LESSONS IN

Data Center Construction

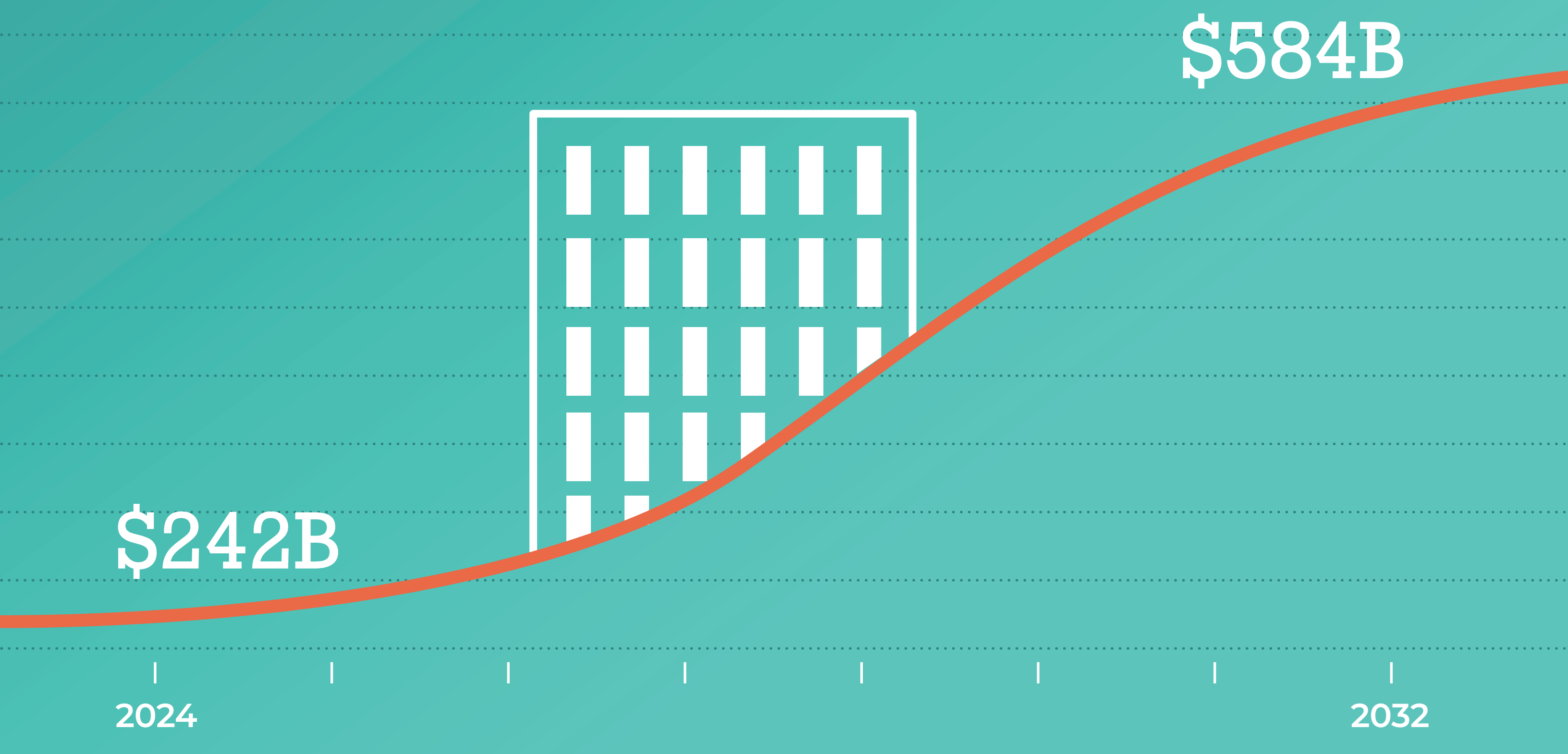
RURAL LAND IS CHEAP. THE SOIL CAN BE COSTLY.

VoidForm

$500B Data Center Boom.

