IMPACTS OF PROJECTED DATA CENTER GROWTH AND EMERGING UNCERTAINTIES ON POWER DEMAND IN THE SOUTHEAST

PREPARED FOR SOUTHERN ENVIRONMENTAL LAW CENTER

December 2025

Prepared by Greenlink Analytics, Inc.
and Science for Georgia

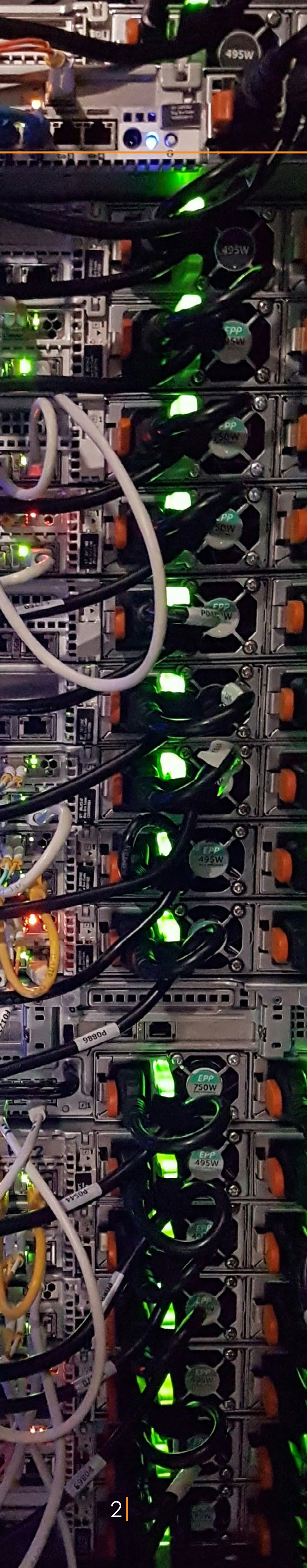


Table of Contents

Click on the section you wish to jump to. Use the **Back to Table of Contents** button at the bottom of each page to navigate back here.

Photo by Massimo Botturi on Unsplash


Photo by Taylor Vick on Unsplash

Executive Summary

Utilities and pipeline companies across the Southeastern United States are planning significant, long-term expansions of natural gas infrastructure over the next 15 years, with projected data center growth cited as one of the primary drivers. This expansion is amplified by the vertically integrated utility structure, which rewards capital investment and encourages the construction of surplus generation capacity as a hedge against service disruptions—even when projected demand may not fully justify such scale.

Herein, we focused on major utilities across the Southeast. The 'Southeast,' defined for purposes of this analysis, includes Alabama, Georgia, North Carolina, and South Carolina. We begin with a retrospective analysis that reveals that, since at least 2007, several Southeastern utilities have consistently overestimated peak demand growth in their ten-year forecasts. Given that overestimations are both common and financially advantageous for utilities, it is essential to critically examine the assumptions behind these forecasts, particularly those linked to data center growth today.

To develop an independent load forecast for the Southeast, we first needed independent growth estimates. Informed Southeastern data center load planning requires reviewing broader datasets and studies. Reliably anticipating regional data center load growth is difficult; therefore, targeted regional research is scarce and still in its early stages, with very few precedent studies available. At the same time, international, national, and regional markets are highly interdependent and integrated, reflecting common demand drivers of the data center market.

According to the International Energy Agency (IEA), the US market remains a constant proportion of the world-wide datacenter market from 2024-2030.[1] As such, we assume that global and domestic growth rate and trend data can be looked at interchangeably. For the remainder of this report, 'global' encompasses both domestic and international markets.

Currently the Southeast is a growing data center market. There are plausible scenarios under which growth in the Southeast could exceed the national

1. "Energy and AI." International Energy Association (IEA). IEA, April 2025, at 258 https://www.iea.org/reports/energy-and-ai. Calculated from Table A.2 p.259. 2024 (42GW/97GW)=43%, (100GW/226GW)=44%

average (continued accelerating growth), lag behind the national average (constrained by saturation or community opposition), or remain in line with the national average. For purposes of this analysis, we adopt the central assumption that Southeast markets will track national (and, by extension, global) market demand growth trends. This alignment assumption is analytically conservative because it avoids pairing low local growth with high global growth (or the reverse), combinations that would require additional, speculative justifications.

