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VIEWPOINT

MICROGRIDS ANSWER MAJOR DEMAND AT AI DATA CENTERS

Data centers are driving new and different demand for power. Traditional generation, transmission and delivery systems are not well-suited to keep pace with the coming requirements. Microgrids and decentralized generation can reduce grid stress and ensure reliability in power-hungry AI data centers.

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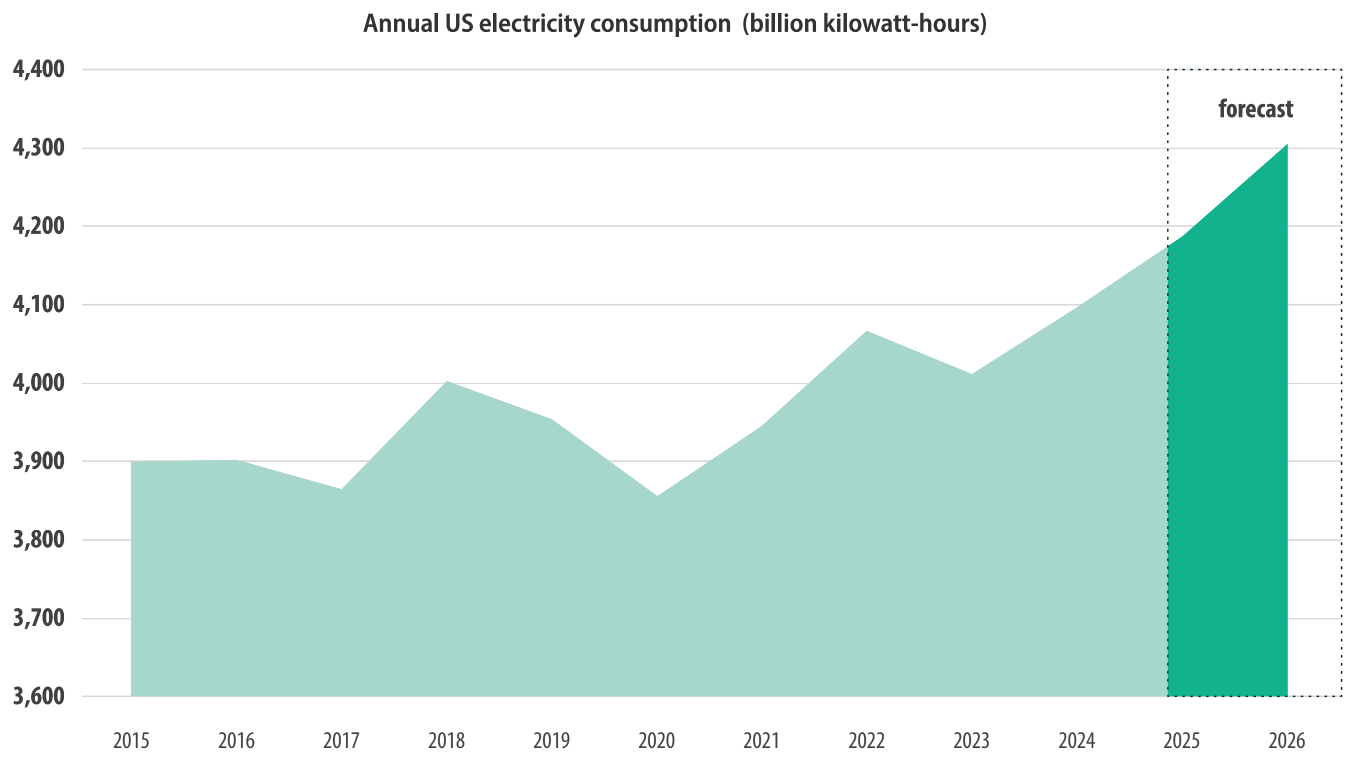
For the first time in decades, electricity demand is set to increase (Figure 1). Data centers play a big role in this new demand and bring some novel strains to power providers and transmission businesses.

New power demand is cropping up in unexpected places — exurban areas with good telecom fiber and affordable land in the US mid-Atlantic states and sparsely populated West Texas, where crypto miners have set up to take advantage of remote, abundant renewal power from wind turbines. Before this new computing-driven demand, these were areas where utilities and administrators had not planned to add infrastructure. Traditional power generation, transmission and delivery models are not well-suited to respond to power demand from artificial intelligence (AI) data centers.

