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How Data Centers are Remaking the U.S. Electricity Sector

Part Two: Emerging Innovations

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The release of ChatGPT, with its potentially momentous implications for energy demand growth, is only a couple of years old. Yet as sketched above, the novel challenges it presents to the U.S. electricity system have already begun to result in innovations with potentially fundamental implications.

In the second article in our three part series exploring how data centers are remaking the U.S. electricity sector, we survey these developments as (1) efforts to improve the speed of interconnection by making data center load easier to accommodate and speeding up the interconnection process administratively and physically and (2) measures to mitigate system impacts via changes to rate and market design.

Accelerating Interconnection

Managing Demand

The gap between traditional grid capital additions and the imperative of "speed to power" by data center customers (and the policymakers competing for them to locate in their jurisdictions) is being addressed in part by relaxing the constraints posed by data center load, increasing the ability to flex the load reliably up and down. The most direct approach is to optimize when and where the underlying compute demand occurs to reflect system constraints. Advanced orchestration platforms, such as Emerald AI, are enabling data centers to shift workloads across sites in real time—as well as slowing or delaying processes—based on energy prices, carbon intensity and GPU availability. These tools turn grid conditions into an active input for compute scheduling, lowering costs, reducing peak draw and aligning operations with renewable generation and cheap electricity.

Taking compute demand as a given, other research and utility pilots show that flexible data center operations, paired with strategic siting, can cut interconnection timelines and grid impacts. A report titled "Rethinking Load Growth" (Norris et al., 2025) finds that 0.25–1% predictable annual curtailment could unlock tens of gigawatts of "curtailment-enabled headroom" in existing U.S. balancing authorities. EPRI's Data Center Flex (DCFlex) work with APS, Duke and TVA demonstrates that batchable workloads and targeted load shedding can be deployed without breaching service-level agreements. This potential grows when facilities locate near distributed energy resources (DERs) or deploy on-site generation—such as hybrid natural gas–renewable microgrids or storage-backed solar—to offset peak grid draw. DER-adjacent siting offers a buffer during grid stress and supports faster interconnections in capacity-constrained areas.

Demand-side flexibility can also be enhanced by employing temporary, DER-based generation solutions to enable data centers to begin operation in advance of system upgrades at the grid or generation level. This enables utilities to offer customers smaller, easier-to-manage chunks of new capacity, reducing the utilities' risk of stranded assets built for data centers that never materialize. Enchanted Rock's "Bridge-to-Grid" solution, developed for Microsoft in San Jose, CA, supplied renewable natural gas power on-site until primary utility service was ready, then transitioned to a flexible standby role.[1] In some jurisdictions, environmental standards for generation are being relaxed to meet urgent load growth. Texas, for example, has allowed more diesel backup generators and introduced greater flexibility in permitting to accelerate capacity additions for large campuses, essentially creating a fast operational exemption pathway that makes it easier for high-emissions backup units to run when ERCOT deems it necessary.

Even more significantly, one of the provisions of Texas' new law (SB 6) on connecting large (>75 MW) includes mandating that new loads must provide a curtailment plan which would be set into motion by the grid operator ERCOT in the event of a grid emergency, subject to 24-hour notice, as well as developing a plan to monetize its demand reduction. It also requires new load with back-up power > 50% of its load to allow ERCOT to take control of the dispatch of its back-up power in the event of grid emergencies.[2] Idaho and Arkansas have also mandated interruptible supply contracts for large loads.[3]

Managing Supply

The ability of existing transmission and distribution grid infrastructure to handle new data center load—taking the load (net of DER) requirements of the data center as constant—is being rethought. Grid-enhancing technologies such as Dynamic Line Rating (DLR) can boost line capacity by 20–40%, unlocking headroom in constrained corridors.[4] Although DLR has been piloted by PJM, SPP and CAISO, it is rarely a base-case assumption in interconnection studies. Similarly, targeted substation and feeder

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[1] Enchanted Rock, Bridge to Grid
[2] Baker Botts (2025), Texas Senate Bill 6: Understanding the Impacts to Large Loads and Co-located Generation
[3] Idaho Public Utilities Commission (2025); Arkansas Public Service Commission (2023), Docket #23-070-TF
[4] EPRI (2025): Dynamic Line Ratings Status, Applications and Opportunities; Power Magazine (June 2024), DLR Is More Than Optimizing Capacity; How Can Utilities Ensure Safety and Reliability?

upgrades, when guided by transparent headroom mapping, can often deliver quicker relief than major transmission builds.

