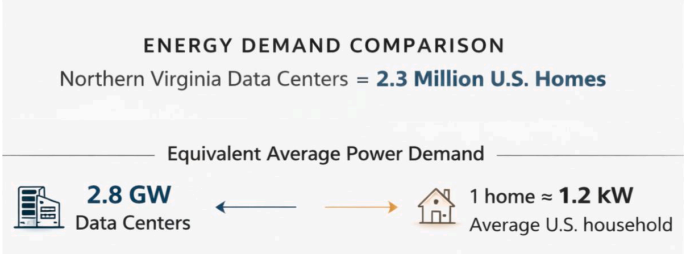


Electricity demand from data centres has grown exponentially since 1985.

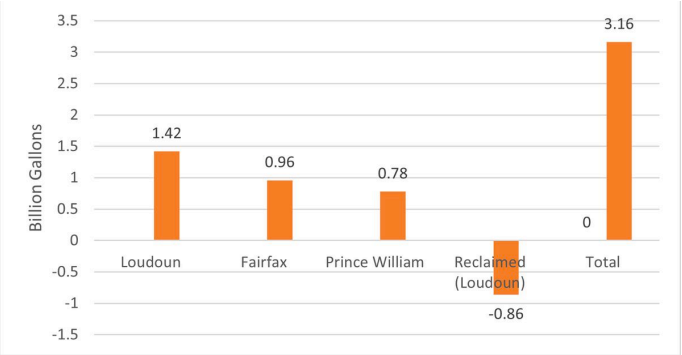
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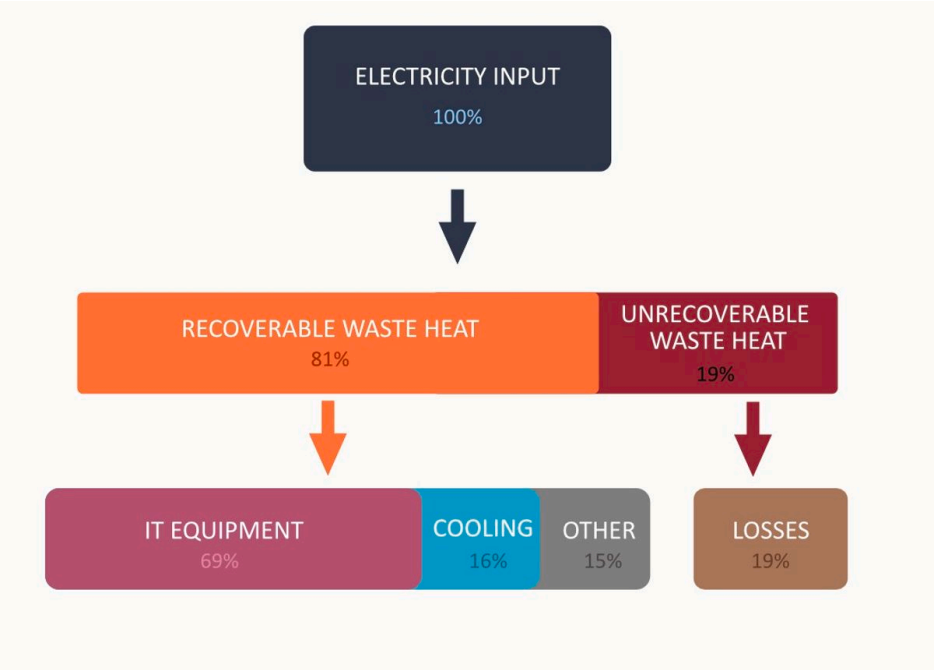


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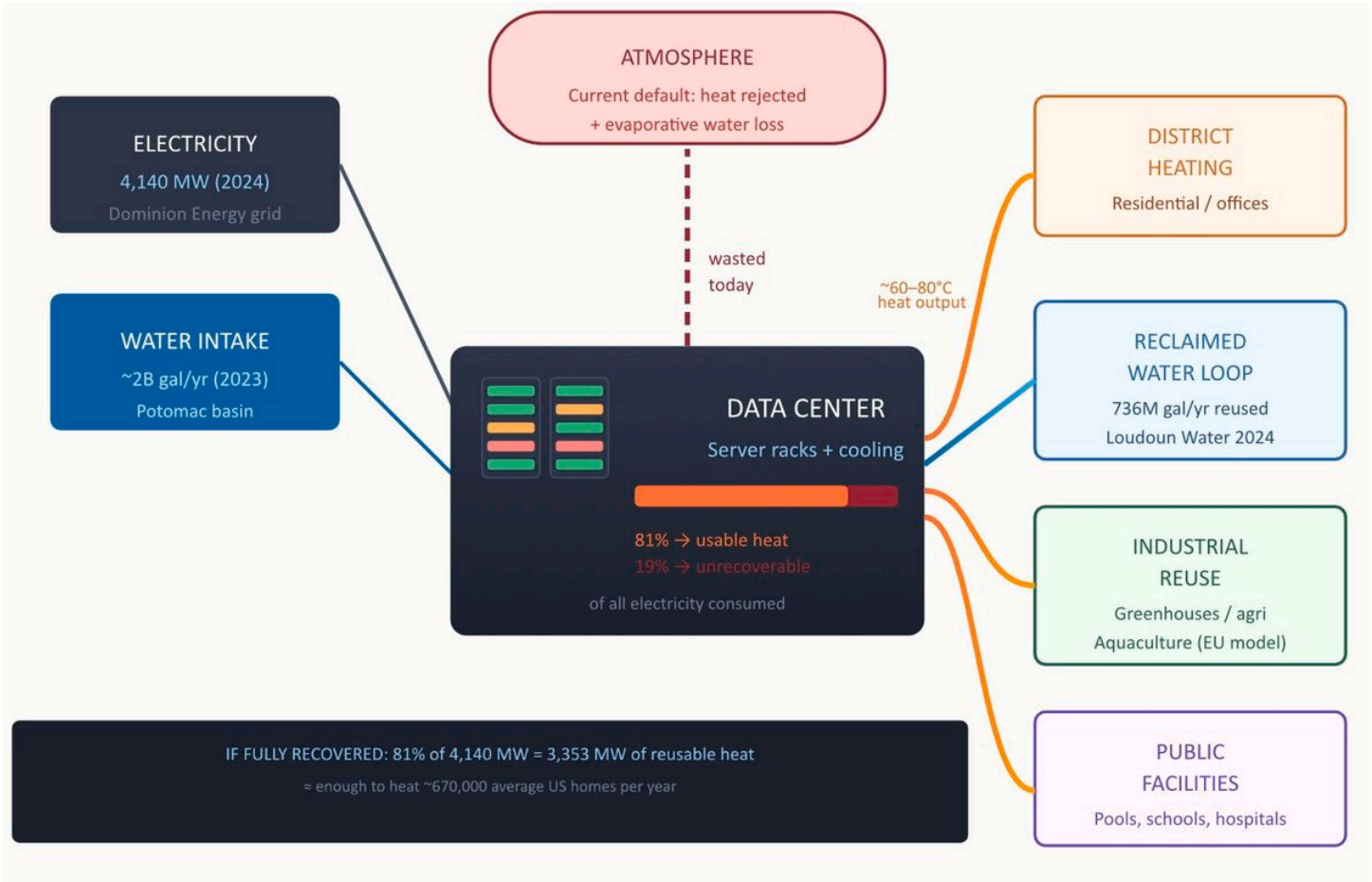


