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Data Center Cost Drivers - Power

The Impact of Power Availability and Cost on Data Center Valuation

The rapid growth of cloud computing and artificial intelligence is driving a significant increase in demand for data centers, placing growing pressure on electrical infrastructure. While data centers have traditionally been evaluated through a real estate lens, this report shows that power availability and cost are becoming central to development feasibility, operating performance, and valuation.

This analysis highlights that data center revenue is fundamentally tied to power capacity, while operating costs are highly sensitive to electricity pricing. Even relatively small differences in energy prices can translate into millions of dollars in annual cost differences for large facilities, with meaningful implications for long-term returns. At the same time, expanding interconnection queues and grid constraints are slowing development timelines, making access to power a key limiting factor for new supply.

Site selection is not driven by power alone. Leading markets continue to benefit from strong demand, connectivity, and established infrastructure, even when power costs are higher. This means investors must evaluate opportunities across multiple dimensions, balancing energy economics with broader market dynamics.

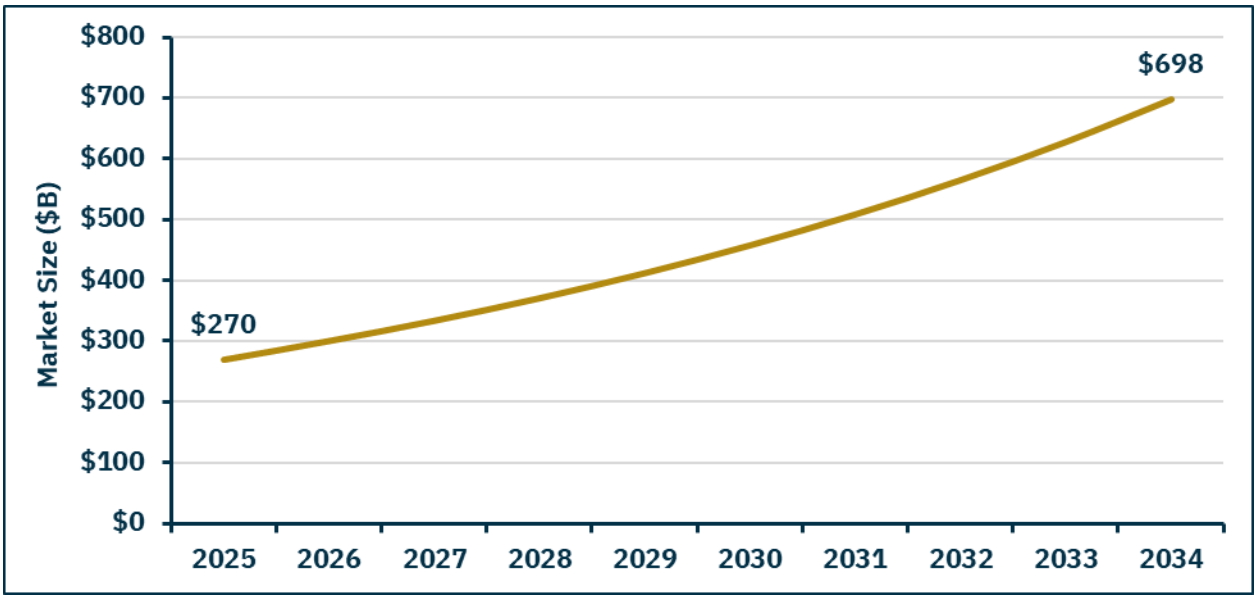
Ultimately, power is no longer just an operating input. It is becoming a core driver of value in the data center sector, influencing where assets can be built, how they perform, and the returns they generate over time.

- Data center revenue is constrained by available power rather than physical space
- Electricity price differences of $0.01/kWh can shift annual operating costs by millions
- Interconnection delays and grid constraints are primary bottlenecks to new supply
- Power availability and cost influence both development and long-term asset valuation

The Growing Importance of Power in Data Center Development

Data centers have become critical infrastructure supporting the modern digital economy, enabling cloud computing, enterprise IT workloads, and the rapid expansion of artificial intelligence. Demand for capacity has accelerated in recent years as hyperscale providers and AI-driven applications require increasing levels of compute, storage, and network infrastructure. Industry forecasts point toward sustained growth over the next decade, with the market expected to expand at an annual rate of approximately 11% in the coming years.

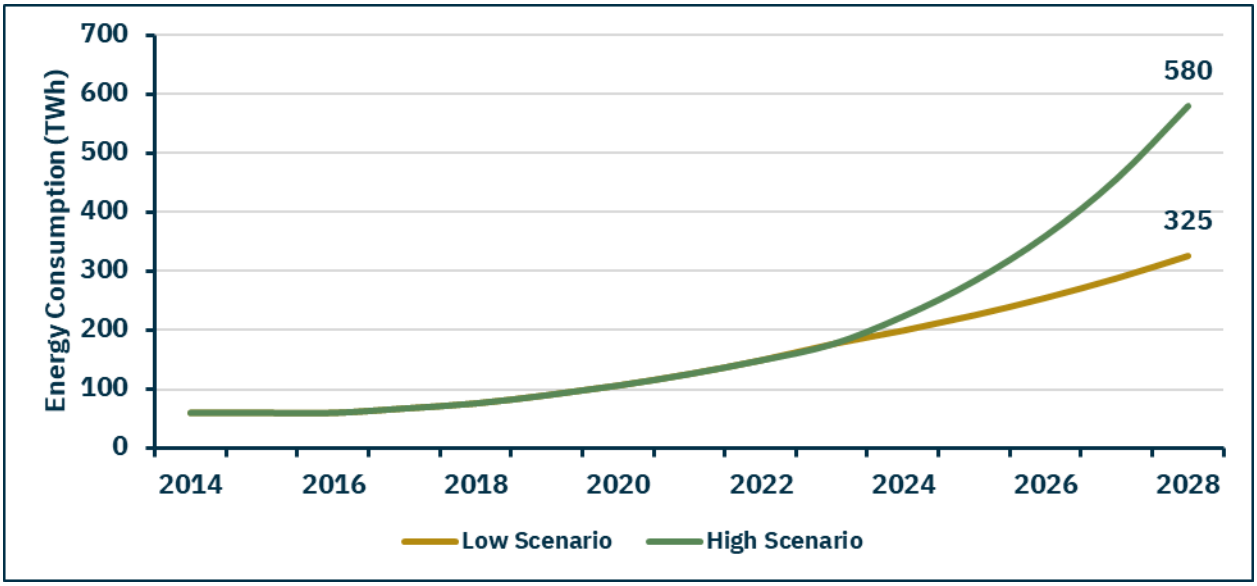
Figure 1 *- Data Center Market Size Forecast ($B)*