The impact of this mismatch goes beyond delayed projects and server shortages. Electricity bills for customers in the regional grid known as the PJM Interconnection territory were projected to climb 20% as utilities grapple with data centers getting built faster than power plants. PJM covers 13 US states from Pennsylvania, New Jersey, and Maryland to Illinois and Tennessee. It is the largest US power grid and home to a huge and growing concentration of data centers.

Figure 1. Demand for power forecast to increase



Source: US Energy Information Administration Short Term Energy Outlook

Whether it's AI or other uses such as cryptocurrency mining, demand from future data centers will be spiky and sporadic. Aligning the long planning cycle for building new conventional power generation and transmission with the quick hype cycle of technology is challenging. Utilities have reasons to be skeptical that today's forecasted AI demand will actually develop into tomorrow's steady ratepayers.

Data centers demand high reliability and uninterrupted power. Their developers should find ways to bring their own energy sources. Intelligent microgrids, developed in concert with new data centers, offer localized generation, backup power, and energy optimization. According to Bloom Energy, about 30% of new data center sites are expected to incorporate microgrids or similar onsite power solutions into their designs by 2030. This marks a greater than twofold increase from just seven months prior. What's more, microgrid systems also support peak shaving — reducing electricity usage in periods of high demand to lower costs — and load management, which will curb demand and manage prices downward, they argue. Further, AI tools can be used to forecast demand and even accelerate planning for new generation sources and interconnections.

The shape and benefits of microgrids

A microgrid is a localized energy system capable of operating independently or in coordination with the main utility grid. It typically includes a combination of distributed energy resources such as solar photovoltaic systems, wind turbines, energy storage systems (such as batteries), and conventional energy resources. These components are integrated with control systems that manage energy generation, storage, and distribution, as well as connections to regional power grids .

Developers can design microgrids to enhance power stability, energy resilience, and sustainability. One of their key advantages is the ability to "island"— that is, to disconnect from the main grid and continue operating autonomously during grid outages or disturbances. This makes them particularly valuable in areas prone to natural disasters or where grid reliability is a concern.

Progress to mainstream

Microgrids have advanced from pilot projects and niche solutions into a mainstream solution for energy resilience, sustainability and decentralization.

By integrating renewable energy generation sources, microgrids reduce dependency on centralized fossil-fuel-based power generation. They also support energy independence, allowing communities or facilities to manage their own energy needs more efficiently. Initiatives are operating in the New England state of Vermont and on an island in American Samoa.

Because microgrids are designed to operate connected to and independently from the main grid, they require more advanced control systems. Advanced control systems enable real-time monitoring, load balancing, and predictive maintenance. These systems often use AI or ML for predictive control, digital twins for simulation, and edge computing for fast local decisions. The dual operating structure of microgrids requires these capabilities, but they also deliver optimized performance and cost savings.

Traditional grids are evolving to incorporate advanced control systems, especially as they become smarter and more decentralized. But the deployment is less uniform and often slower due to legacy infrastructure and regulatory constraints.

In contrast, modern microgrids are gaining momentum thanks to the development of high-grade controllers. These controllers go beyond basic automation and enable real-time decision-making based on live data, optimization around multiple variables, predictive analytics, adaptive control and the capability to integrate a mix of assets, including traditional power sources, renewable energy and long-term power storage batteries (Figure 2).

Microgrids offer benefits in both urban and rural settings. In urban areas, they support grid modernization and decarbonization goals. In remote or underserved regions such as islands in the South Pacific, they provide access to reliable electricity where traditional grid infrastructure is lacking or economically unfeasible.

With the rise of smart grid technologies and digital energy management software platforms such as Advanced Distribution Management Systems (ADMS) and Distributed Energy Resources Management System (DERMS), microgrids are becoming more intelligent and adaptive.

In Northern California, the Blue Lake Rancheria Native American tribe partnered with the Schatz Energy Research Center and engineering group Siemens to develop a microgrid using solar photovoltaic panels and battery backups. The system helps the Blue Lake Rancheria reduce energy costs and serves as an emergency source of power for the remote community, some 300 miles north of San Francisco Bay.