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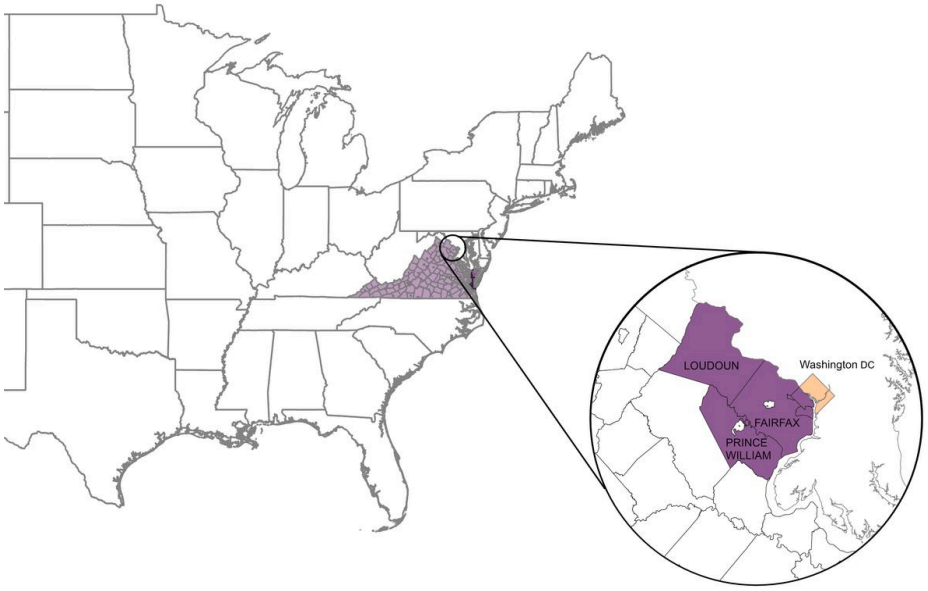


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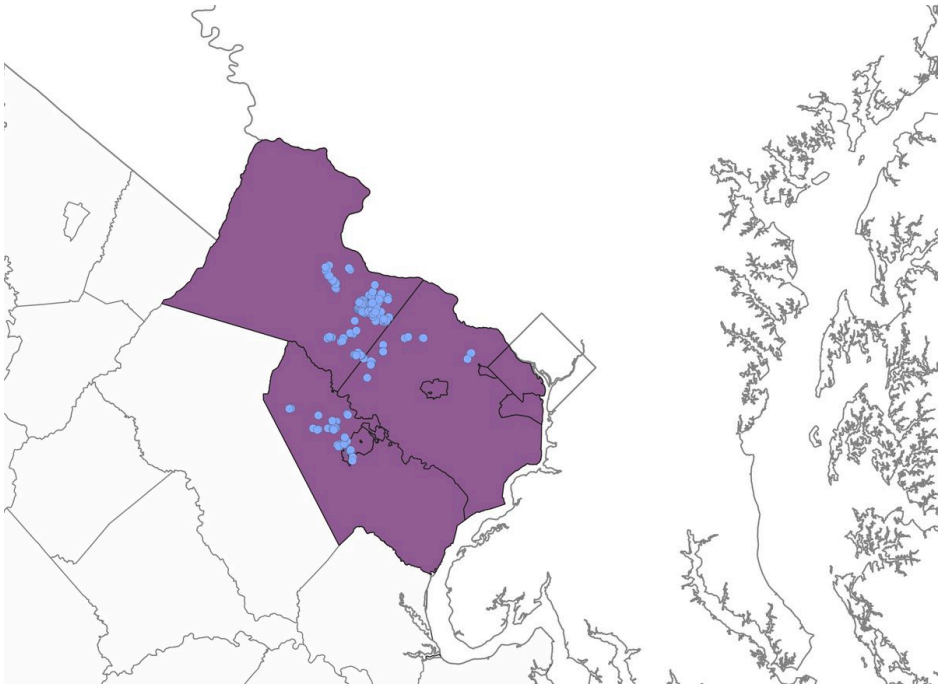
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Location of the Northern Virginia data centre cluster near Washington, D.C.

Northern Virginia has emerged as the largest data centre cluster in the world. Located at the intersection of major fibre corridors and within close proximity to Washington D.C., the region concentrates a critical share of the infrastructure that supports global cloud services, digital platforms, and financial networks. Over the past two decades, this accumulation of digital infrastructure has transformed the suburban landscape into a strategic node of the global internet.



Data centre concentration across Loudoun, Fairfax, and Prince William Counties.

Data centres in Northern Virginia are not evenly distributed but concentrated within three counties: Loudoun, Fairfax, and Prince William. This spatial clustering reflects the presence of fibre network corridors, available land for large-scale campuses, and direct proximity to Washington, D.C. As a result, suburban landscapes have been progressively transformed into specialised zones of digital infrastructure, forming the core of what is commonly referred to as “Data Center Alley.”

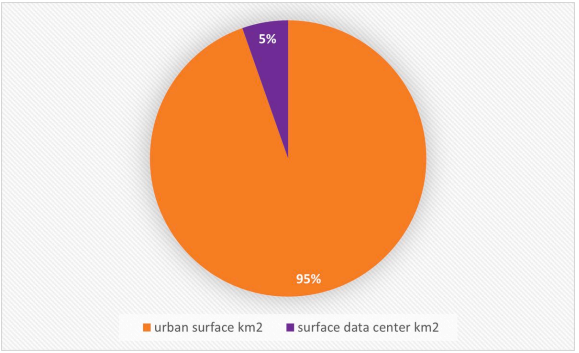
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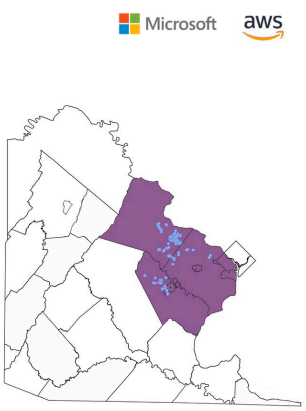