Source: Fortune Business Insights

Historically, data center site selection and valuation have been driven by traditional real estate and infrastructure factors, including land availability, fiber connectivity, and proximity to major demand centers. As power requirements continue to scale, this dynamic is shifting, with power availability increasingly constraining development feasibility while electricity costs play a growing role in shaping long-term operating performance.

Figure 2 *- Data Center Load Growth Forecast, Low and High Scenarios (TWh)*



Source: Lawrence Berkeley National Laboratory

This raises a fundamental question for investors, developers, and appraisers: to what extent do power availability and cost influence data center valuation relative to traditional location factors? As energy becomes both a limiting input and a major operating expense, its role is increasingly central to understanding market dynamics, development feasibility, and asset value.

Data Center Economics – Revenue Model

Data centers generate revenue primarily through leasing power capacity rather than physical space. Unlike traditional real estate assets, where rent is typically quoted on a per square foot basis, data center pricing is most commonly structured in dollars per kilowatt (kW) per month. This reflects the core function of a data center: delivering reliable power and cooling to support customer IT infrastructure.

Figure 3 *- Data Center vs Traditional Real Estate Revenue Model*

Metric	Data Centers	Traditional Real Estate
Cost Driver	$/kW/month	$/sqft/month
Key Constraint	Power	Space
Typical Price/Unit	$120-180	$2-4
Asset Scale	30,000 kW	150,000-250,000 sqft
Revenue Potential	$4,500,000	$600,000
Revenue Density ($/sqft)*	$20-30	$2-4

*Revenue Density refers to the equivalent value per square foot of real estate

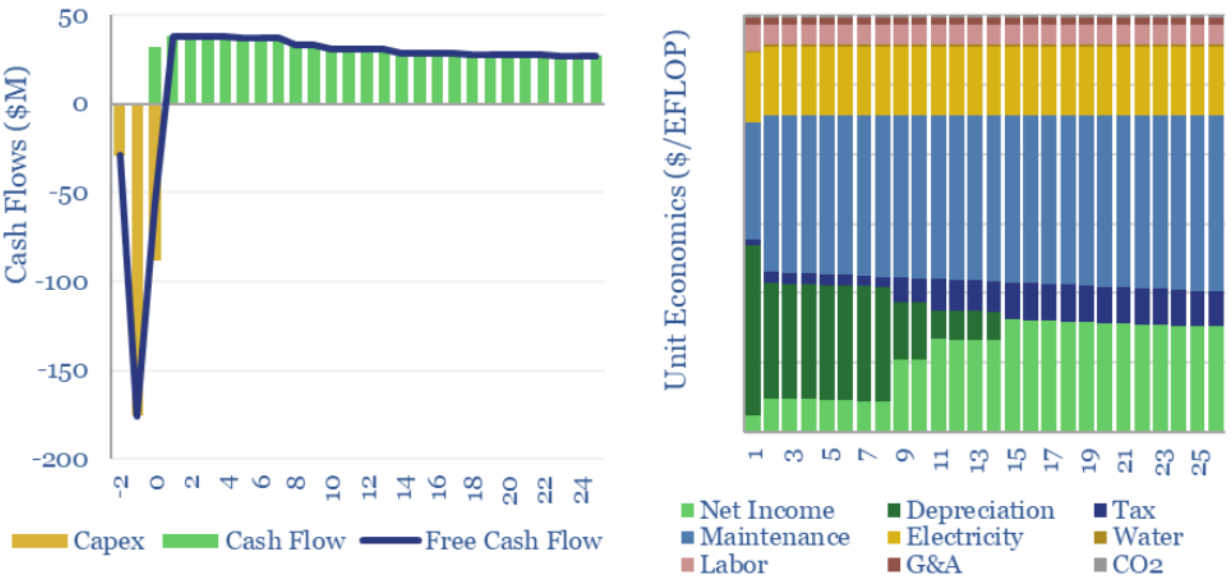
Customers range from large hyperscale cloud providers to major technology companies, with lease structures varying based on scale, contract duration, and service level requirements. Agreements often include charges for both reserved power capacity and actual energy consumption.

As a result, revenue is fundamentally tied to the amount of power a facility can deliver and sustain, rather than the size of the underlying property. Facilities with greater capacity, higher reliability, and access to scalable power infrastructure are generally able to command higher lease rates and maintain stronger occupancy. Hence, power capacity directly influences both revenue potential and asset valuation, making it a primary consideration in underwriting data center investments.

Data Center Economics – Cost Structure

Data centers are highly capital-intensive assets, requiring significant upfront investment as well as ongoing operating costs. Broadly, their cost structure can be divided into two primary components: capital expenditures (Capex), associated with development and construction, and operating expenditures (Opex), driven by day-to-day operations.