In parallel with these innovations in how load and the grid are managed, another set of changes implicitly takes underlying load requirements as a given but modifies contractual terms to mitigate the need for system build-outs. Some operators are willing to trade a small, quantifiable increase in outage or curtailment risk for months—or even years—off their interconnection timeline. By explicitly valuing the expected cost of an outage against the opportunity cost of delay, utilities and developers can craft service-level agreements that prioritize speed to market while maintaining acceptable reliability for critical workloads.
Interruptible or “partially firm” interconnection agreements give large loads faster access to the grid in exchange for accepting defined curtailment rights during peak stress events. The load manages the operational risk—often through on-site generation or workload shifting—while the utility avoids overbuilding infrastructure for infrequent peaks. However, resistance to PJM’s recent suggestion to fast-track data center load by treating it as “non-capacity-backed load,” including objections from data centers, utilities and IPPs, suggests these contractual and market design approaches are still in early stages.

A parallel set of initiatives seeks to reduce interconnection delays through improved administration of grid connection requests. Load interconnection queues remain fragmented and, in some cases, prone to speculative filings that slow processing for viable projects. Issues vary by market type, with each regulatory structure presenting distinct challenges in integrating demand-side flexibility into system planning and interconnection permitting. In vertically integrated markets like Virginia, the constraint is not generation capacity but the slow expansion of transmission-distribution infrastructure, including substation headroom, feeders and mid-voltage saturation. Dominion’s Northern Virginia territory illustrates how permitting delays, siting restrictions and community resistance can extend substation lead times to 8–10 years, even for projects with approved queue positions.

In more loosely regulated environments such as ERCOT in Texas, decentralization produces different problems: the absence of a formal load queue and headroom transparency leads to speculative filings (e.g., the 40+ GW of inquiries to Oncor and AEP, much of it without site control), scattered engineering reviews and uncoordinated interconnection approvals. The SB6 Texas legislation noted above introduces multiple measures to address this, including increasing fees associated with interconnection requests. In hybrid models like California’s, centralized transmission planning through CAISO is undermined by fragmented distribution authority in investor-owned utilities, creating friction where system-level siting potential exists but local substations are already near capacity.

Reform to the permitting process itself, including applying lessons learned (or proposed) in acceleration generation interconnection, shows promise. Applying principles from FERC Order 2023 to load could help, as could lessons from generator queues where reform has reduced processing times. For example, PJM’s application of cluster studies and readiness milestones led to a 20% reduction in interconnection times.[5] MISO is attempting to "clean up" interconnection queues by increasing withdrawal penalties, while CAISO is allowing fast-tracking for low-impact projects.

Embedding verified demand-side control capabilities (e.g., curtailable or interruptible load) into interconnection studies and permitting criteria could help prioritize "grid-aligned" projects and better match capacity expansion with the operational flexibility of new large loads. Incorporating flexibility commitments

[5] Federal Energy Regulatory Commission, Order No. 2023 (July 2023): Improvements to Generator Interconnection Procedures and Agreements

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into planning models could help align infrastructure pacing with private development timelines and reduce reliability risks when load arrives faster than upgrades. However, the adoption of analytical tools sufficient to model this level of complexity and uncertainty still lags behind the need.

Mitigating the Externalities of Rapid Growth

Utility Rates

While the measures described above seek to eliminate constraints on "speed to power," a parallel set of developments aims to protect other electricity customers from the costs of serving data centers. Traditional ratemaking to fund shared infrastructure emphasizes fairly attributing increased costs to the customers that caused them. Rapid data center load growth is prompting regulators to tighten cost allocation safeguards so legacy customers are not saddled with infrastructure costs for a small number of high-demand users. Principles include "beneficiary pays" cost recovery, minimum bills tied to contracted capacity and long-term service commitments aligned with utility capital planning cycles. Oregon's POWER Act that sets minimum contract lengths for new data center customers to protect other customers from increased and potentially stranded costs associated with connecting these loads.[6] Examples include Indiana Michigan Power's tariff requiring payment of the greater of 80% of contracted demand or the customer's peak historical use and the Georgia PSC's requirement for review and cost recovery mechanisms for new loads above 100 MW. There is a parallel set of concerns about what happens if the data centers and their investors or creditors are unable to use and/or pay for the grid investments they've requested. Who will be left footing the bill?

Behind-the-meter (BTM) arrangements, including co-location with generation, can avoid formal interconnection upgrades but still rely on the grid for backup and stability, raising fairness concerns around cost allocation. This has triggered disputes, most prominently PJM's Section 206 complaint, where stakeholders argued that co-located loads with private wire arrangements should contribute to shared transmission and capacity costs. Without such rules, BTM-heavy campuses risk shifting fixed costs onto other customers while reducing transparency in load forecasting.