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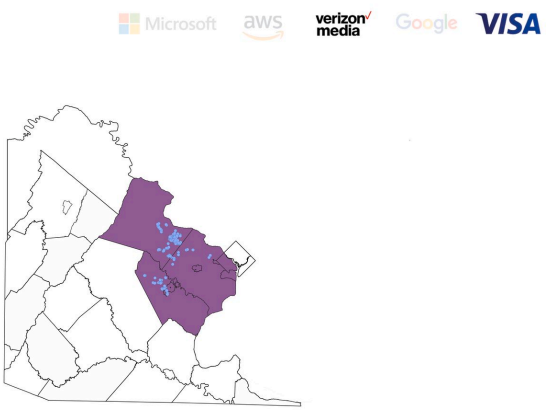


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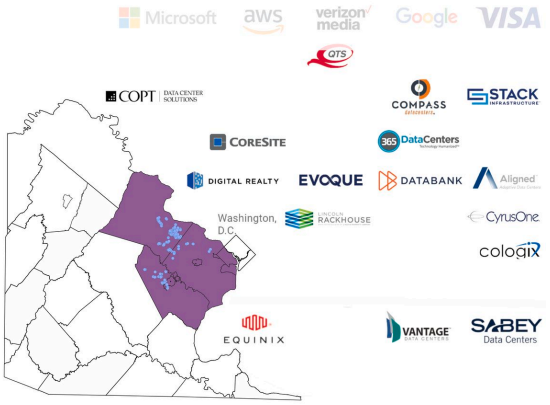
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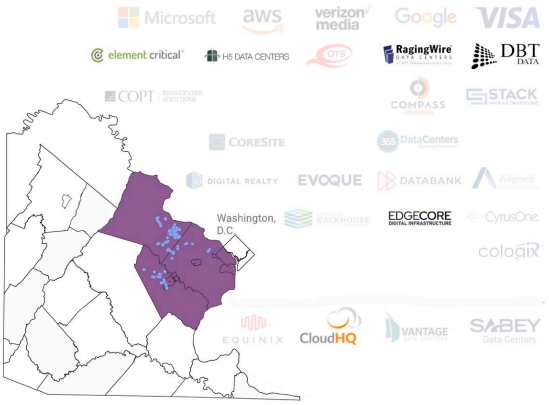
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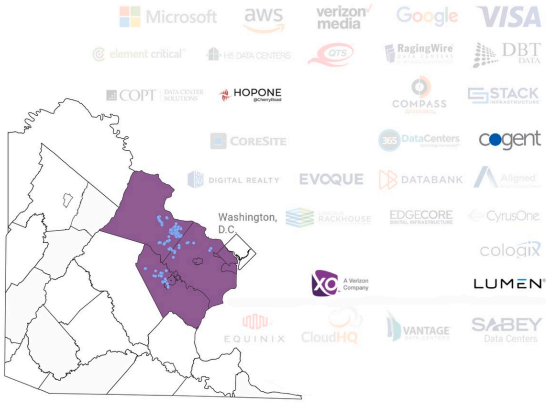
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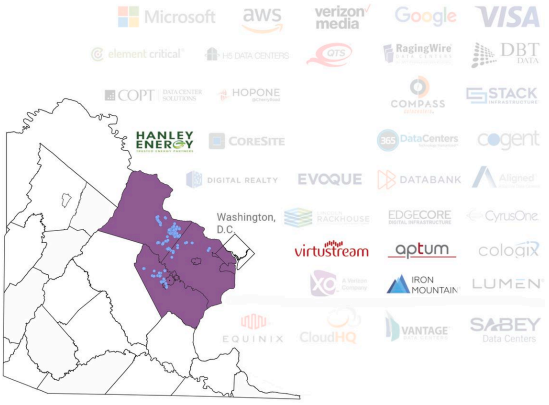
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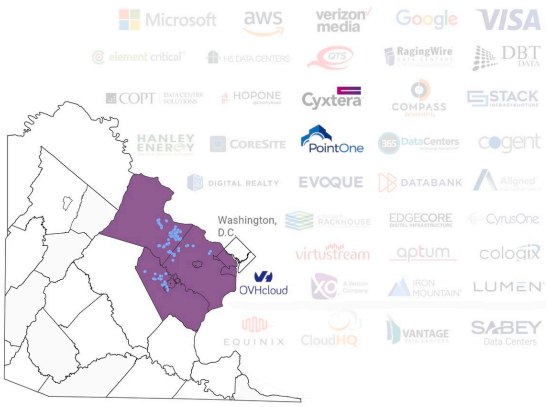
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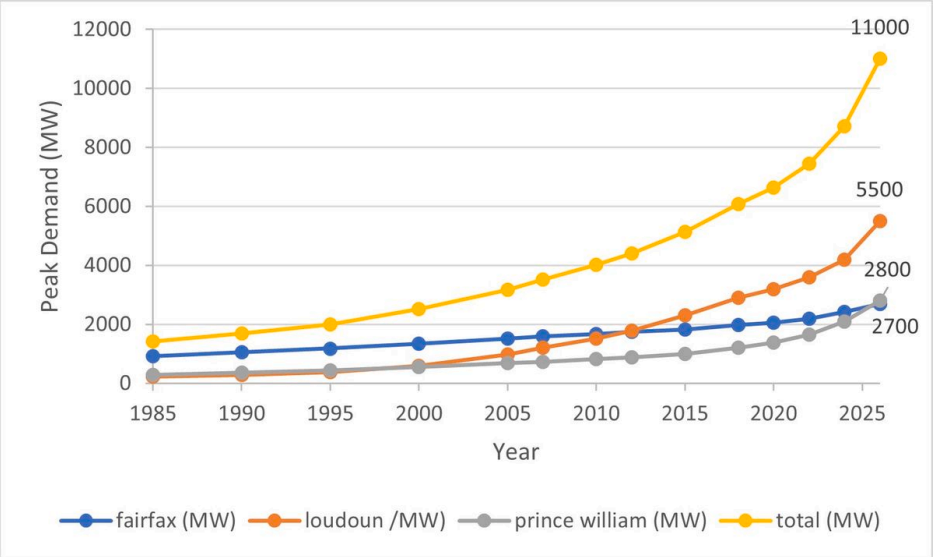
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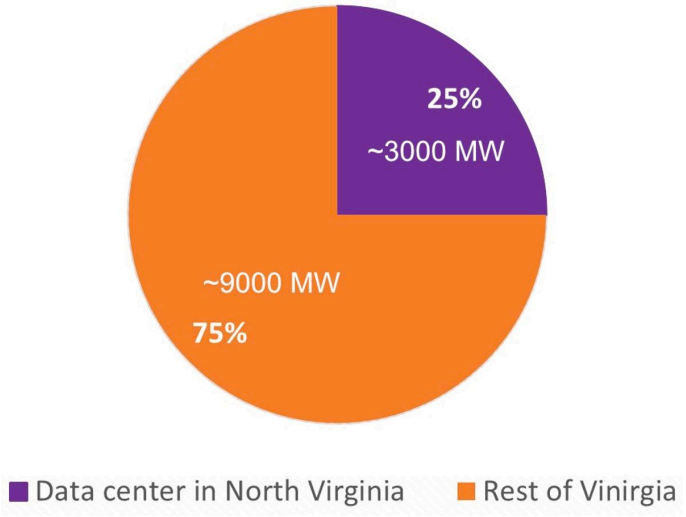
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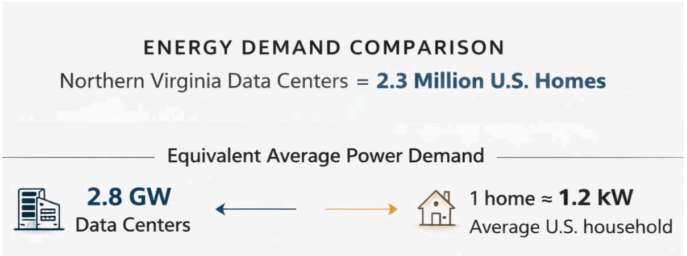