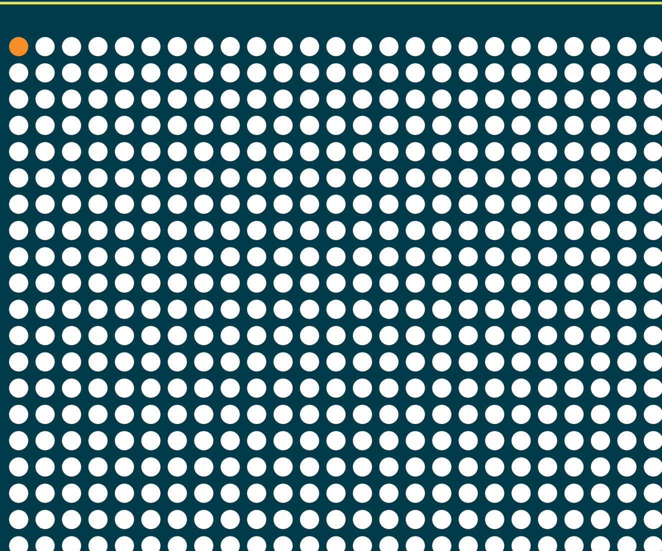
Once we established a basis for using independent analysis at a global scale, we performed an uncertainty analysis using Monte Carlo (MC) simulations. Rather than producing a single-point forecast, the MC analysis generated a probability distribution of potential outcomes, providing a statistically robust means to evaluate uncertainties in future demand projections. We created two forecasts from the MC simulations. One has a conservative efficiency outlook, only incorporating subject matter experts' estimated shifts in domestic and global data center markets. The second forecast is more optimistic about efficiency gains that could be achieved via advancements in hardware technology and computing algorithms.

The results of the first conservative efficiency MC forecast indicate data center load growth of between 2.4 and 6.7 GW over the next five to six years in the Southeast. In contrast, the utilities' growth forecast is approximately 10 GW[2] growth over the next five years. The utilities' expected growth exceeds 99.7% of the simulations from the conservative efficiency forecast. In other words, utilities are planning for a future that seems to have about a 1-in-500 likelihood of occurring, or less than a 0.22% chance. Moreover, the second MC forecast highlights that significant data center expansion could continue while the associated load growth is mostly offset by continued adoption of energy-efficient and emerging technologies. In this case, the utilities' expected growth falls well outside our predicted growth.

Even when accounting for surplus generation capacity as a safeguard against service disruptions, our findings indicate that utilities' forecasts lie well outside the most probable range of outcomes. Infrastructure planning or investment decisions that rely on high demand forecasts risk driving unnecessary investments and infrastructure. We recommend healthy skepticism of aggressive utility forecasts to avoid underutilized or stranded assets and increased retail electricity costs for ratepayers.

Key Point: What does 1 in 500 look like?

The utilities' expected growth exceeds **99.7%** of the simulations from the conservative efficiency forecast. In other words, utilities are planning for a future that seems to have about a **1-in-500** likelihood of occurring, or less than a 0.22% chance.



2. Recent Georgia PSC proceedings provide more context. On Dec. 10, 2025, Georgia Power and Georgia PSC Public Interest Advocacy Staff filed a stipulation in Docket Nos. 56298/56310 authorizing procurement certification on the order of ~10 GW of resources within Georgia Power's territory. This does not change this report's Monte Carlo results, which model load uncertainty; GW of approved resources is not a one-to-one proxy for realized data-center load. Notably, five days earlier, Staff filed an "Excess Capacity Risk" exhibit labeling >4.3 GW as "Speculative Load Growth," and after the stipulation for ~10 GW was filed, Staff reaffirmed that the exhibit remained accurate. See attached Addendum for additional details, references, and figures.