Figure 4 *- Data Center Capex and Cash Flow Model*



Source: Thunder Said Energy

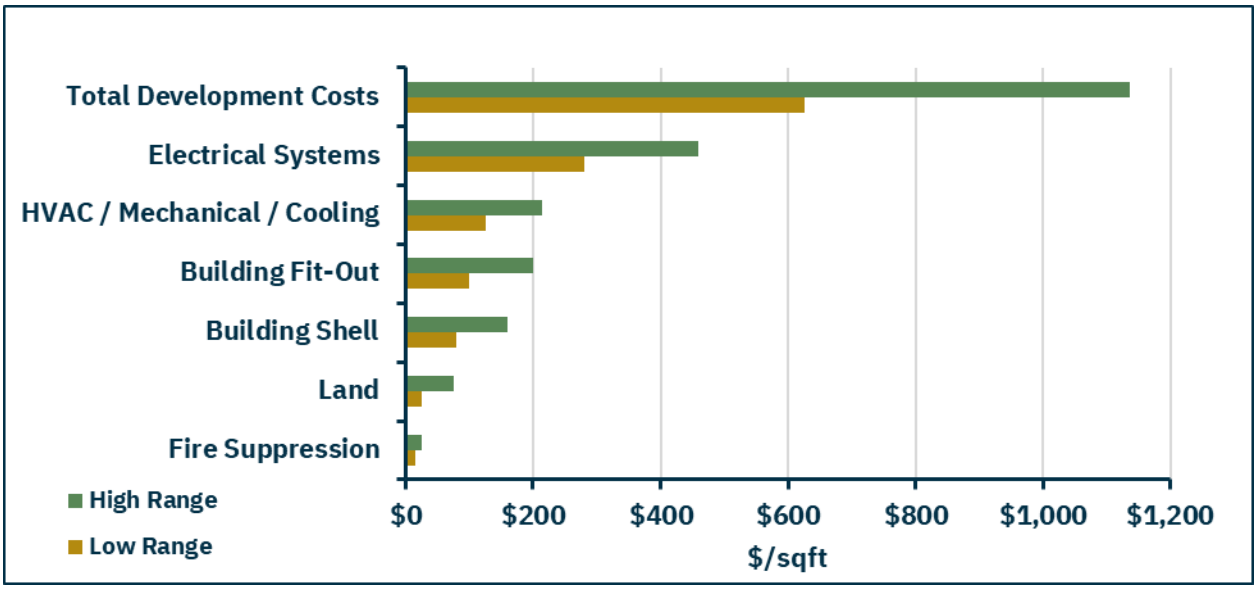
This distinction between upfront and ongoing costs is central to understanding data center economics. While capital costs determine initial project feasibility, operating costs, particularly electricity, play a key role in long-term profitability. As a result, both the availability and cost of power influence not only whether a data center can be built, but also how it performs over its lifecycle.

Data Center Economics – Capex

Capital expenditures typically include land acquisition, building construction, and the installation of specialized infrastructure such as electrical distribution systems, cooling equipment, and backup power systems. These systems are designed to meet strict uptime and redundancy requirements, increasing development costs relative to traditional real estate assets.

Capex is commonly evaluated on a per-megawatt ($/MW) basis, reflecting the central role of power capacity in defining asset scale and value. Industry estimates place total development costs in the range of $7 to over $12 million per megawatt, depending on location and design specifications. As a result, access to sufficient grid power is not only a technical requirement, but a prerequisite for deploying capital efficiently, as insufficient power availability can delay projects, increase development costs, and reduce expected returns.

Figure 5 *- Data Center Capex by Equipment Type*



Source: Dgtl Infra

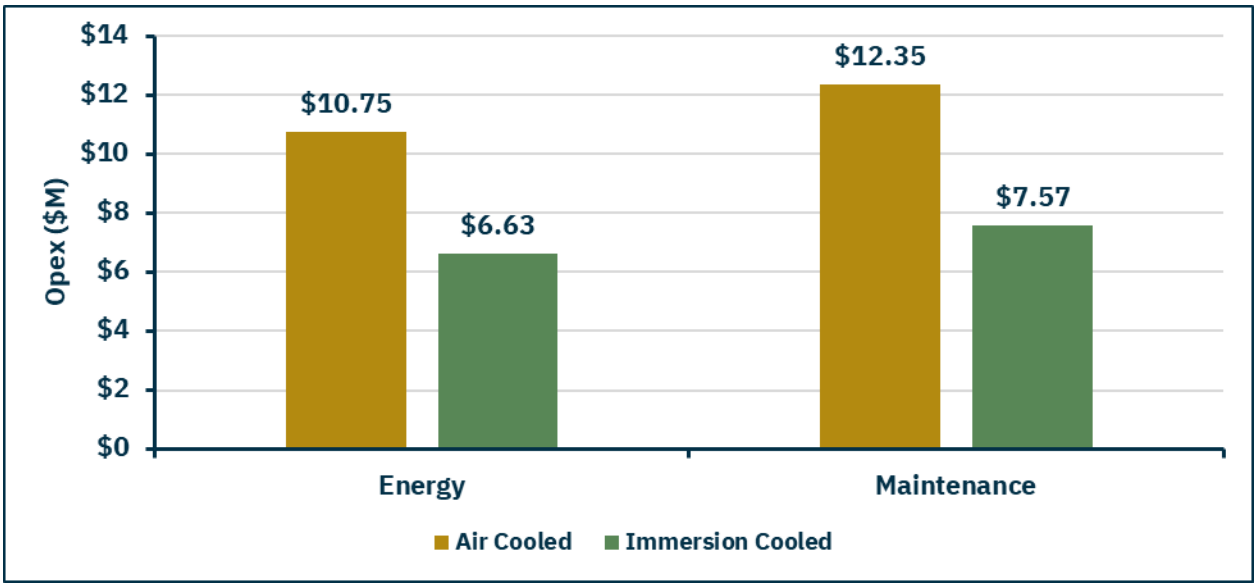
From a valuation perspective, capital costs determine initial project feasibility and influence required returns. Markets with limited power availability may face higher development costs or delays, increasing project risk and constraining the economic viability of new supply.

Data Center Economics – Opex

Operating expenditures represent the ongoing costs required to maintain and operate a data center over its lifecycle. These costs scale with both facility size and utilization, reflecting the continuous operation needed to support customer workloads.

Core operating expenses include maintenance and operations, staffing, network connectivity, and electricity used to power IT equipment and cooling systems. The composition of these costs can vary based on facility design, particularly the type of cooling system used. For example, immersion cooling can reduce energy consumption associated with cooling but may introduce different maintenance requirements compared to traditional air-cooled systems.