Electricity demand from data centres has grown exponentially since 1985.

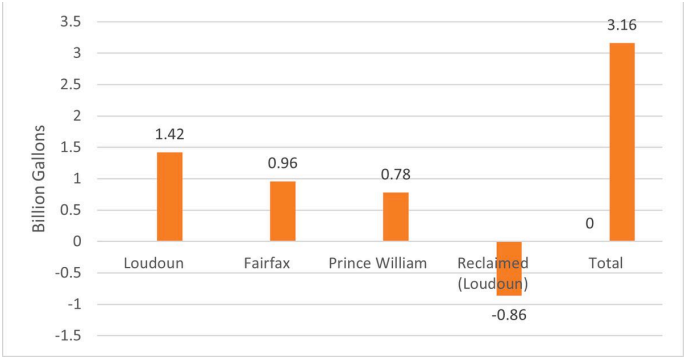
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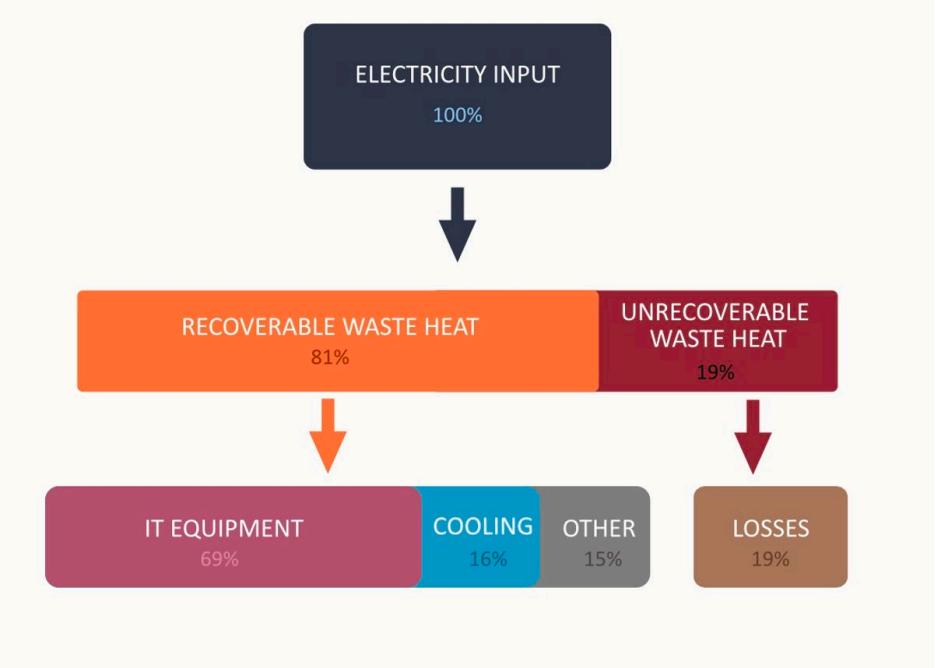


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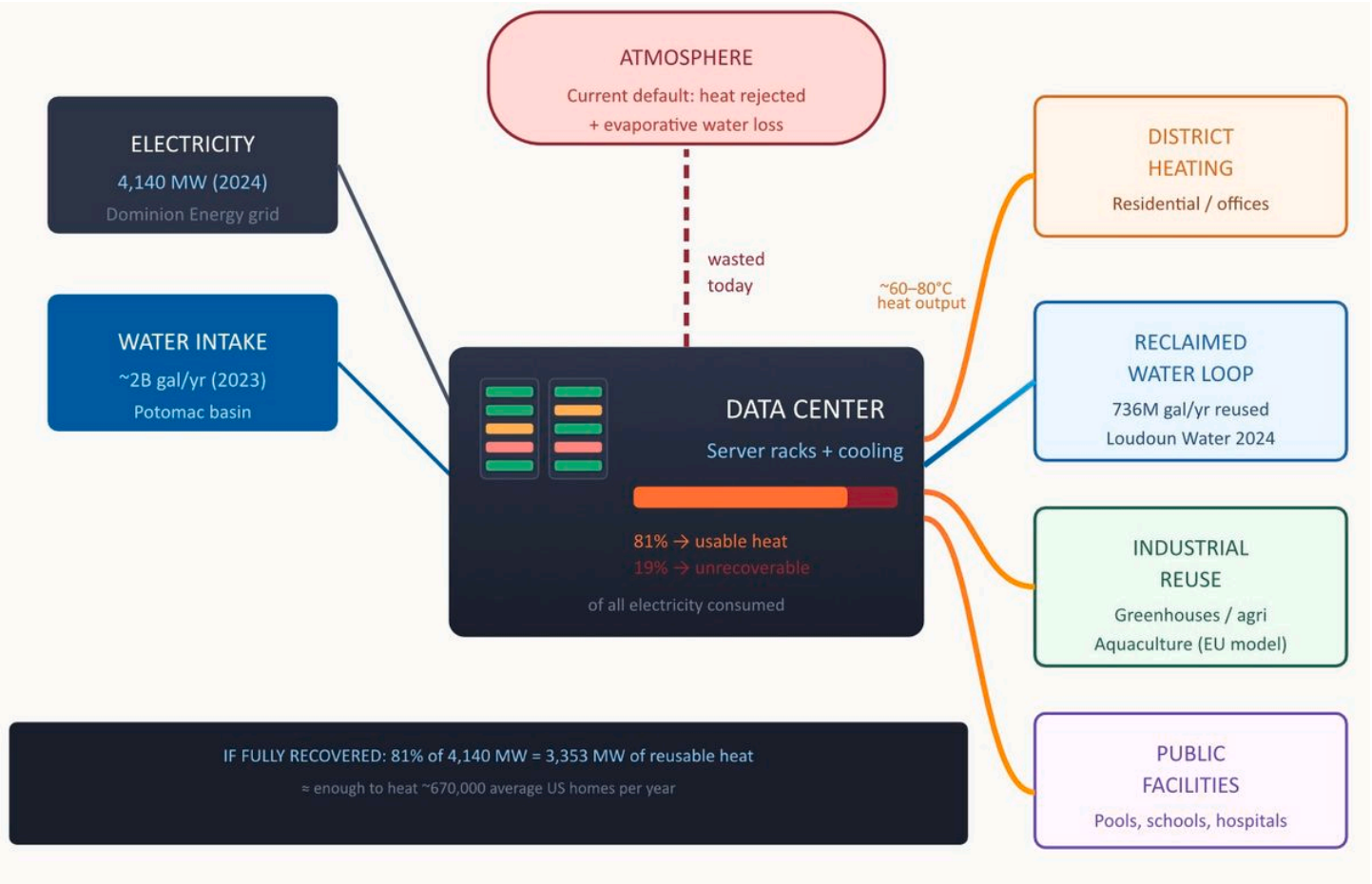