Recent estimates detail an explosive market, with a global market size hitting USD 242.72 billion in 2024 and a predicted CAGR of 11.7% to reach USD 584.86 billion by 2032. Major players, the likes of Apple, Microsoft, NVIDIA, Alphabet, and Meta, are all racing to expand their computing capacity to demonstrate AI dominance. Data Center Frontier reports that Apple alone is set to invest $500 billion in data center infrastructure over the next four years. The Stargate Project announced in early 2025 is yet another example; it's a $500 billion partnership between OpenAI, SoftBank, Oracle, and MGX with a plan to build 20 new data centers to support Microsoft, NVIDIA, Oracle, and OpenAI.

The numbers don't lie; the world is in the midst of a data center building boom. According to the Visual Capitalist, there are currently more than 5,380 data centers in the continental U.S. (Data Center Map puts this number slightly lower, at 3,827). By either count, American data centers account for the majority, perhaps accounting for as much as 45% of global distribution. The concentration in the U.S. is exponentially higher than what exists elsewhere in the world. Particularly in Virginia (585 centers), Texas (363), and California (314), data centers have become pervasive across the landscape as critical pieces of infrastructure.

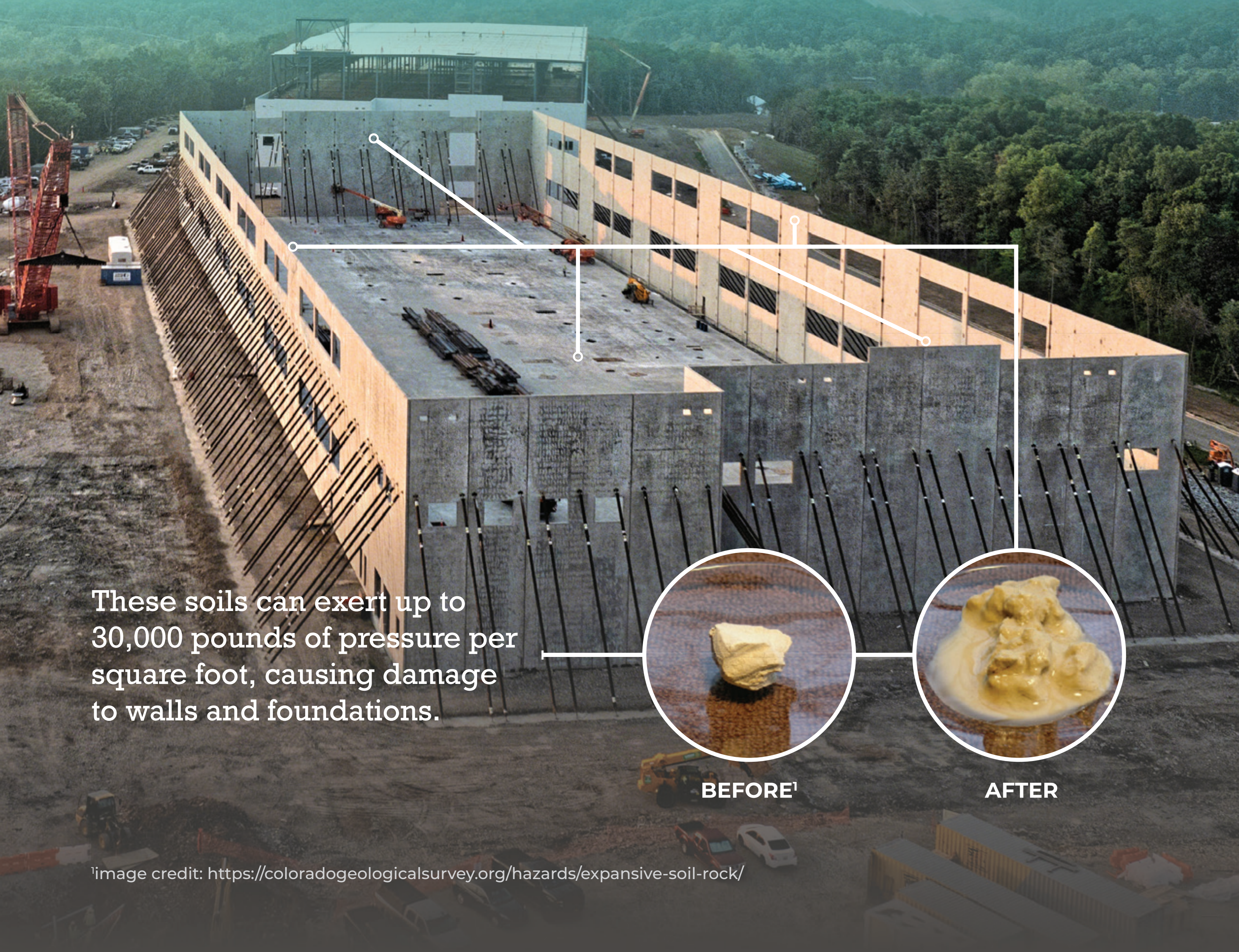


Here's the dirt on data centers.

Texas has the second most data center construction, building on clay-rich soils with a high shrink-swell potential.

According to an updated national analysis published in 2009, expansive soils in the U.S. already cause an estimated **$13 billion in annual damage** to buildings and infrastructure surpassing the combined damage caused by earthquakes, floods, hurricanes, and tornadoes.

These expansive soils or expansive clays can *trash and crash* sensitive IT infrastructure, the kind companies are spending trillions on.



These soils can exert up to 30,000 pounds of pressure per square foot, causing damage to walls and foundations.

BEFORE[1] AFTER

[1]image credit: https://coloradogeologicalsurvey.org/hazards/expansive-soil-rock/

The Move from Urban to Rural Development