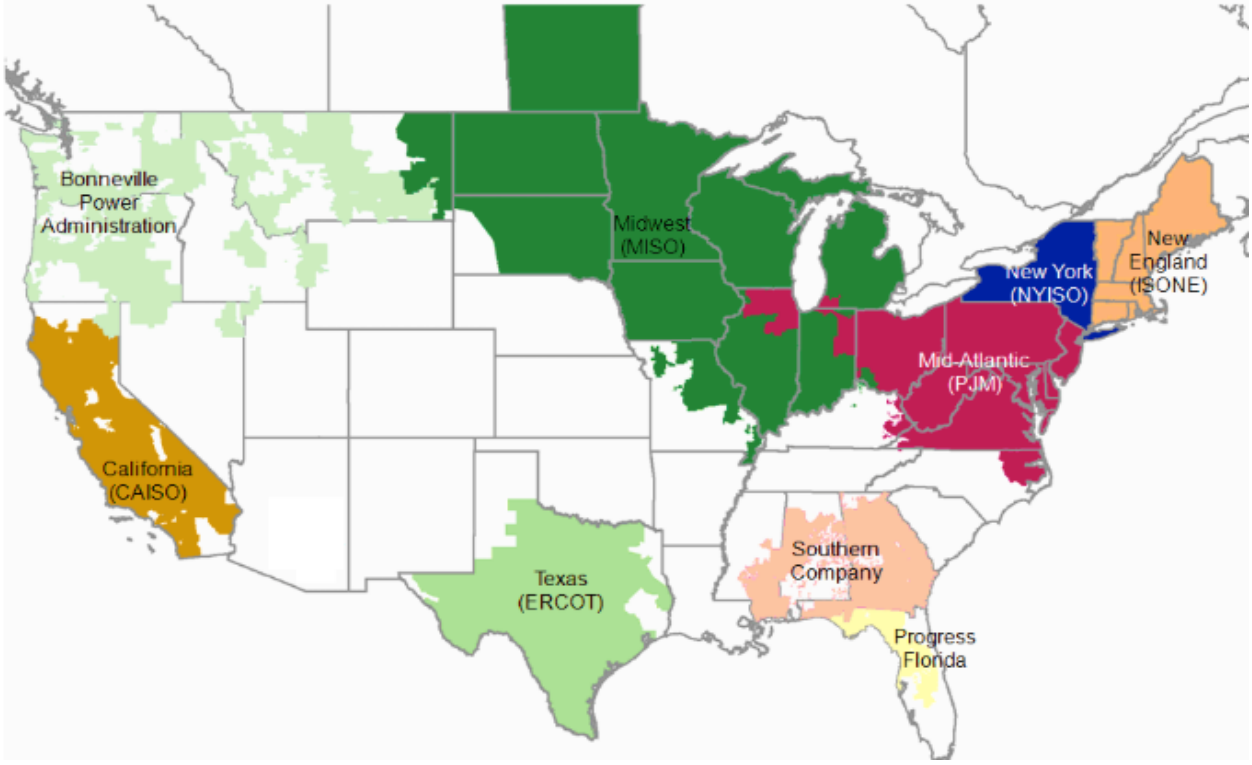
Figure 6 *- Data Center Opex by Cooling Mechanism Used*



Source: Profile IT

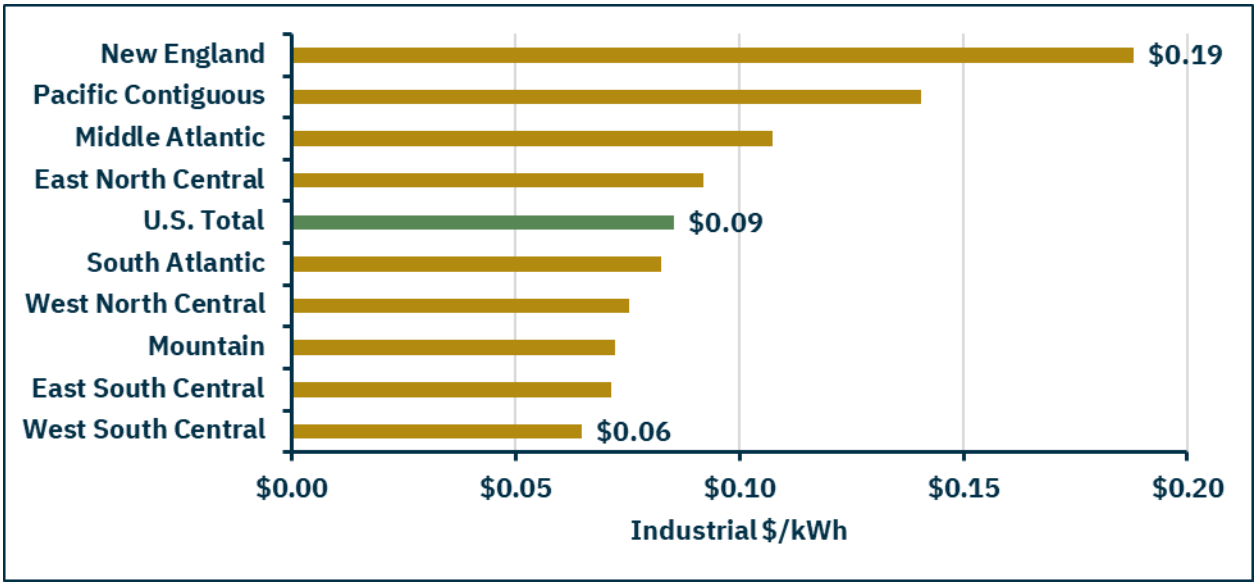
Unlike capital costs, which are incurred upfront, operating expenses directly impact ongoing profitability. Variations in electricity prices across markets can materially affect operating margins, creating persistent cost advantages for facilities located in lower-cost regions.