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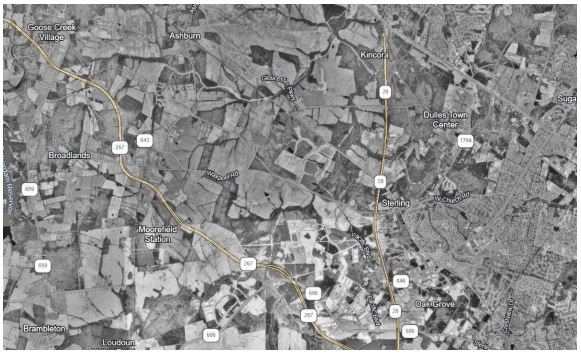
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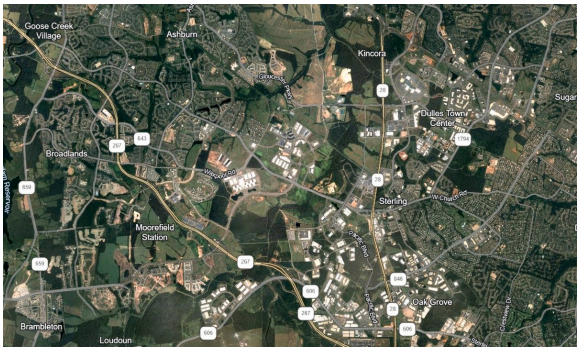
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The Data Centre Backlash

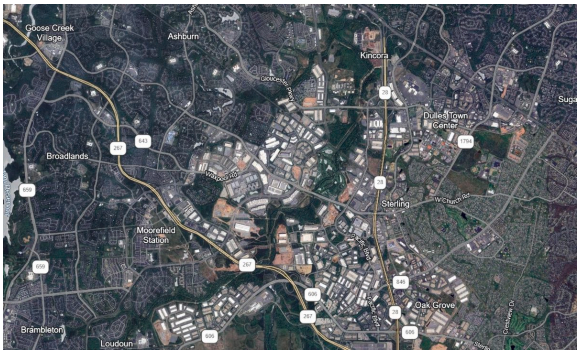
FROM FARMWELL TO FIBRE



Ashburn, VA, 1991.

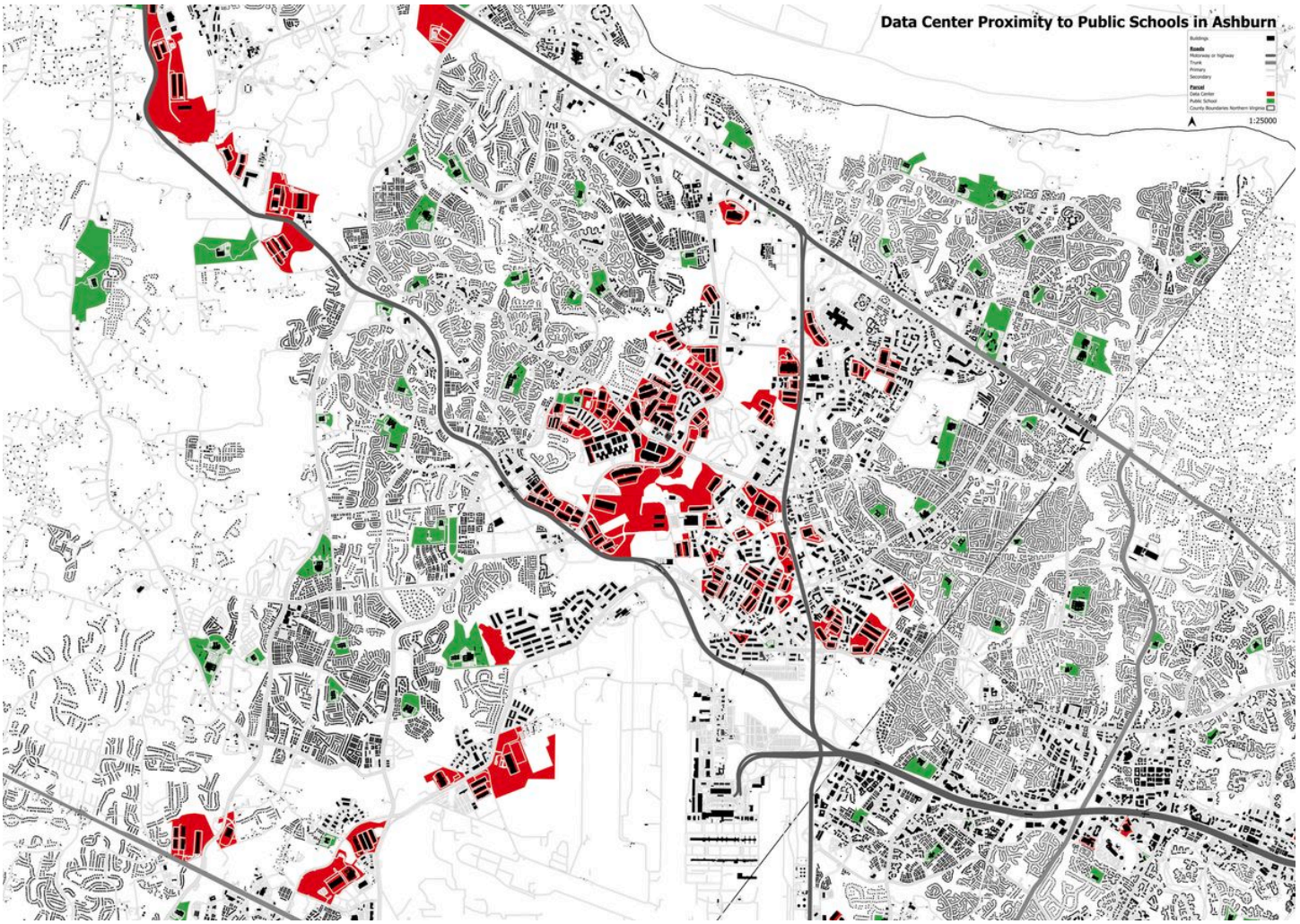


Ashburn, VA, 2003.