Photo by by Michael Schwarz

1. Introduction

Over the next 15 years, utilities and pipeline companies in the Southeastern U.S. are planning a significant expansion of methane, or natural gas, infrastructure, including new pipelines and power plants.[3] In recent discussions and projections on load growth, data centers have emerged as one of the primary justifications for the substantial proposed expansion of gas infrastructure.[4]

In recent years, the data center industry has undergone rapid, substantial growth driven by evolving technologies, consumer needs, and global economic shifts. It is increasingly challenging to pinpoint a definitive measure of total current power demand required nationwide by existing data centers already in operation, as there is no uniform reporting. Recent estimates of 2024 data center demand in the United States (which we define as the peak power draw from data centers already in operation) vary widely. When it comes to state-level data in the Southeast region, the picture is more opaque due to the lack of consistent state-level data or a comprehensive reporting system.

This study examines the range of predicted data center demand in order to create an independent data center load forecast for the Southeast. This independent forecast will be compared with an aggregation of Southeastern utilities data center load forecasts. For purposes of this study, the Southeast region is defined as encompassing the four states of North Carolina, South Carolina, Georgia, and Alabama. Within these states, we examined the service territories of Duke Energy (both Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP)), Georgia Power Company (GPC), Alabama Power Company (APC), Santee Cooper,

3. Institute for Energy Economics and Financial Analysis. Data Centers Drive Buildout of Gas Power Plants and Pipelines in the Southeast. Jan. 2025, pp. 5–9. https://ieefa.org/resources/data-centers-drive-buildout-gas-power-plants-and-pipelines-southeast. Accessed 15 Sept. 2025.

4. Institute for Energy Economics and Financial Analysis. Data Centers Drive Buildout of Gas Power Plants and Pipelines in the Southeast. Jan. 2025, pp. 12–13. https://ieefa.org/resources/data-centers-drive-buildout-gas-power-plants-and-pipelines-southeast. Accessed 15 Sept. 2025.

and Dominion Energy South Carolina (DESC), which accounts for the vast majority[5] of the four Southeast states' annual load.

Due to explosive growth, the lack of transparency around current and forecasted capacity, and the volatile global market situation, forecasts of data center load growth are highly variable.[6] In this report, we endeavor to provide a quantification of this variable demand by using well-established and accepted Monto Carlo (MC) techniques.

By simulating thousands of possible future scenarios, MC simulations generate a probabilistic range of outcomes rather than a single forecast and estimate the likelihood of each outcome. For instance, an MC simulation might anticipate a 50% chance of lower demand occurring than how much the utilities forecast due to the current chip shortage and a 5% chance of higher demand occurring due to the prevalence of machine learning technologies.

State Public Utility Commissions (PUCs), which regulate utilities, use modeling techniques involving stochastic simulations such as MC in Integrated Resource Planning (IRP) processes to evaluate future power demand under uncertainty. While not every IRP explicitly mentions MC modeling, many of the modeling approaches used in IRP proceedings align closely with the general practice of MC modeling. PUCs require utilities to assess multiple future scenarios involving uncertain variables such as weather, fuel prices, economic conditions, and technology adoption. These scenarios are used to evaluate the performance of different resource portfolios over time. More detailed explanations of the MC modeling techniques and the interpretation of the results are included in Section 3 and Appendix A.

This report begins with reviewing utilities' historical energy demand forecasts and then presents a best estimate of the current data center load in the Southeast region. In projecting future growth, two contingencies are considered in this analysis. The first case, serving as a reference (comparison) case, estimates data center load growth based on publicly available information from utilities and news outlets such as Integrated Resource Plan (IRP) discussions, news articles, and energy committee meetings as described in Section 2, resulting in the utilities' cumulative data center load growth estimates that are driving requests for capacity expansion. The second case, as detailed in Section 3, involves conducting a literature review to gather credible insights from technology and market experts, followed by MC simulations that provide an uncertainty analysis for data center electricity demand in the Southeast, with our conclusions outlined in Section 4.

---

5. Using the EIA-861 2024 ER data and the most recent Integrated Resource Plan (IRP) documents, we compared the total peak load across four states and that of the six utilities. We found that the combined peak load of the six utilities represents approximately 86–90% of the total peak load of the four states. Due to differences in boundary definitions across datasets and literature, as well as variations in reporting timelines and temporal resolution, we present these figures as ballpark estimates rather than precise measurements.