Several converging trends are driving the rapid growth of digital infrastructure. As more of the world's operations shift online, demand for cloud-based computing has surged. At the same time, artificial intelligence, still in its early stages, is fueling unprecedented demand for high-density, high-throughput data processing. According to McKinsey, within a few short years, **up to 70% of data center demand will be AI-driven,** requiring significantly more power and space than traditional applications.

While investment in data centers is at an all-time high, the sector faces a long-term challenge: a persistent shortage of viable development sites due to the limitations of local power grids and water infrastructure, especially in urban areas.

Historically, data centers were sited in or near urban centers to minimize latency. This was particularly true for serving latency-sensitive industries such as financial markets. Urban environments also offered mature electrical infrastructure, multiple redundant grid connections, and access to robust ancillary services.

However, as demand has shifted toward hyperscale campuses, often requiring millions of square feet of space and hundreds of megawatts of power, urban locations have become increasingly impractical. The cost of land in metropolitan areas has skyrocketed, making large-scale development financially prohibitive. For instance, the Stargate Project in Abilene, Texas, is expected to reach nearly 4 million square feet upon completion, a footprint that would be impossible to accommodate in most metro areas.

The second motive behind the rural data center revolution is the intensified need of these facilities for both power and water. Both utilities are essential for data center operations. Aging urban infrastructure cannot absorb intense new demands on the local electrical grid and water systems. In many cases, rural power grids can more readily accommodate the load requirements of new facilities. If no power exists, it's more financially feasible for technology companies to make those structural investments themselves. This is particularly important as hyperscale projects now typically require dedicated substations or even on-site generation.

Furthermore, growing regulatory scrutiny and local opposition in urban areas, driven by concerns over noise, heat, and resource consumption, have accelerated the industry's pivot to secondary and rural markets.

Places like Virginia and Texas are prime examples, offering affordable real estate availability, robust access to utilities (or greater economic feasibility of building ancillary infrastructure), and improved operational flexibility.