Figure 7 *- Electric System Operator Territories in the United States*



Source: Energy Information Administration (EIA)

Figure 8 *- Industrial Electricity Rates by Region ($/kWh)*



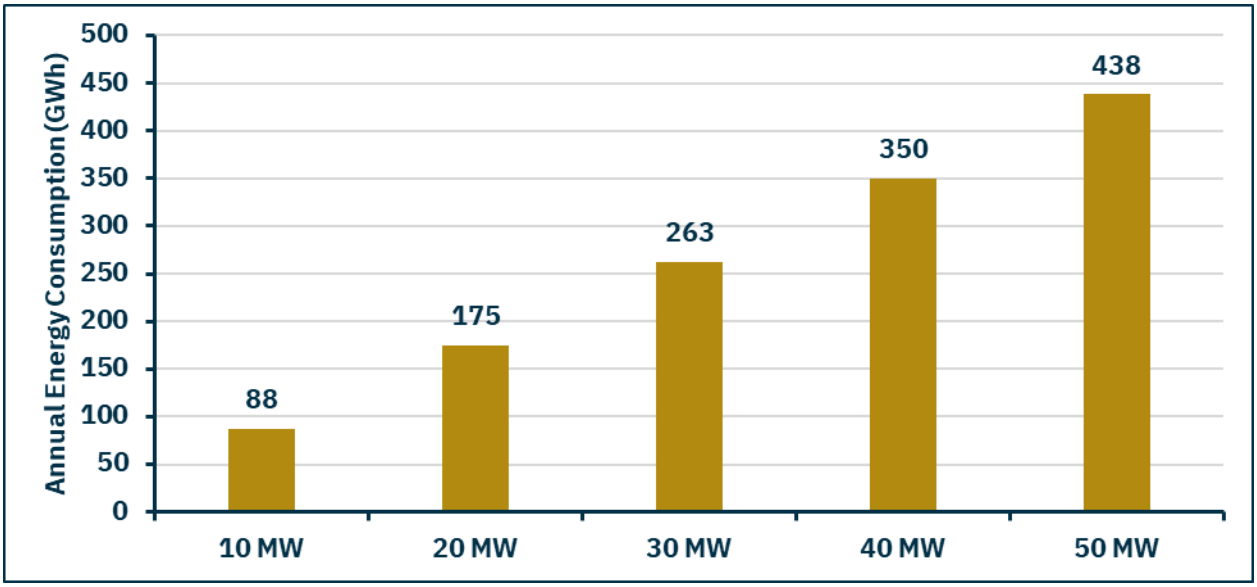
Source: Energy Information Administration (EIA)

Markets with lower power prices can offer a structural cost advantage, while higher-cost regions may face reduced operating margins. These regional differences play an important role in shaping site selection decisions and can materially influence the long-term attractiveness and valuation of data center assets.

Power as a Cost Driver: Sensitivity, Scale, and Market Impact

Due to data centers' continuous operation, their electricity consumption scales directly with installed power capacity. As facilities increase in size, annual energy requirements grow linearly, reaching substantial levels even at moderate scales. This relationship is shown in Figure 9 below.

Figure 9 *- Annual Energy Consumption by Data Center Size (GWh)*

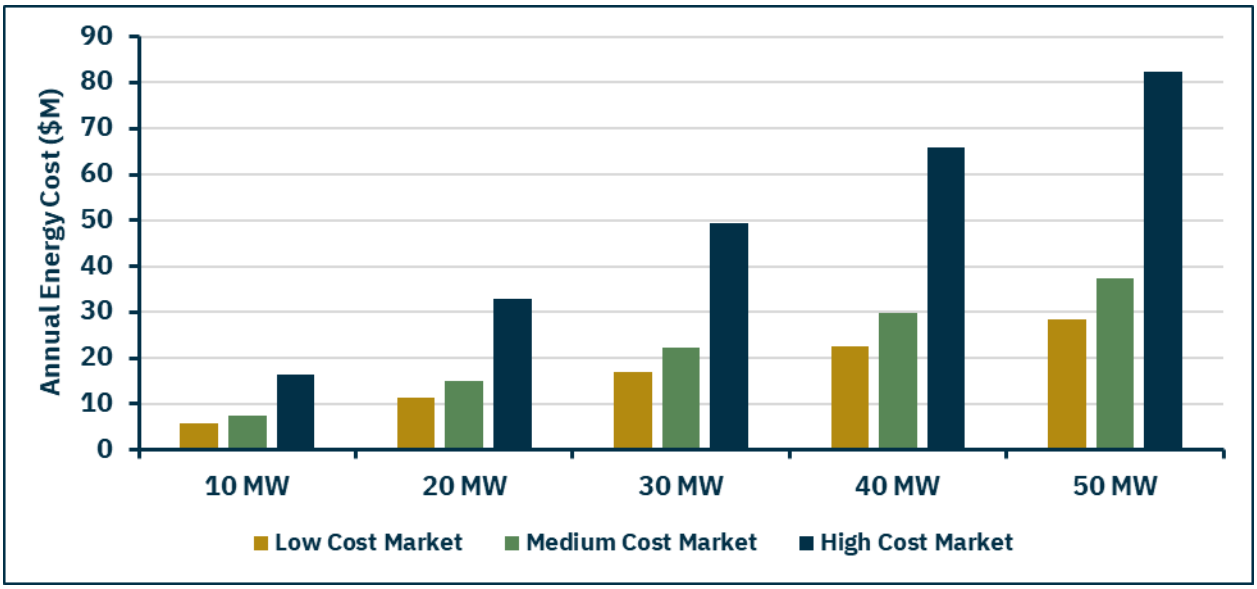


Source: Independent Analysis

While total energy consumption provides a useful baseline, the financial impact of electricity ultimately depends on local power prices. Because data centers operate continuously at high loads, even modest differences in pricing can lead to significant variations in annual operating costs. Thus, identical facilities can face materially different cost structures depending on their location. This implies that site selection decisions can have a first-order impact on long-term operating costs, even when facility design and scale are identical.

The relationship between facility size, electricity price, and total energy cost is illustrated in Figure 10 below, highlighting how both scale and regional pricing contribute to overall operating expenses.

