THIRD WAY

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From Texas to Virginia: Powering AI's Energy Revolution

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As the US electric grid continues to evolve, surging AI and data center demands underscore the urgent need for novel and sustainable energy solutions. This surging electricity demand, reaching levels not seen in decades, has opened a new window of opportunity for US leadership. If seized, this 'age of electricity' can foster new economic growth, boost US competitiveness in emerging technologies, and address load growth with resilient, sustainable solutions.

Recent announcements by tech giants Amazon, Google, and Microsoft about advanced geothermal, nuclear energy, and long-duration storage projects highlight the path forward. This corporate commitment has not only accelerated progress, but also sparked broader policy discussions, particularly around the significant energy demands of data centers. With our current grid makeup, inconsistent federal regulations, and unique data center concentrations, state-level policies are emerging as promising solutions to satiate growing AI demand with clean and firm power. In this

memo, we use Virginia and Texas—the two leading locations for data centers in the US—as case studies to better understand this evolving landscape, and present solutions for meeting these challenges.

Surging Demand from AI-optimized Data Centers

The data center industry is experiencing unprecedented growth in energy demand, with projections indicating a potential doubling by 2030. This surge marks a significant departure from the early 2000s, when efficiency gains kept energy consumption relatively stable despite increasing data center growth. Although the current expansion is driven by multiple factors, including the rise of cloud computing and cryptocurrency mining, the most transformative force is the rapid advancement of artificial intelligence (AI).

AI's energy demands are exponential—training AI models consumes significantly more power than traditional data center tasks, with a single AI-powered search using nearly 10 times the energy of a traditional web search. As AI models grow in complexity and their deployment across enterprise, government, and consumer applications also increases, their computational demands—and thus, energy footprint—will substantially increase.

A recent Goldman Sachs study found that by 2028, AI is projected to account for approximately 19% of data center power demand, highlighting its significant impact on infrastructure requirements. The intense competition among major tech companies to develop more advanced generative AI models has further increased energy consumption, so much so that within two years, data centers in the US might use as much energy as entire countries like Sweden or Germany.

Meeting Future Energy Demand

The rapid growth in data center energy consumption is increasing pressure on existing power grids and electric infrastructure. Ensuring sufficient, reliable, and sustainable power sources will be critical to maintaining U.S. leadership in AI and mitigating potential constraints on future data center expansion.

Rising to these challenges while enhancing US economic competitiveness and catalyzing technological innovation presents a once-in-a-generation opportunity. While variable renewable energy (VRE) sources like solar and wind are rapidly growing—projected to account for 94% of utility-scale generating capacity additions in 2024—their intermittent nature poses significant challenges for industries with constant energy demands, such as data centers.

Near-term solutions, such as Virtual Power Plants (VPPs), Grid-Enhancing Technologies (GETs), and demand flexibility programs can provide short-term relief, but a significant expansion of dispatchable generation will still be needed over the long-term.

In this context, Clean firm power, or technologies like advanced nuclear (including Small Modular Reactors or SMRs), enhanced geothermal, carbon capture and storage (CCS) and long-duration energy storage (LDES) present a viable solution to these challenges. The Department of Energy has identified these emerging technologies as key to powering the future of data centers. These technologies provide reliable, steady electricity, crucial during extreme weather or when renewable sources like wind and solar fall short. Clean firm power represents not only a solution to energy reliability but also a significant economic opportunity for the United States. With a global market projected to exceed $2 trillion, the nation that leads in scaling energy solutions for data centers—while securing supply chains and advancing domestic manufacturing—will dominate the next phase of the global energy transition.

Adopting clean firm power to operate data centers can significantly reduce environmental impact and optimize grid efficiency. It minimizes the need for excess renewable capacity and costly peaker plants, leading to a more cost-effective system. Integrating nuclear and other firm resources even lowers decarbonization costs by reducing reliance on variable generation, energy storage, and transmission. This strategy supports growing energy demands while maintaining grid stability and advancing decarbonization.

Despite the growing need, the deployment and commercialization of these technologies on a national scale remain significantly delayed. High capital costs and complex permitting hinder investment in early-stage projects. Here, individual states can play a crucial role, leveraging diverse technologies and resources that align with their unique geographic and economic conditions. By tailoring energy planning to local realities, states can accelerate the adoption of clean firm power, enhancing grid reliability and advancing our economic goals.

Ensuring a Reliable Regional Power Supply

While data centers are consuming electricity at a record rate, this problem is not consistent across the country. Compared to other facilities like steel plants and mineral mines, data centers exhibit the highest concentration of energy demand. This intense density is a significant factor in affecting local load growth by intensifying energy demand and straining load profiles. In 2023, about 80% of US data center electricity consumption was concentrated in just 15 states, with Virginia and Texas leading the way. In Virginia, data centers accounted for 25% of the state's total electricity consumption in 2023. That outnumbers all other states; the next-most was Texas, at nearly 22 million MWh per year and a little over 4.5% of the state's electricity consumption.