> "Data center operators have recognized that it's easier to move gigabits of data than electrons and have entered locations where land is available and additional power is more attainable."
>
> **Jeff Johnston of CoBank**

Texas as a Microcosm of the Rural Data Center Boom

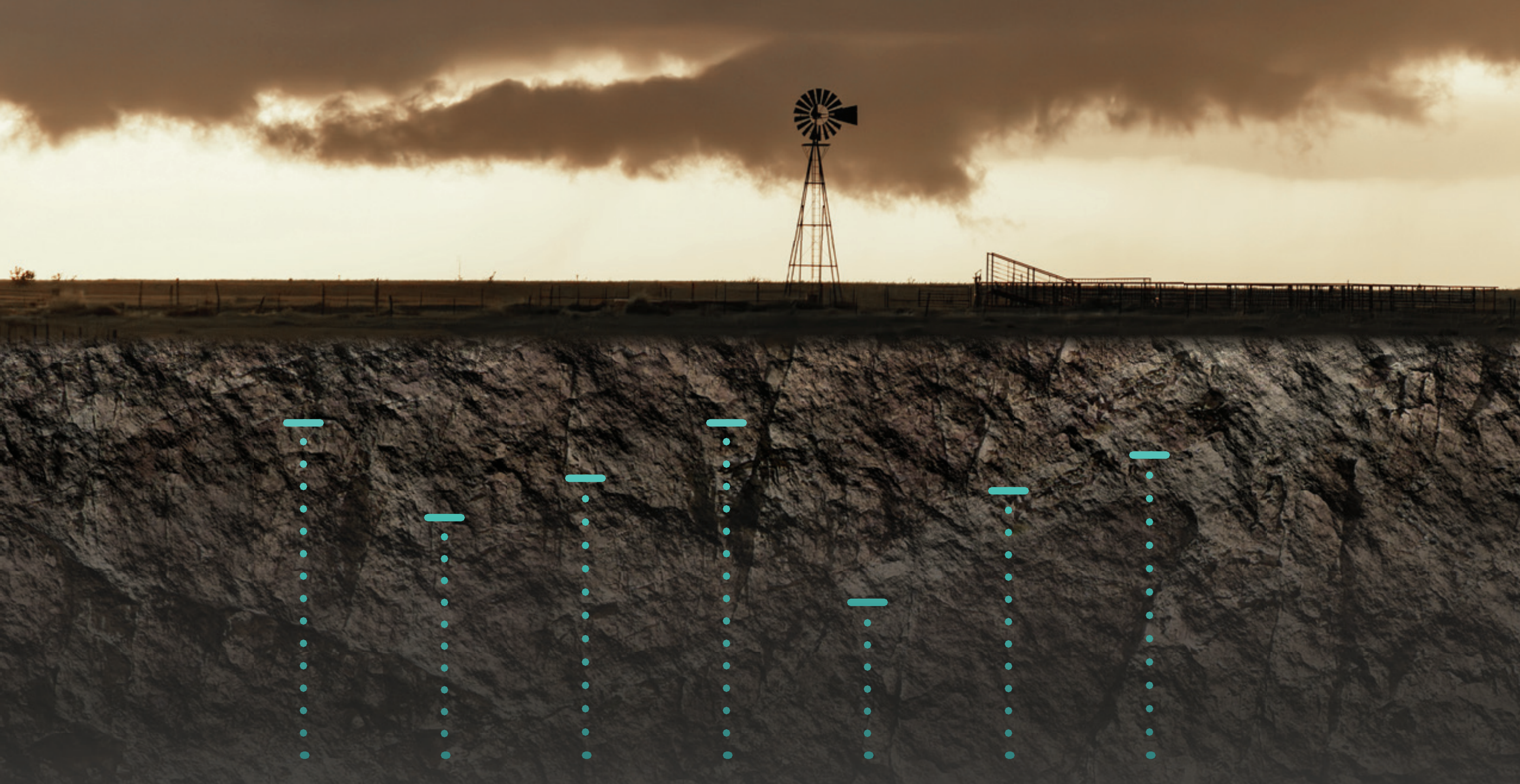
The Lone Star State is a prime example of how the American data center industry has recently expanded into rural areas. With nearly three-quarters of Texans living on just 4% of the state's land, Texas offers vast, undeveloped areas that, on the surface, seem ideally suited for the large-scale development required by hyperscale data centers.