6. London Economics International LLC. Uncertainty and Upward Bias Are Inherent in Data Center Electricity Demand Projections. Southern Environmental Law Center, 7 July 2025, p. 8. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf. Accessed 15 Sept. 2025.

Photo by Conny Schneider on Unsplash

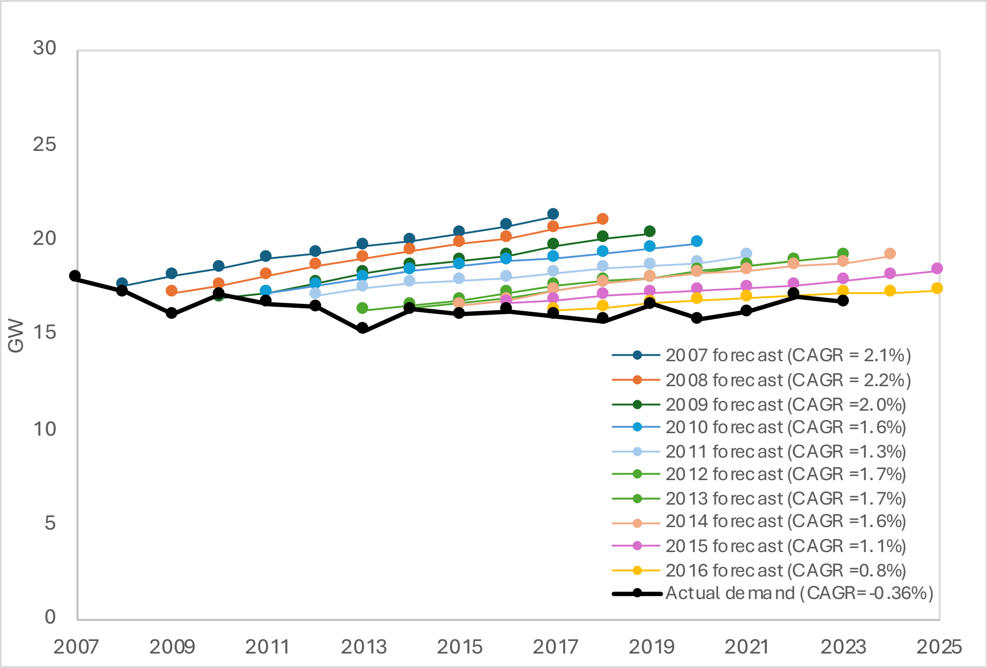
2. Utility Demand Forecasts

This section provides a comprehensive review of historical demand forecasts developed by utility companies in the Southeast, offering insights into how past projections have aligned with actual power demand each year. It then discusses the power demand of data centers, both in the present and over the next 10 years, highlighting their dominance in driving the projected growth of overall electricity demand. As data centers continue to expand in scale, they are recognized as one of the most significant factors in the projected increase in load in some power markets, including in the Southeast region.

2.1 Historical Analysis of Utility Demand Forecast

To compare the demand forecasts with the actual demand each year and to assess the accuracy of utilities' demand projections, this section reviews 17 years of GPC and 18 years of DEC peak demand forecasts based on direct filing data submitted by the two utilities to the Federal Energy Regulatory Commission (FERC) through FERC Form 714. The black dots and the line represent the actual peak demand as it changed year after year. The colored dots and the lines show utility growth forecasts starting at different points in time (Figures 1, 2, and 3).[7]

FIGURE 1 GPC'S PEAK LOAD FORECASTS (2007 FORECAST TO 2016 FORECAST). THE BLACK LINE SHOWS ACTUAL DEMAND, WHILE THE VARIOUS COLORS INDICATE FORECASTS.