Figure 2. How high-grade controllers compare

Feature	Traditional controller	High-grade controller
Functionality	Basic automation, protection	Advanced optimization, orchestration
Data use	Limited, periodic	Real-time, high-frequency
Flexibility	Rigid, rule-based	Adaptive, AI-driven
Asset Integration	Centralized generation	Centralized generation or distributed energy resources
Resilience	Manual recovery	Self-healing, predictive control

Source: Infosys utilities

Regional drivers

On a regional basis, a variety of triggers have compelled further microgrid development around the globe (Figure 3).

In Asia, microgrid development is driven by electrification needs in remote villages as well as in new industrial parks and newly developing cities. India, China, Indonesia and the Philippines lead the way.

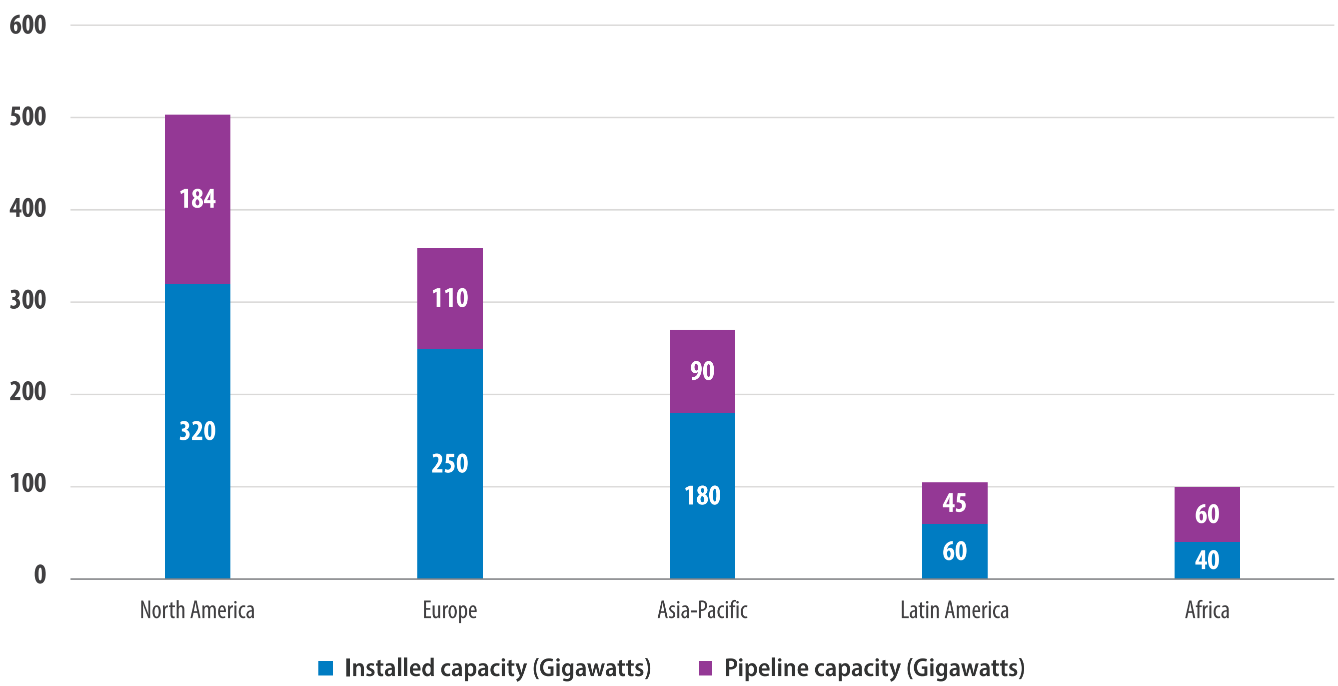
In North America, energy resilience is a primary driver and has been implemented at hospitals, military bases, college campuses, and data centers. The case for resilience has been particularly compelling in California and Texas. Even with rollbacks of government incentives, locations rich in distributed renewable energy generation continue to pursue microgrid development.

Europe's decarbonization goals and national interests in energy independence are driving renewable-powered microgrid development. European microgrids are frequently used for urban energy sharing and electric vehicle charging hubs. Germany, the Netherlands and the Nordic nations are leaders in microgrids.

In Africa, energy access and rural electrification drive microgrid development. This is often backed by non-governmental organizations, development agencies and national governments to put solar-powered microgrids to work in previously off-grid communities.