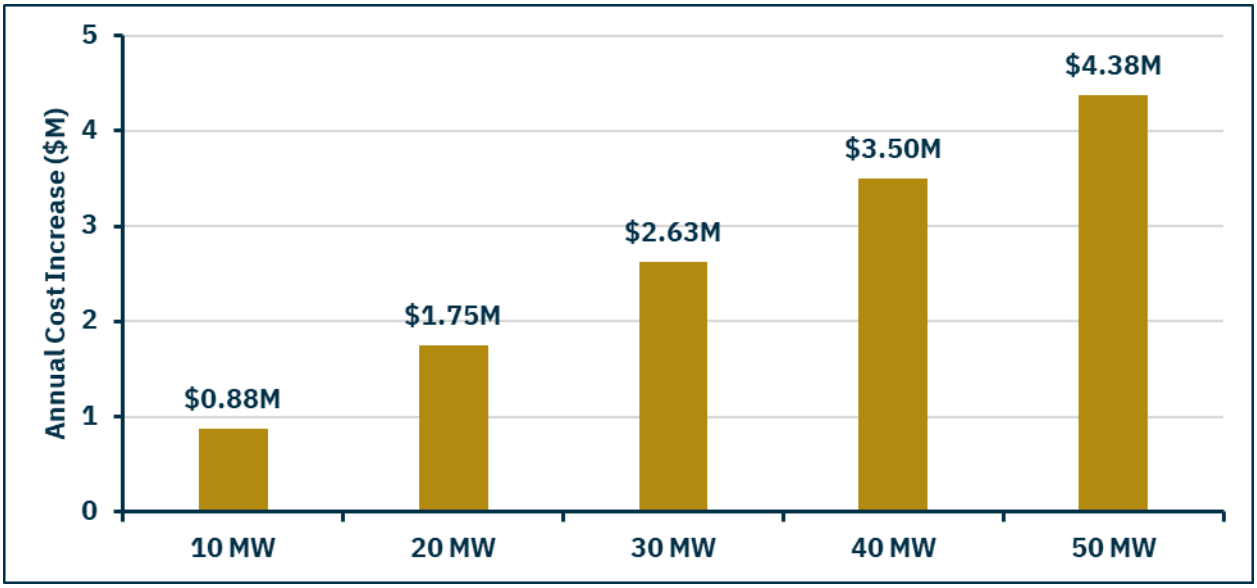
Figure 10 - Annual Energy Costs by Data Center Size ($M)



Source: Energy Information Administration (EIA), Independent Analysis

Because data centers operate continuously at high load, electricity costs scale linearly with both power consumption and local energy prices. This creates a direct and measurable relationship between changes in electricity price and total operating costs.

Figure 11 *- Annual Energy Costs Increase From a $0.01/kWh Price Increase*



Source: Energy Information Administration (EIA), Independent Analysis

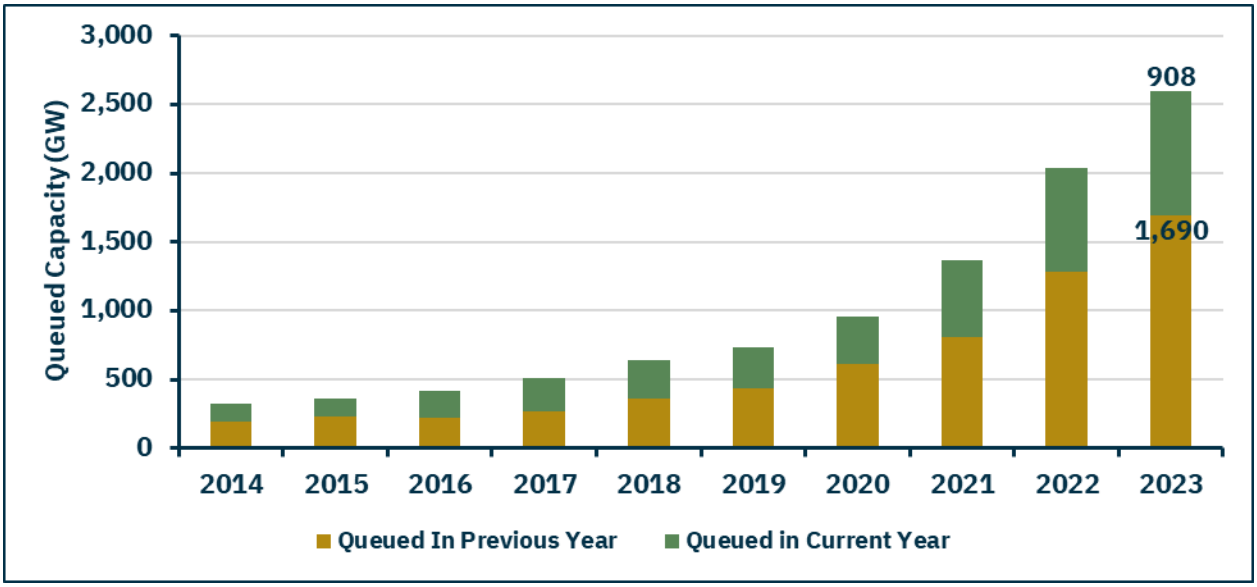
These sensitivities highlight that relatively small differences in electricity pricing between markets can translate into millions of dollars in annual cost differences. For example, a $0.01/kWh increase results in approximately $4.38 million in additional annual costs for a

50MW facility (Figure 11). Over the life of an asset, these differences compound, materially impacting operating margins, investment returns, and ultimately asset valuation.

Availability & Interconnection Limitations

Access to electrical infrastructure has become a binding constraint on new data center development, driven in part by rising demand for grid interconnection. As electrification accelerates across sectors, including data centers, renewables, and industrial loads, interconnection queues have expanded significantly, placing increasing pressure on existing transmission and distribution systems. This trend highlights both the scale of demand for new capacity and the challenges associated with integrating it into the grid.