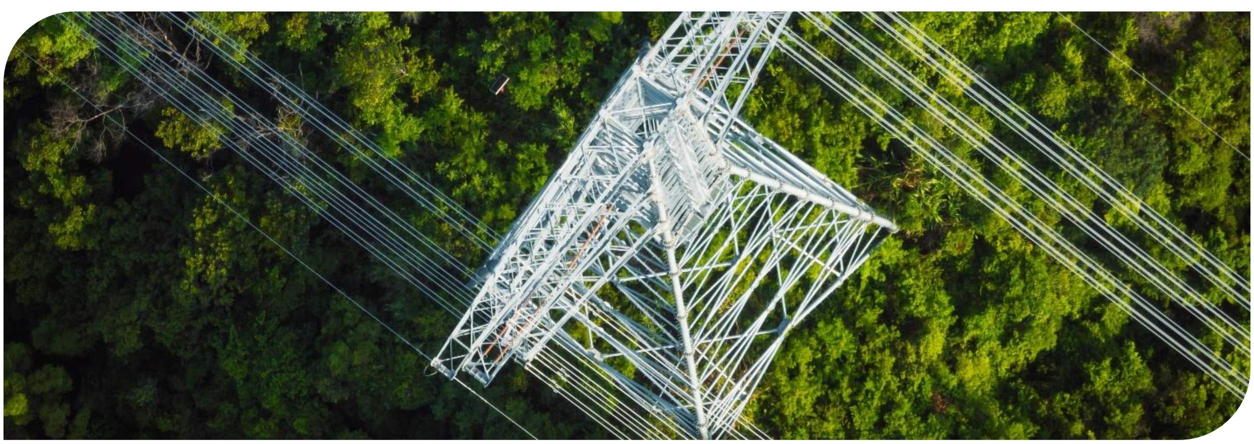
[6] Indiana Public Utility Commission (2025), Cause #46097; Oregon House Bill 2546 (2025); Georgia PSC (2025), PSC Approves Rule to Allow New Power Usage Terms for Data Centers

Some utilities and large-load customers are turning to direct bilateral agreements that bundle long-term supply, infrastructure cost recovery and in some cases renewable procurement. NV Energy's Clean Transition Tariff agreement with Google, for example, combined a 15-year service term, direct funding of transmission upgrades and bundled renewable energy credits. While these deals can expedite interconnection, they also raise questions about transparency and precedent in rate design.

Power Markets

Arguably, the ratemaking apparatus long-used by electric utilities is relatively well adapted to address the challenges of allocating the costs of rapid load growth.[7] However, the organized wholesale power markets—designed during a period of slow demand growth and excess supply at the turn of the century—are facing more severe challenges from the advent of data center-driven demand.[8] Several RTOs are adjusting market rules to encourage capacity investment in response to large new loads. PJM's removal of capacity price caps was intended to boost supply incentives, though political pushback led to the "Shapiro collar" compromise limiting extreme price swings. The underlying tension remains: balancing price signals strong enough to attract investment with protections against volatile rate impacts and concerns about "windfall profits" for existing generators.

Despite RTOs' attempts to mitigate the adverse impacts of data center growth, political frustration over perceived delays, cost allocation disputes and resource adequacy concerns is driving threats of state withdrawal from RTOs, most notably in PJM. While such moves could give states more direct control over resource development for large-load customers, they risk fragmenting markets, reducing efficiency and reversing decades of integration that have supported reliability and competitive pricing. More dramatically, frustration with high costs has led policymakers in some states to revisit limits on vertically integrated utilities owning generation in organized market footprints, particularly for capacity intended to serve specific large loads. Pennsylvania lawmakers have floated allowing utility-owned generation to meet in-state load growth, possibly including BTM assets. Supporters argue this could speed deployment; critics warn of undermining competitive procurement and distorting market signals.



[7] After all, that is the heritage of the political compact underlying utility regulation, which sought to provide investors with incentives to deploy long-term capital to serve new electricity load, equitably, during the first decades of the 20th century
[8] These include Regional Transmission Organizations (RTOs) in the mid-Atlantic and Chicago (PJM), the Midwest (MISO), New Yorks and New England (NYISO and ISONE), California (CAISO), and Texas (ERCOT)

Authors

Dan Gabaldon
Vice Chair, Management Consulting and Head of Energy

Bob Zabors
Vice Chaiman, Management Consulting and Head of Infrastructure & Innovation

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This is the second article in a three-part thought leadership series from Teneo's Energy and Infrastructure team, exploring how the rapid expansion of data centers is transforming the U.S. electricity sector. Drawing on real-world developments, the series brings together perspectives on technology, regulation and market design. The third and final article will look ahead to the lasting implications — what these changes mean for prices, markets and regulation, and how they could reshape the sector for decades to come.

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