In Latin America, microgrid demand is driven by the need to increase resilience and recovery and to supply electricity in remote regions. Hybrid microgrids that use solar and diesel have been deployed in islands and mountainous areas. Brazil, Chile and Caribbean nations lead the way.

Figure 3. Microgrid capacity by region



Source: American Clean Power, Clean Power Quarterly Market Report, May 29, 2025

What microgrids deliver for data centers

A microgrid tailored for a data center can enhance reliability, uptime, and resilience, by switching into island mode when the main power source endures an outage. It also can address demand and sustainability challenges that are growing in response to rapid data center expansion.

Microgrids can help data center operators manage their power profile, or what and where they source energy for the data center. This requires smart integration with distributed energy resources and coordination with the regional grid. Then, microgrid operators can engage in use-specific monitoring, management, and automation of grid and data center activities.

Infosys and partners have developed a microgrid on Singapore's Jurong Island that uses a cloud-based energy management system to monitor and manage electricity usage there. The system monitors power demand and helps manage electric load for the island with the support of long-term energy storage batteries.

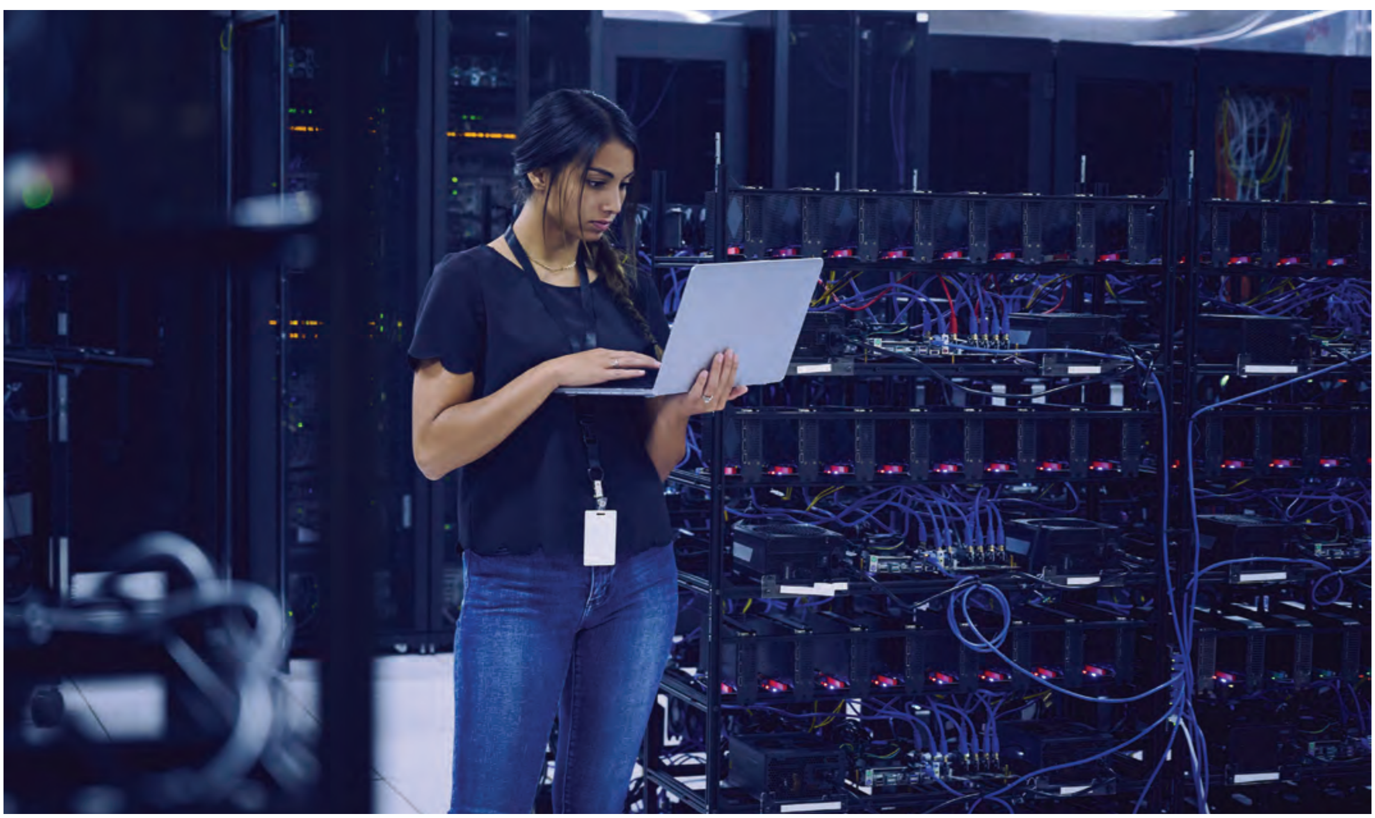
This is particularly relevant when one considers the nature of compute demands in the data centers of tomorrow. AI-driven demand in future data centers will come in sudden spikes, often driven by automated digital processes.