Ashburn, VA, 2025.

In 1991, if you visited Ashburn, Virginia, you would have known it as “Farmwell.” It was a village of silos, soil, and families who had worked the land for generations. By 2002, the arrival of the internet changed everything. Today, Ashburn is no longer a village; it is the “Godfather of Data Centers,” a concrete jungle of servers that powers our global digital life. But as this “digital frontier” expands, it is colliding head-on with the people who still live on the land.



Data centre proximity to public schools in Ashburn. Drawing: the authors.

In Ashburn, large data centre developments (red) are located directly adjacent to local public schools (green). This close proximity illustrates how industrial-scale digital infrastructure has been integrated into the daily life of residential neighborhoods, often separated by only a single road or property lines. As Ashburn has transformed into a global technology hub, the shared landscape between server farms and educational spaces has become a visible symbol of the ongoing tension between rapid technological expansion and community-focused urban planning.



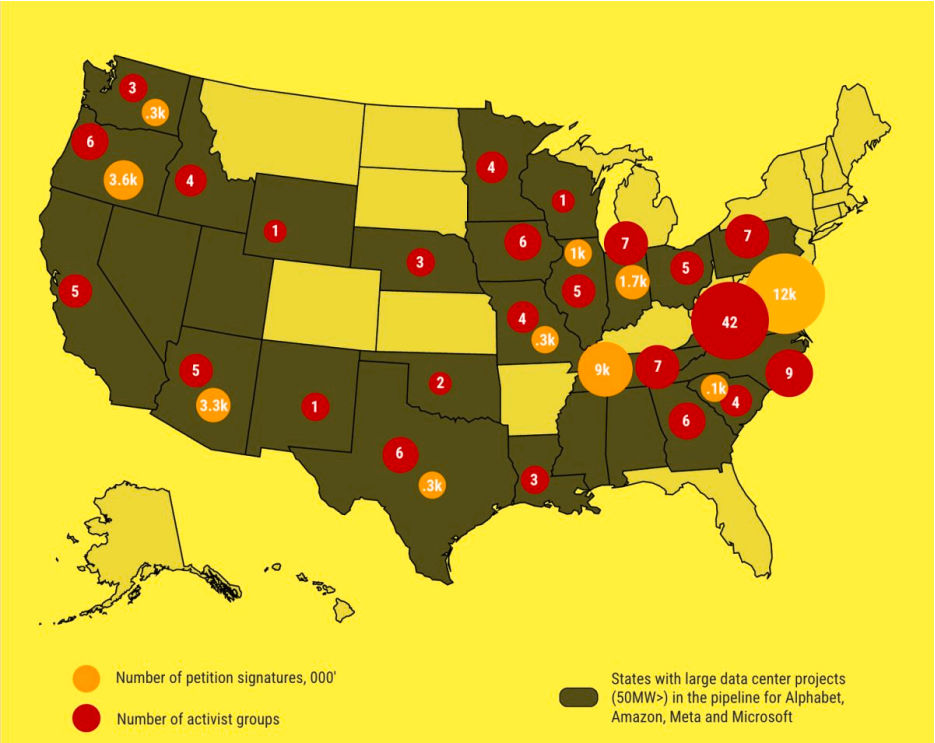
A protest against a data centr4 in Saline, Michigan, on 1 December 2025. Photograph: Jim West, Universal West.



Data centre reform coalition, Peidmont Environmental Council, 2018.

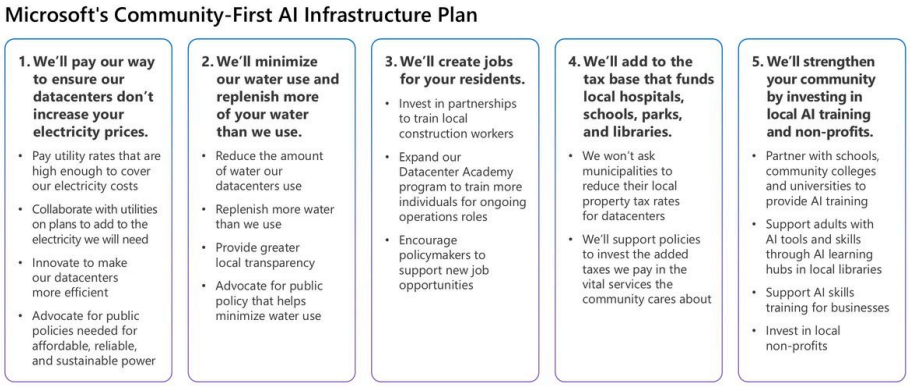
This collision is no longer just a local story in Virginia; it has become a national flashpoint. From the heartland of Kentucky to the tech corridors of the East, $64 billion for US data centre projects are currently blocked or delayed as a rare wave of bipartisan opposition takes hold.

This resistance bridges the political divide: while Republicans sound the alarm over energy grid strain and corporate tax breaks, Democrats are fighting for water conservation and environmental protection. Together, they are obstructing construction and championing restrictive zoning, effectively demanding that the “quiet infrastructure” of the cloud finally answer to the people on the ground.



"Data Center Watch": https://www.datacenterwatch.org/report [https://www.datacenterwatch.org/report]

INDUSTRY REACTIONS



Microsoft's 5 point plan: https://blogs.microsoft.com/on-the-issues/2026/01/13/community-first-ai-infrastructure/ [https://blogs.microsoft.com/on-the-issues/2026/01/13/community-first-ai-infrastructure/]

In response, tech giants like Microsoft and Amazon are abandoning their secretive "stealth mode." The industry is shifting toward a "Community-First" model, offering legally binding agreements to replenish local water, fund schools and hospitals, and pay for their own grid upgrades.

PRESERVING THE PAST



Environmental activist Gem Bingol in front of the historic slave cemetery. Photograph: Cheriss May, 2025.