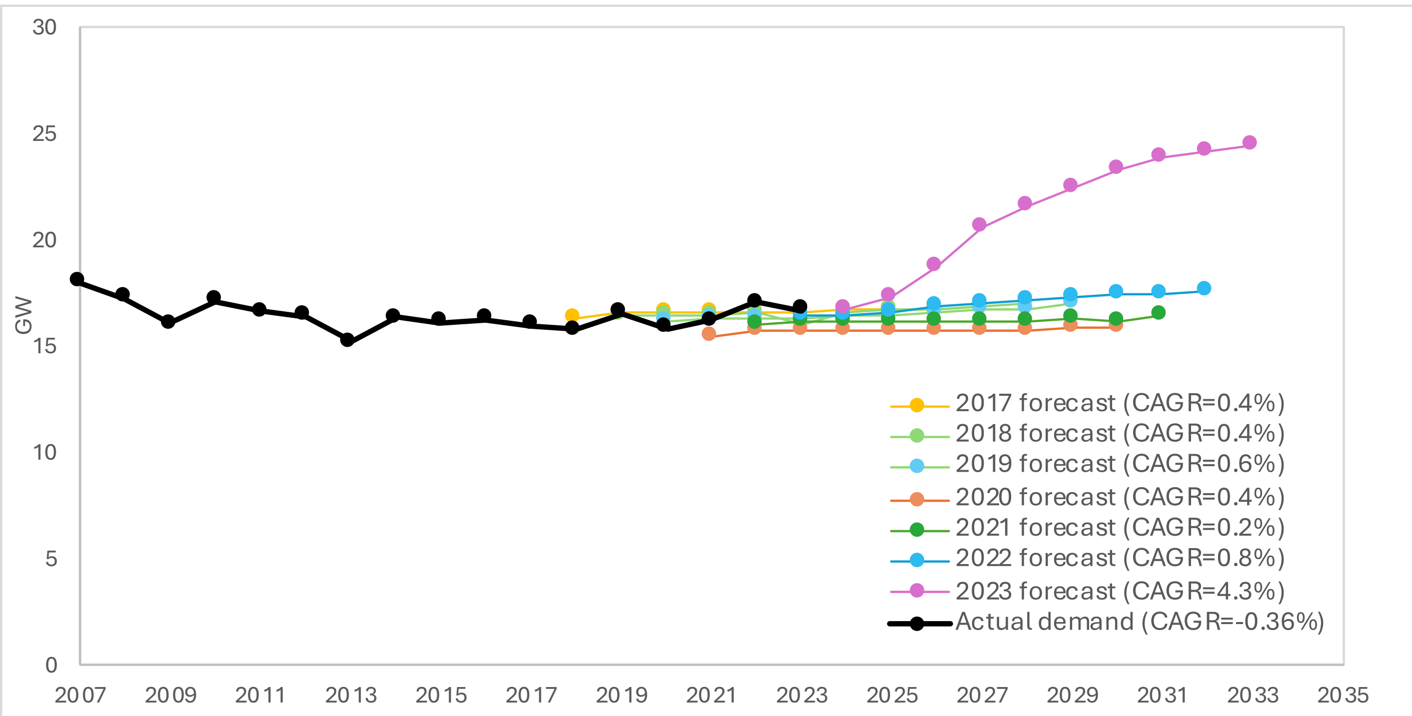
7. Federal Energy Regulatory Commission, FERC eForms Submission History, https://ecollection.ferc.gov/submissionHistory. Accessed March 2025. For each year, we filtered by company and reporting year and collected 17 years of Georgia Power Company (GPC) and 18 years of Duke Energy Carolinas (DEC) peak demand forecasts from the FERC eForms Submission History database.

Figure 1 presents GPC's peak load forecasts, showing that the actual peak load has been consistently below GPC's ten-year forecasts. For the years projected by the 2007 to 2013 forecasts, the largest actual ten-year growth was 1.5 GW (for 2013 to 2023), while the smallest GPC forecasted load growth was 2 GW (the 2011 forecast for 2021).

The biggest GPC forecast misses were 2007 and 2008 forecasts for 2017 and 2018, both off by over 5 GW. By 2015, the load forecasts became noticeably less steep (see compound annual growth rates, CAGRs, in the legend).

Figure 2 shows a different pattern for GPC forecasts in 2017 and through the COVID-19 pandemic, aligning more closely with historical load demand. The 2023 load forecast (pink) is an anomaly exceeding the previous pattern of steep growth rates.

FIGURE 2 GPC'S PEAK LOAD FORECASTS (2017 FORECAST TO 2023 FORECAST). BLACK LINE SHOWS ACTUAL DEMAND. VARIOUS COLORS SHOW FORECASTED DEMAND. PINK IS THE 2023 FORECAST.