An integrated microgrid like the one on Jurong Island can profile power loads and forecast future demand. This is one way a microgrid can optimize energy costs and reduce grid strain. Further, an integrated microgrid with monitoring and management can itself be automated to keep pace with the dynamic power demands of data centers. In markets with competitive power pricing, energy management systems can be deployed to automatically switch between grid, solar, and battery.

Integration and coordination will be a site-to-site consideration, depending on the variety of distributed energy resources, (solar, wind, battery storage, and even electric vehicles) and adjacent regional grid or demand.

In developing microgrids with major utilities, Infosys has developed a method to integrate electric vehicles as occasional or last-resort power sources for grid and data center. To be sure, this sort of vehicle-to-grid technology is not yet widely deployed and is dependent on policy development and standards. But once those factors mature, the reference architecture is ready to go, with cybersecurity and governance requirements already in place.

In our experience, the best approach to optimizing energy costs in a microgrid involves economic modeling, robust



digital integration, and smart operational practices. By coordinating energy resources with the grid, a configurable cloud-based energy monitoring platform optimizes the cost of energy.

Infosys and BP have in partnership developed a digital asset and commercial optimization solution that is being used by a leading German airport to support energy efficiency. The platform has the potential to implement use cases like demand response in microgrids.

Microgrids at macro scale

In the future, imagine a collection of digitally integrated and configurable microgrids, operating adjacent to each other and linked via an interoperable infrastructure. This is reflected in the digital energy grid concept articulated by Infosys co-founder Nandan Nilekani. In India, this concept could soon earn governmental support, driven by a desire to reduce power costs and increase reliability.

Taken to its full extent, a digital energy grid composed of multiple microgrids, along with other generation, transmission, and distribution assets, could turn every home with solar panels or another distributed power generation source into an energy market participant. In theory, this would reduce costs and increase reliability.

Digital interoperability and automation, driven by AI, can then manage and optimize microgrids by forecasting demand, scheduling distribution, and balancing supply and demand dynamically in real time. Here, microgrids at a macro scale would improve resilience and efficiency.

As articulated by Nilekani and the Foundation for Interoperability in a Digital Economy, digitizing and decentralizing the grid aims to reduce energy generation, transmission, and distribution costs significantly (up to 25%), encouraging more microgrid deployments and local energy entrepreneurship.

Develop resilience, consider cost options

Data center developers can use natural gas or renewable power and battery storage in a microgrid to address dmand for power and related challenges. This enhances resilience, improves quality and load balancing, reduces costs, and lowers the carbon footprint.

Cost considerations for the development of a data center microgrid should be viewed through a pair of familiar spending lenses: capital expenditures versus operational expenditures.

The CapEx front includes installation, interconnection with grid, permitting and financing. The OpEx side focuses on ongoing costs including operations, monitoring, maintenance and repairs, and software and technology costs.

With that view established, data center developers can consider different ownership or partnership models. An EaaS model would shift some critical upfront CapEx to the OpEx side.

They can also consider a middle path for development: Own the microgrid, but cede operational control to expert partners. Such partnerships make it easier to participate in power markets and potentially save further on costs.

For example, the government of Montgomery County, Maryland, partnered with utility provider Duke Energy to build a microgrid system designed to enhance resilience and reduce carbon footprint. The project uses an EaaS model and was built with no upfront cost to the county.

Microgrids coupled with renewable energy generation sources enable data center developers to reduce dependence on centralized fossil fuel-based power generation, increase resilience, and head off emerging community concerns of data centers' thirst for power.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