As activists like Gem Bingol fight to protect historic sites, such as slave cemeteries now surrounded by the beeping of excavators, the message is clear: the digital future cannot come at the cost of our physical heritage. The next decade will be defined by this fragile negotiation between our global demand for data and our local desire to protect the land that fed us long before the “cloud” existed.

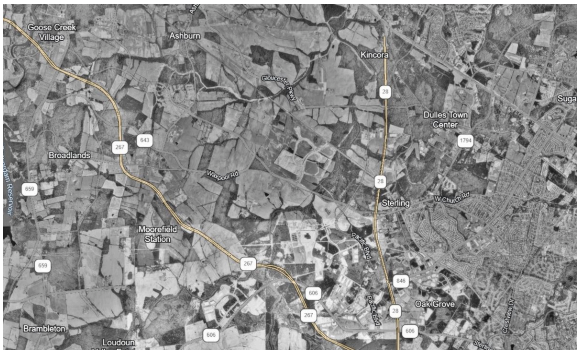
FUTURE COEXISTENCE



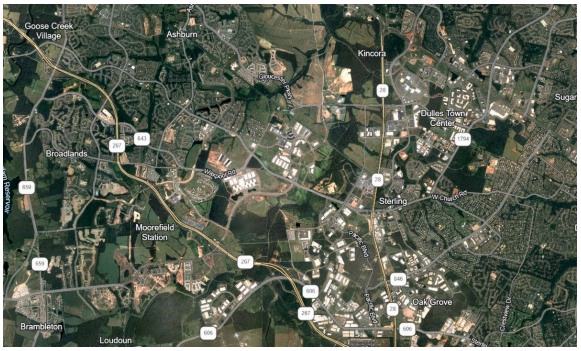
An aerial view shows a data centre situated near single-family homes in Stone Ridge, Va., in 2024. Photograph: Nathan Howard.

The future of the American landscape will be defined by a fragile negotiation between global demand of data centres and local demands of daily life. Ultimately, the success of this “data centre boom” will depend on whether Big Tech can truly coexist with the communities they inhabit, ensuring that the progress of tomorrow does not come at the cost of the heritage and resources of today.

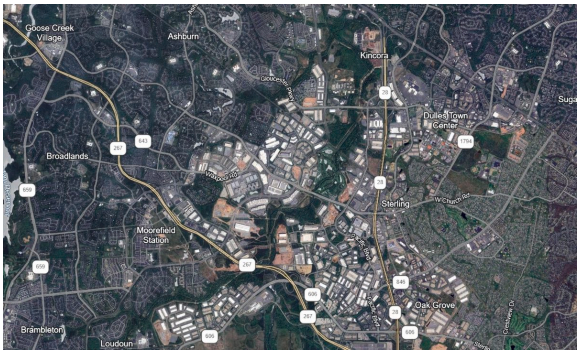
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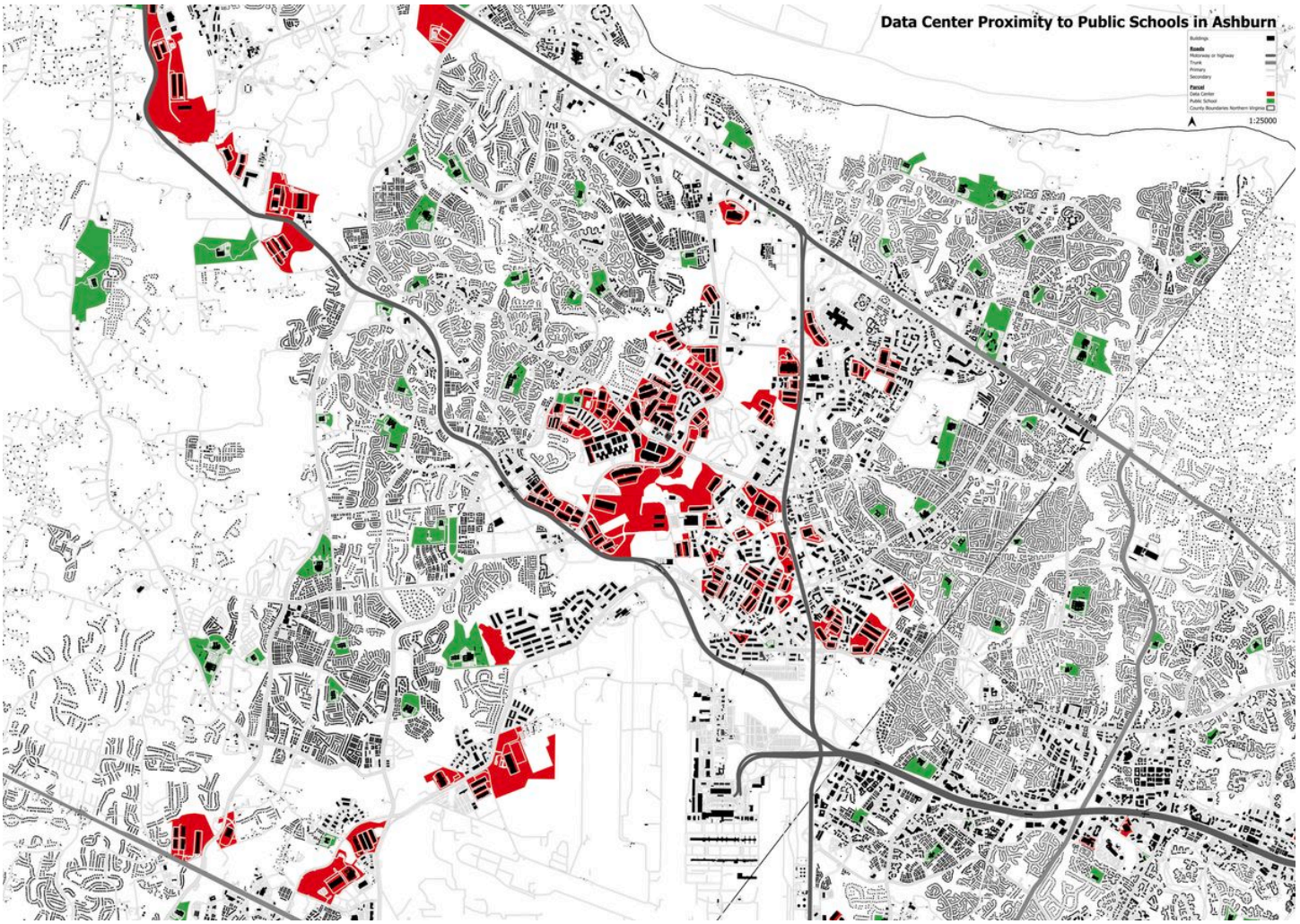


Ashburn, VA, 2003.



Ashburn, VA, 2025.