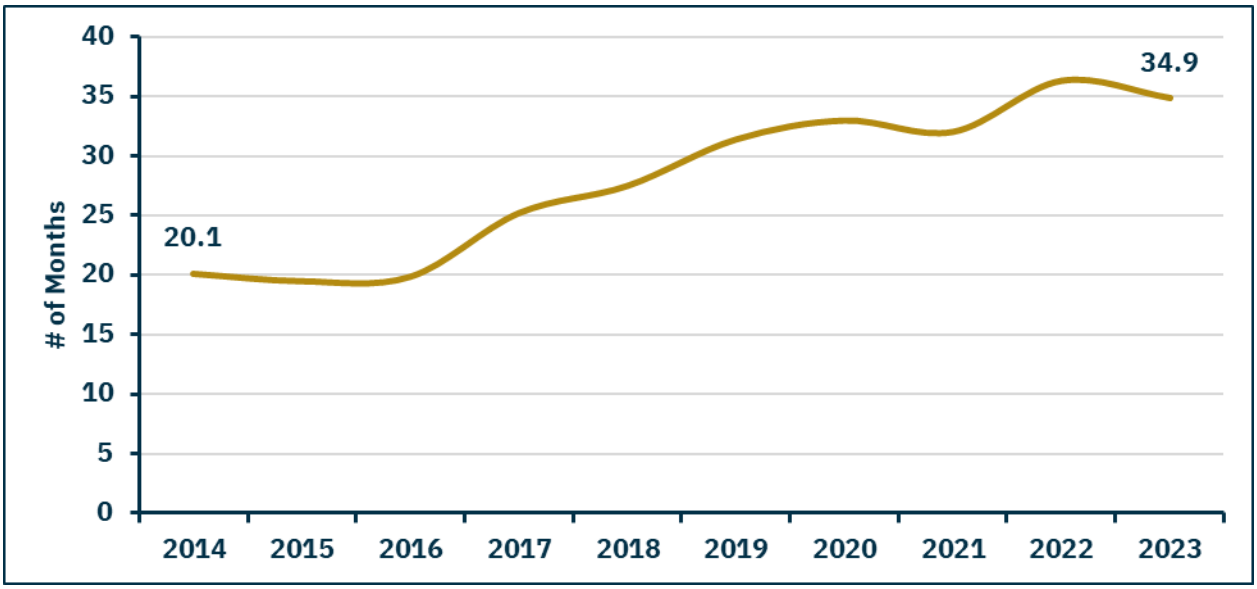
Figure 12 *- Total Power Capacity (GW) in Interconnection Queues*



Source: Lawrence Berkeley National Laboratory

The growth in interconnection queues has been accompanied by longer project timelines. As more projects compete for limited grid capacity, the time required to secure interconnection has extended, often due to system impact studies, permitting processes, and required infrastructure upgrades. These delays introduce additional uncertainty and can materially affect project development schedules. From an investor perspective, this translates to timing risk, potentially deferring revenue generation and reducing project returns.

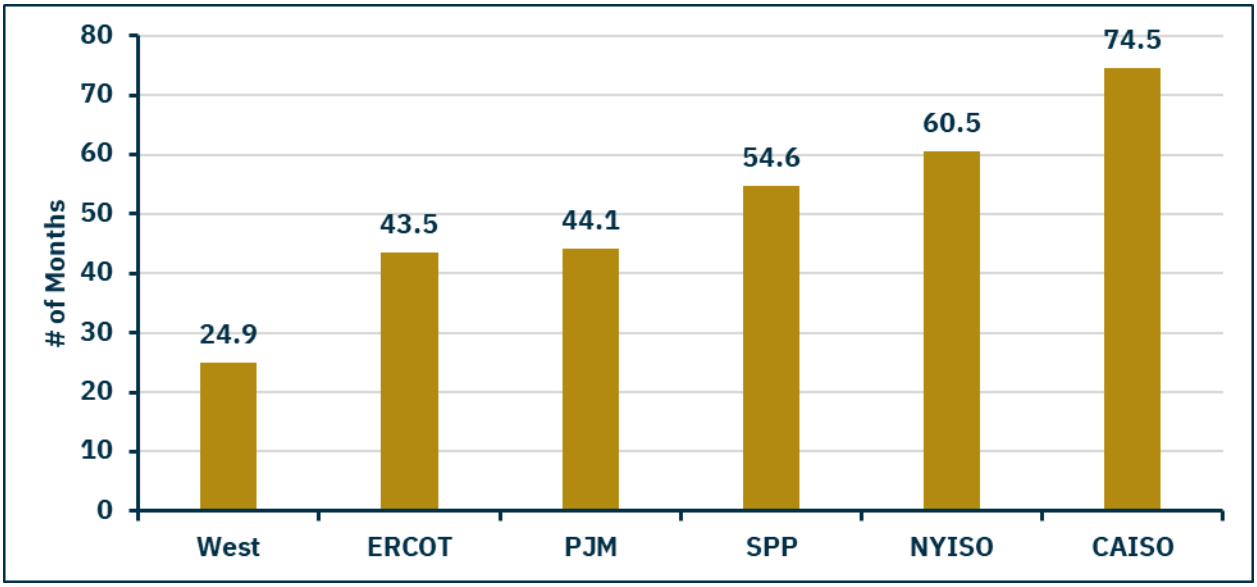
Figure 13 *- Median Time Between Interconnection Request (IR) and Agreement (IA)*



Source: Lawrence Berkeley National Laboratory

Importantly, interconnection timelines are not uniform across regions. Differences in grid infrastructure, regulatory frameworks, and overall demand for capacity result in significant variation in wait times across major U.S. power markets. This creates a geographic dimension to power availability, where some regions are better positioned to support new development than others.