Virginia and Texas also present a stark contrast in their electric grid structures, with Virginia integrated into the larger PJM Interconnection and Texas maintaining its independent ERCOT grid. However, both states face a common challenge: increased demand from data centers is outpacing their ability to power these facilities with clean, firm energy technologies. Virginia grapples with transmission congestion and interconnection queues, Texas struggles with grid reliability issues, and neither state has fully embraced solutions like advanced nuclear, geothermal, or long-duration energy storage to provide the consistent, clean firm power that data centers require. This shared struggle highlights the urgent need for both states to innovate and invest in clean-firm power sources to sustainably meet the escalating demands of the digital age.

Virginia

Virginia's emergence as a leading hub for data center deployment stems from its decision to offer incentives to developers when the industry was still in its infancy in the late 2000s. While more than 30 states across the nation now offer similar incentives, Virginia has continued to outpace them, thanks to its densely packed fiber backbone essential for data transmission, proximity to the nation's capital, and a rapidly growing skilled workforce.

More recently, the rapid and concentrated growth of AI-optimized data centers has put immense strain on existing power grids, with demand increasing significantly over the years. Companies like Google and Microsoft have over $1 billion in investments in data centers in Northern Virginia (NOVA) alone. Dominion Energy (the state's primary energy provider) has struggled to keep up, temporarily pausing new connections while they upgrade their transmission and distribution networks to accommodate the growth.

The mismatch between the swift pace of data center development and the historically lengthy process of permitting and constructing traditional transmission projects has exacerbated the issue. However, Virginia is already on track to tackle Statewide-permitting delays, with the establishment of its Office of Regulatory Management in 2022 which has already overseen the elimination or streamlining of more than 50,000 regulatory requirements.

Improved statewide permitting enhances opportunities for deploying clean technologies, particularly advanced nuclear technologies, like Small Modular Reactors (SMRs), present a promising long-term solution for Virginia. Due to their compact size, SMRs offer localized power generation, reducing the need for long-distance transmission, and their scalable capacity of around 300 megawatts aligns well with modern data center needs. While this technology has not been deployed on a wide scale, Virginia's existing nuclear infrastructure and transmission lines make it an ideal candidate for SMR expansion, with the US leading global development efforts against competitors like Russia, China, Japan, and the UK.

This push aligns with Virginia's 2022 Energy Plan, where Governor Youngkin set a goal to build an SMR within the next decade. Recent agreements, such as Amazon Web Services (AWS) and Dominion Energy's MOU to explore SMR technology, and Microsoft's Power Purchase Agreement (PPA) with Constellation Energy for reliable nuclear power, highlight the state's commitment to clean, firm energy solutions.

Texas

Texas, long known for its oil and gas industry, is now experiencing a seismic shift in its energy landscape driven by the rapid growth of data centers and artificial intelligence (AI). A report by Electricity Reliability Council of Texas (ERCOT) cites an exponential demand growth in the Permian Basin region of Texas, where there is a growing data center presence. Today, power demand in the region is largely driven by oil and gas operations, however, ERCOT predicts that in the next 5 years, around 58% of new demand will come from data centers and crypto mining.

For Texas, with its strong oil and gas legacy, advancing geothermal energy by leveraging its geological expertise, skilled subsurface workforce, and infrastructure is a natural fit. Companies like Houston-based Fervo Energy are already pioneering geothermal projects, using deep drilling to tap hot rock formations for electricity generation. Geothermal holds immense potential, with estimates suggesting that enhanced geothermal projects could become a $10 billion-per-year industry by 2030, deploying over 4,000 MW annually.

Sage Geosystems is also a leading startup advancing clean firm energy through both Enhanced Geothermal Systems (EGS) and Advanced Geothermal Systems (AGS). AGS is a technology that extracts heat from deeper, previously inaccessible rock formations without relying on natural reservoirs, allowing for the broader deployment of geothermal energy. Sage's EarthStore Project focuses on developing a 3-megawatt commercial geo-pressured geothermal system in Texas. Although not directly aimed at powering data centers, this project highlights Texas's growing interest in scalable, carbon-free geothermal technologies. It also highlights the significant growth potential of these systems far beyond their current capabilities. As companies like Google already partner with geothermal providers in states like Nevada, Texas-based projects like EarthStore could soon help meet the reliable energy demands of regional data centers—paving the way for large-scale deployment well beyond just a few 3 MW projects in the future.

Texas has also already made significant strides to advance new energy deployment. In June 2023, new state legislation provided much-needed clarity on geothermal resource ownership, establishing that geothermal energy belongs to the surface estate owner, distinguishing it from mineral rights and thereby reducing legal risks for companies. Additionally, it streamlined the regulatory landscape by transferring oversight of closed-loop geothermal injection wells from the

Texas Commission on Environmental Quality to the Railroad Commission of Texas, making the permitting process more efficient for developers.