In 1991, if you visited Ashburn, Virginia, you would have known it as “Farmwell.” It was a village of silos, soil, and families who had worked the land for generations. By 2002, the arrival of the internet changed everything. Today, Ashburn is no longer a village; it is the “Godfather of Data Centers,” a concrete jungle of servers that powers our global digital life. But as this “digital frontier” expands, it is colliding head-on with the people who still live on the land.



Data centre proximity to public schools in Ashburn. Drawing: the authors.

In Ashburn, large data centre developments (red) are located directly adjacent to local public schools (green). This close proximity illustrates how industrial-scale digital infrastructure has been integrated into the daily life of residential neighborhoods, often separated by only a single road or property lines. As Ashburn has transformed into a global technology hub, the shared landscape between server farms and educational spaces has become a visible symbol of the ongoing tension between rapid technological expansion and community-focused urban planning.



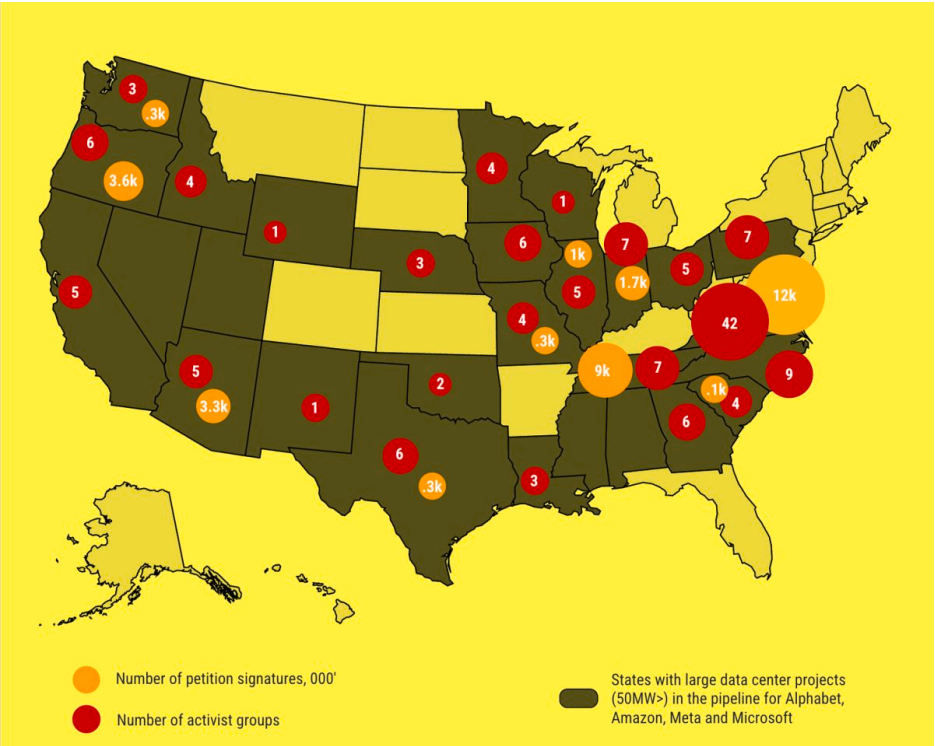
A protest against a data centr4 in Saline, Michigan, on 1 December 2025. Photograph: Jim West, Universal West.



Data centre reform coalition, Peidmont Environmental Council, 2018.

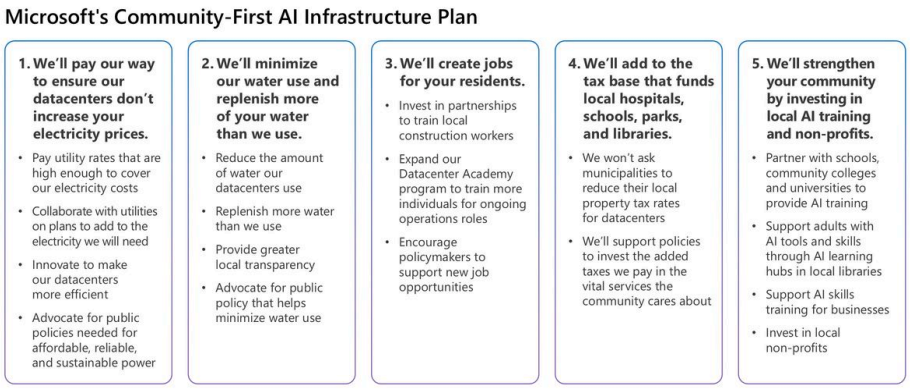
This collision is no longer just a local story in Virginia; it has become a national flashpoint. From the heartland of Kentucky to the tech corridors of the East, $64 billion for US data centre projects are currently blocked or delayed as a rare wave of bipartisan opposition takes hold.

This resistance bridges the political divide: while Republicans sound the alarm over energy grid strain and corporate tax breaks, Democrats are fighting for water conservation and environmental protection. Together, they are obstructing construction and championing restrictive zoning, effectively demanding that the “quiet infrastructure” of the cloud finally answer to the people on the ground.



"Data Center Watch": https://www.datacenterwatch.org/report [https://www.datacenterwatch.org/report]

INDUSTRY REACTIONS



Microsoft's 5 point plan: https://blogs.microsoft.com/on-the-issues/2026/01/13/community-first-ai-infrastructure/ [https://blogs.microsoft.com/on-the-issues/2026/01/13/community-first-ai-infrastructure/]

In response, tech giants like Microsoft and Amazon are abandoning their secretive "stealth mode." The industry is shifting toward a "Community-First" model, offering legally binding agreements to replenish local water, fund schools and hospitals, and pay for their own grid upgrades.

PRESERVING THE PAST



Environmental activist Gem Bingol in front of the historic slave cemetery. Photograph: Cheriss May, 2025.

As activists like Gem Bingol fight to protect historic sites, such as slave cemeteries now surrounded by the beeping of excavators, the message is clear: the digital future cannot come at the cost of our physical heritage. The next decade will be defined by this fragile negotiation between our global demand for data and our local desire to protect the land that fed us long before the "cloud" existed.

FUTURE COEXISTENCE



An aerial view shows a data centre situated near single-family homes in Stone Ridge, Va., in 2024. Photograph: Nathan Howard.

The future of the American landscape will be defined by a fragile negotiation between global demand of data centres and local demands of daily life. Ultimately, the success of this “data centre boom” will depend on whether Big Tech can truly coexist with the communities they inhabit, ensuring that the progress of tomorrow does not come at the cost of the heritage and resources of today.

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This work by Leonardo Mühlestein, Vithursan Manoharan, and Alberto Früh was created as part of the design studio The Production of Cloud at ETH Zurich in Spring 2026. The PDF is intended for educational purposes only. Its commercial distribution is strictly forbidden.

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