As one of the country's most business-friendly states, it already boasts more than 360 data centers with more underway. In just the last two years, the world's latest tech companies, alongside major real estate investors like Blackstone, have been aggressively acquiring real estate in the region, all pegged for more data center development. Again, the Stargate Project is just one of the flashiest examples of how tech giants are racing to build hyperscale facilities here, but it is far from the only project underway.

Real estate firm CBRE Group Inc. reported that the Dallas-Fort Worth area is now the second-largest market in the United States for leased data center space. This influx of data centers (and planned developments) has prompted Texas to take proactive measures to bolster the state's electric grid capacity. Both the state government and private firms are actively exploring innovative energy solutions. AI tech companies have also begun partnering with gas pipeline companies, while other projects are exploring potential next-generation technologies such as modular nuclear reactors.

Texas serves as one of the clearest examples of how data centers have rapidly shifted from urban cores to rural landscapes. But this is a story playing out across the country, from Washington State to Virginia and back again.

The Reality of Unpopular Real Estate: Expansive Soil



In data center development, rural sites are often positioned as the more straightforward choice, promising fewer neighboring land use conflicts, lower real estate costs, and greater access to necessary utilities than urban alternatives. On the surface, the logic is sound: more land means less competition and fewer constraints.

However, even in data center and business-focused states like Texas, rural land presents its own set of challenges, many of which are under-reported and underestimated. Much of this land has remained undeveloped for a reason. Rural sites frequently lack critical infrastructure and face logistical limitations, both of which tech companies are learning to overcome by funneling additional resources into shoring up local power grids and infrastructure or simply building their own supply.

But what is frequently overlooked, and what is highlighted here, are the serious geotechnical risks caused by soil conditions that lurk below the surface. Successful development demands not only power and acreage but also a deep understanding of what lies beneath.

The Geologic Conditions

Beneath many fast-growing rural development zones lie complex and often challenging geological conditions. Areas of Texas, Colorado, and much of the land now targeted for data center development sit on swaths of expansive, corrosive, and seismically active soils. These subsurface risks pose serious challenges for foundations and long-term structural performance.

Expansive soils remain among the most underestimated environmental threats to built structures. Swelling and shrinking soils undergo substantial volume changes in response to moisture fluctuations. This behavior is driven by clay minerals like smectite and montmorillonite, which absorb water and expand, often causing volume changes of up to 20% and exerting pressure as high as 30,000 pounds per square foot — enough to damage concrete slabs and compromise piers.

According to the American Society of Civil Engineers, shrink-swell soils **cause damage to around 25% of U.S. homes,** with annual losses now estimated to exceed $13 billion following an updated analysis published by Puppala, A. J., and A. Cerato in 2009.

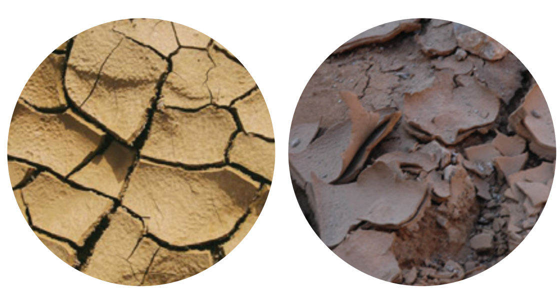
Texas, a current epicenter of data center development, sits atop some of the most expansive soils in North America. Active clays are widespread, with the most severe concentrations in the Blackland and Grand Prairie regions, spanning over 19 million acres. In these soils, intracrystalline swelling occurs within montmorillonite, where water penetrates and expands the crystal lattice, driving the dramatic shrink–swell cycles that make these formations so challenging for construction.

Swelling clays can cause foundation movement, leading to cracking, misalignment, and degradation of critical infrastructure. For hyperscale facilities housing millions of servers and sensitive equipment, even minor shifts can threaten uptime and drive up costs. The threat to both physical assets and service continuity is significant.