Figure 14 *- Average Time From Interconnection Request (IR) to Commercial Operations Date (COD)*



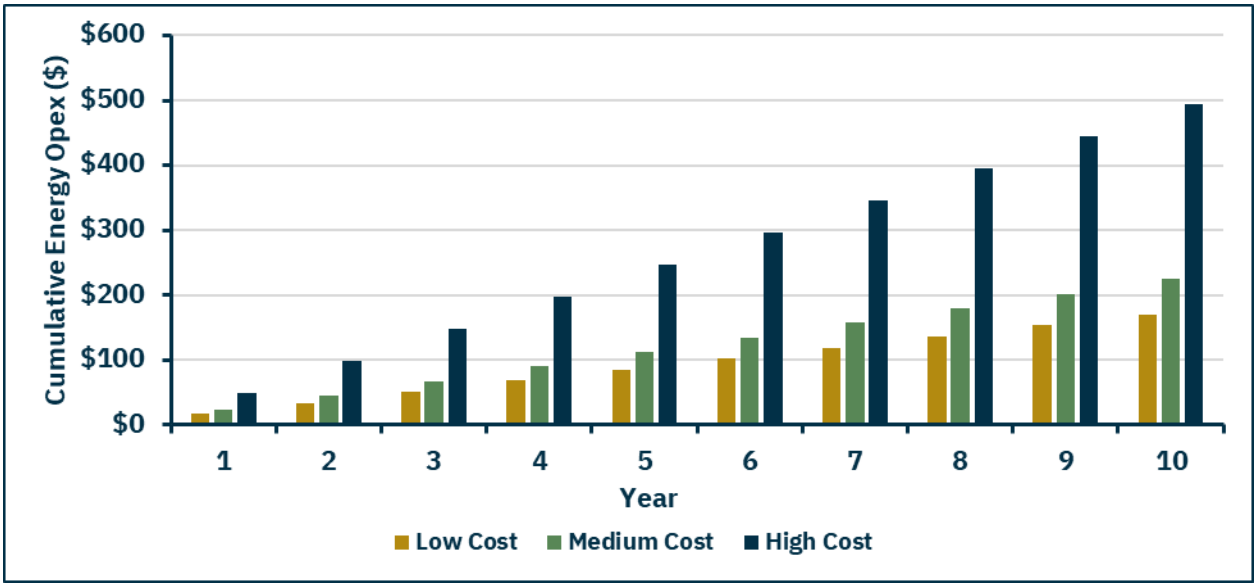
Source: Lawrence Berkeley National Laboratory, Independent Analysis

Together, these dynamics reinforce power availability as a gating factor in data center development. Expanding interconnection queues and longer wait times limit the pace at which new capacity can be delivered, even in markets with strong demand. As a result, regions with available grid capacity or shorter interconnection timelines are likely to attract a disproportionate share of new investment, while more constrained markets may see limited supply growth despite favorable demand fundamentals.

Effects of Energy Prices on Data Center Returns

Electricity costs play a central role in determining the operating performance and investment returns of data center assets. While revenue is largely driven by contracted capacity and demand for compute, operating expenses, particularly those tied to energy consumption, can vary significantly across markets. As a result, differences in electricity pricing translate directly into variations in operating margins.

Figure 15 *- Cumulative Opex (Low vs Med vs High Scenarios, 30MW Data Center)*



Source: Energy Information Administration (EIA), Independent Analysis

The sensitivity of energy costs to pricing, as shown in the previous section, underscores the magnitude of this effect. For large-scale facilities operating continuously, even small changes in electricity prices can result in millions of dollars in annual cost variation. Over the life of an asset, these differences compound, materially impacting cumulative cash flows and overall returns.

From an investor perspective, this creates a structural advantage for assets located in lower-cost power markets. Facilities in these regions benefit from lower baseline expenses, improving margin stability and supporting stronger long-term returns. Conversely, assets in higher-cost regions may face margin compression unless offset by higher pricing power or other competitive

advantages. As a result, electricity pricing is not just an operational consideration, but a key driver of financial performance and investment outcomes.

Tradeoffs: Cheap Power vs Strategic Location

While electricity cost and availability are critical factors in data center development, they are not the sole drivers of site selection. Industry frameworks, such as those developed by Cushman & Wakefield, show that location decisions are influenced by a combination of infrastructure, market, and operational considerations. As shown below, power availability ranks as a top-tier criterion, while power cost is typically evaluated alongside a broader set of medium-priority factors.

Figure 16 *- Criteria of Market Selection for Data Center Investment, Ranked*

Importance	Criteria	Weight
1	Power Availability	High
2	Land Availability	High
3	Market Size	High
4	Capacity Under Construction	Medium
5	Planned Capacity	Medium
6	Land Price	Medium
7	Fiber Connectivity	Medium
8	Vacancy & Absorption	Medium
9	Regulations & Incentives	Medium
10	Power Cost	Medium
11	Cloud Availability	Medium
12	Renewable Power Options	Medium
13	Environmental Risk	Low
14	Taxes	Low
15	Water Availability	Low
16	Political Stability	Low

Source: Cushman and Wakefield

In practice, many of the largest data center markets, such as Northern Virginia and Phoenix, continue to attract significant investment despite not always offering the lowest electricity prices. This reflects the importance of other high-priority factors, including land availability and market size, as well as the advantages of established ecosystems. Dense fiber networks, proximity to major demand centers, and existing development pipelines create structural benefits that can outweigh differences in power pricing.

As a result, developers and investors must evaluate data center locations across multiple dimensions. While access to affordable power remains a key consideration, it is typically optimized alongside other factors rather than minimized in isolation. The most competitive

markets are those that balance power availability, demand, connectivity, and development readiness, rather than simply offering the lowest electricity costs.

Implications for Investors and Valuation

The analysis above highlights the central role of power in shaping both the development and performance of data center assets. Unlike traditional real estate sectors, where value is primarily driven by location and tenant demand, data center valuation is increasingly influenced by access to reliable, scalable, and cost-effective power. As a result, power considerations extend beyond operational factors and directly impact both risk and return.

From an operating perspective, electricity costs are a key driver of margins, with even modest differences in pricing translating into meaningful variations in annual cash flow. Over the life of an asset, these differences compound, affecting cumulative returns and overall investment performance. At the same time, power availability introduces a distinct form of development risk, as interconnection delays or grid constraints can limit new supply and defer revenue generation.

These dynamics create clear differentiation across markets. Regions with available capacity and favorable energy economics are better positioned to support faster development and more stable operating performance, while constrained or higher-cost markets may require stronger demand fundamentals or pricing power to justify investment. As a result, investors must evaluate opportunities across multiple dimensions, incorporating power availability, cost, and infrastructure alongside traditional real estate considerations.

As the sector continues to grow and power requirements increase, access to electricity is becoming a primary determinant of both asset performance and valuation. In this context, power is not simply an input cost, but a foundational driver of value, shaping where data centers can be built, how they operate, and the returns they generate over time.