Texas Making Strides

Apart from geothermal, the state of Texas has been making significant advancements and conducting thorough studies on the potential of other clean firm technologies.

Long-Duration Energy Storage (LDES): Texas also has potential to adopt LDES at scale to power AI-centered data centers. LDES allows for the capture of excess energy during low-demand periods, to be released when the demand is high thereby supporting the grid when needed. Texas' geographical presence makes it a strong benefactor of wind and solar energy but the lack of storage capabilities to save renewable energy during low periods results in huge losses of potential firm energy that LDES can bridge.

Thanks to the financial credits from the Inflation Reduction Act a number of companies are trying to build LDES facilities including a project by Energy Vault, which is an above-ground gravity storage system in Texas, being implemented in partnership with Enel Green Power.

Advanced Nuclear Potential: Recently, Texas completed a comprehensive study on its potential to lead in new nuclear development. The state currently operates two nuclear power plants with a combined capacity exceeding 5,000 MW, generating about 10% of its total electricity. In 2023, Governor Greg Abbott formed the Advanced Nuclear Reactor Working Group to evaluate the feasibility of adding five new nuclear plants and to streamline regulatory processes. This group is also exploring the implementation of Small Modular Reactors (SMRs), with a demonstration project slated for completion by 2030. Collaborations like Dow Chemical's partnership with X-energy to develop an SMR at its Seadrift complex further highlight Texas's commitment to integrating nuclear power into its industrial landscape.

Carbon Capture and Storage (CCUS): In tandem with nuclear advancements, Texas is also focusing on CCUS technologies to reduce emissions from its significant industrial sector. The state's existing infrastructure and expertise in oil and gas make it an ideal candidate for implementing CCUS projects that can capture carbon emissions from large industrial sources and store them safely underground. This dual approach not only enhances energy security but also aligns with broader decarbonization goals.

The Way Forward: Different States, Different Solutions

To decarbonize the American grid and strengthen global competitiveness—particularly as China invests nearly twice as much in next-gen clean firm technologies as the US—individual states, guided by national interests, are well-positioned to lead with targeted policy interventions. Such measures can support AI development while aligning it with a sustainable energy supply. Ultimately, the transition to powering data centers with clean, firm energy will vary across states, influenced by their unique geography, resources, and regulatory frameworks.

Design state-specific policy frameworks that recognize and incentivize the unique benefits of different clean firm technologies.

For states, amending legislation to introduce incentives for utilities and other load serving entities to procure a specific percentage of their electricity from clean, firm power sources, such as small modular reactors (SMRs) can help. For Virginia and Texas, it would mean implementing specific requirements for emerging technologies for electricity generation within their existing Renewable Portfolio Standards (RPS). It could include setting escalating targets for clean firm power, starting at 10% and increasing to 30% by 2040.

Encourage innovative financing mechanisms tailored to the risk profiles and development timelines of various clean firm sources.

Innovative financing models for nuclear and other clean firm energy sources offer a promising solution for states to meet the growing electricity demand from data centers while advancing clean energy goals. Strategies could include permitting cost-share programs, multi-state procurement for collective purchasing power, and assistance for cost overruns through government-backed guarantees.

Flexible Power Purchase Agreements (PPAs), like Google's Clean Transition Tariff, can incentivize investment in emerging technologies. Additionally, leveraging impact investing, public-private partnerships, targeted tax incentives, and digital financing platforms will mobilize capital and enhance transparency, fostering a supportive environment for clean firm energy solutions and advancing decarbonization efforts.

Introduce state-level incentives for carbon-aware data centers and reliable power integration.

States should incentivize all large energy users like data centers to adopt carbon-aware computing and demand flexibility strategies through a combination of policy measures and financial incentives. Although this technology is still in its initial stages, introducing incentives can accelerate its adoption by other large energy users. These incentives could include offering tax credits for implementing advanced workload management systems, providing grants for grid-scale battery storage installations, and establishing regulatory frameworks that reward data centers for reducing their load during peak demand periods. States also should allow data centers to use on-site back-up generation during grid emergencies to continue providing critical services while relieving strain on the power grid.

For example, Alphabet's spinoff, Verrus, is designing sustainable data centers, set for release by 2027. Using intelligence software for workload management and grid-scale battery storage, Verrus plans to reduce peak electricity load by optimizing the use of clean, reliable energy sources like advanced geothermal.

Conclusion

The US must lead the energy revolution to power AI and data centers sustainably. By investing in advanced nuclear, geothermal, and energy storage, we can ensure a resilient, clean grid that fuels economic growth and global leadership. The future of energy is here, and it is time for the US to lead the way in this critical new era.