These risks extend beyond data halls. Ancillary infrastructure—such as water reservoirs and on-site power facilities, including modular nuclear reactors—must also contend with soil dynamics. As Darin Pendergraft of GEOVision notes, "Safety is a top concern for nuclear power plants... Finding a suitable location involves identifying an area that is geologically stable and close to the power grid."

In such high-value environments, mitigating expansive soil movement is not optional—it's essential to long-term operational stability.

H_2O +



= 30k lbs of pressure per ft^2

VARIOUS EXPANSIVE SOILS

Solutions for Making Expansive Land Work

Despite the challenges posed by expansive soils, hyperscale data centers can be safely constructed on these sites, provided that appropriate geotechnical mitigation strategies are implemented during planning, site preparation, and construction.

There are several established means to reduce the future risk of foundations and structures including:

Over-Excavation

Soil excavation (aka select fill) involves removing problematic, expansive soil from the area where construction is planned and replacing it with a more stable, non-expansive fill.

LightBox estimates a typical hyperscale site to span around 10 acres, with buildable footprints reaching up to 1.4 million square feet and electrical demand exceeding 300 MW. **When expansive clays run deep, excavation becomes cost-prohibitive, logistically complex, and environmentally burdensome.** For these reasons, over-excavation is rarely a viable primary solution for large-scale facilities.

Chemical Stabilization

A second option is chemical stabilization, a process of mixing chemical additives with soil can reduce its swelling potential and decrease plasticity and compressibility.

For large-scale infrastructure projects, the feasibility of chemical stabilization is limited by soil type and the surrounding environment. Soils with low plasticity or high sand and gravel content often lack sufficient clay for chemical additives like lime or cement to effectively react. Similarly, organic-rich soils resist stabilization due to interference with chemical bonding, and cold or saturated sites can hinder chemical reactions. Additionally, **projects located near sensitive ecosystems or working with specific environmental regulations may restrict the use of chemical stabilizers** due to contamination concerns.

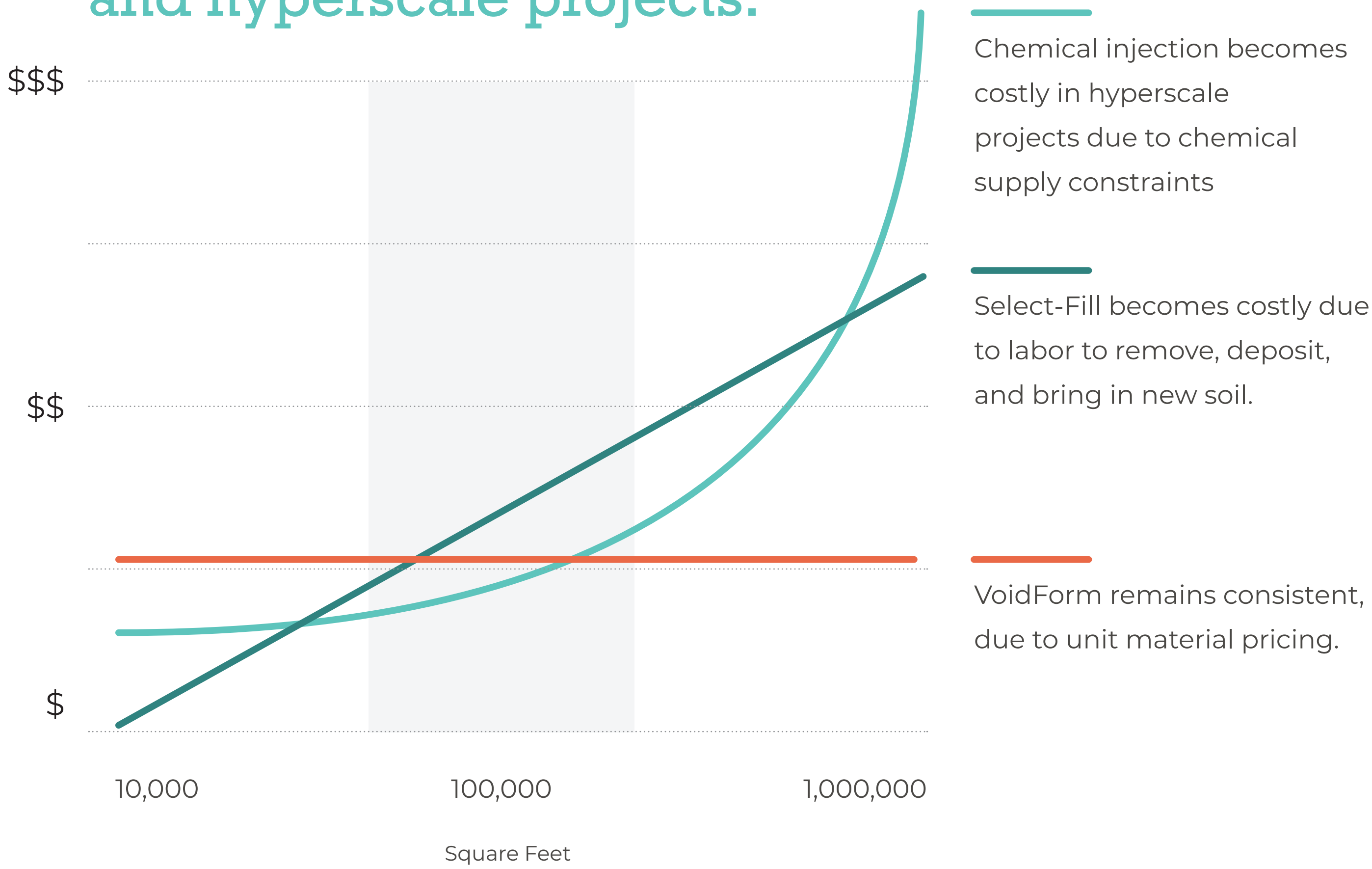
Structural Solutions

The third option is void forming, which is a process of creating a space below and around concrete in which soil can swell. Void forming systems are often made from corrugated paper, plastic or foam. By definition, the system should be strong enough to tolerate construction loads and wet concrete placement, but should not transfer pressure to the structural components when collapsed or compressed over time.

Unlike environmentally challenging chemical stabilization or expensive over-excavation, void forms do not alter native soil conditions. And unlike foam and rigid plastic void forms, corrugated paper void forms absorb ground moisture and deteriorate, creating the required void space that won't transfer pressure. Plastics, like copolymer polypropylene (PPC) work well as interior cell structures because they are flexible, and when wrapped in a biodegradable cover, the soil can migrate into the cells.

VoidForm's product systems, SureVoid® and StormVoid®, both meet the definition of an ideal void forming system but how do they satisfy the unique requirements of data center construction?

Cost dynamics on large and hyperscale projects.



Summary

Explosive Market Growth: The global data center market is projected to grow from $242.72B in 2024 to $584.86B by 2032, fueled by AI-driven demand from tech giants like Apple, Microsoft, and NVIDIA.

Shift to Rural Sites: Urban centers can no longer support massive facilities due to high land costs, power/water constraints, and regulatory opposition.

Texas as a Case Study: Texas exemplifies the rural data center boom with over 360 centers and major projects underway. The state's inexpensive land and improving energy grid attract hyperscale projects.

Geotechnical Risks in Rural Areas: Clay soils in rural zones pose significant structural challenges, threatening uptime and requiring extensive foundation mitigation.

Void Forms as the Solution. Without altering the soil, void forms provide an effective alternative for large and hyperscale projects.

Questions and Support

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About VoidForm Products, LLC

VoidForm Products is the leading North American manufacturer of products designed to protect concrete structures from damage caused by expansive, corrosive soil, and seismic conditions. Founded in 1980, the Company's products have protected over a hundred million square feet through their use in a broad range of applications, including industrial, commercial, residential, and municipal infrastructure. VoidForm is headquartered in Fort Worth, Texas.