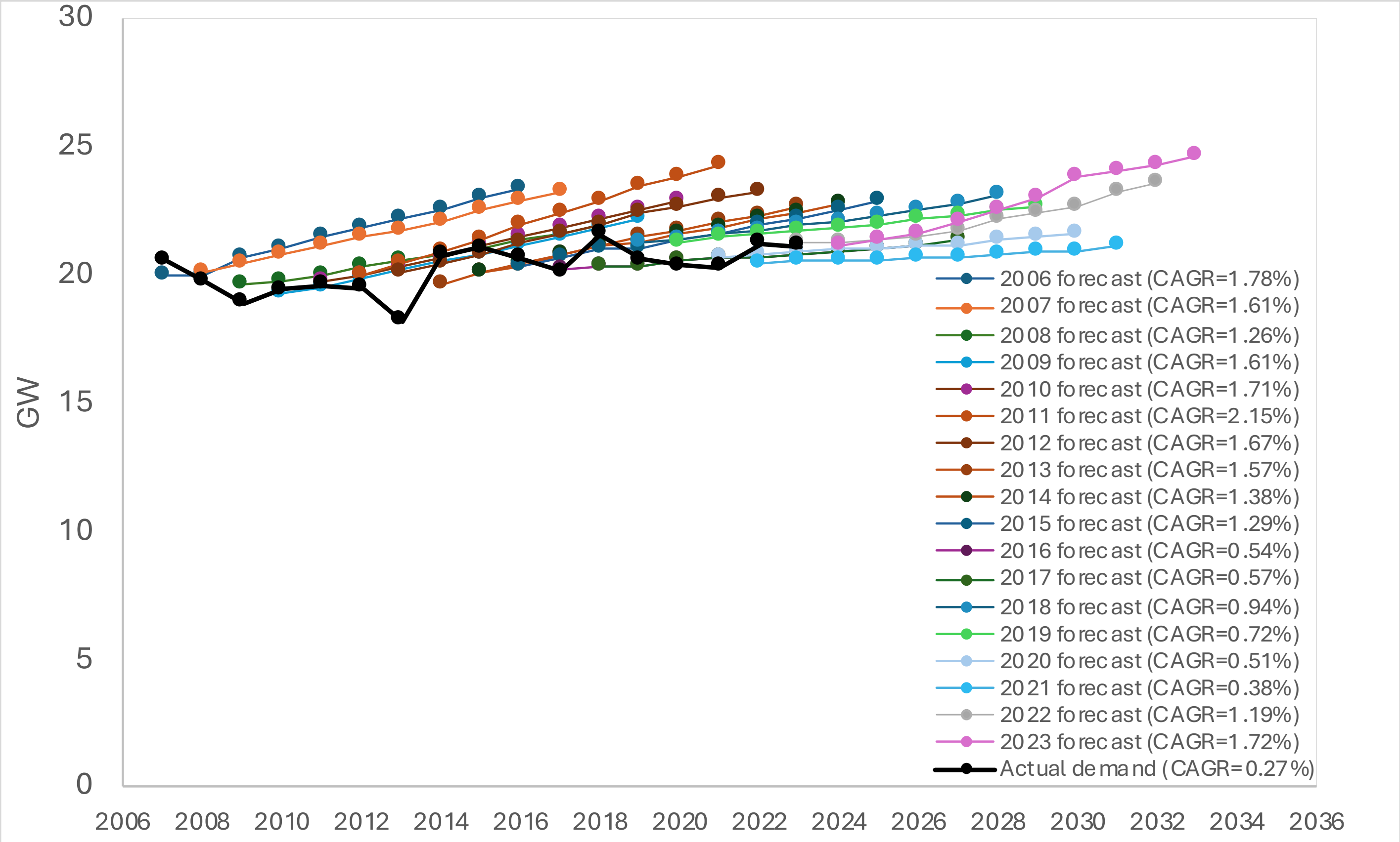
Comparing real demand with historical forecasts in Terawatt hours (TWh) using FERC-714 data, the Bipartisan Policy Center and Koomey Analytics also highlight that recent utility forecasts, particularly GPC's 2023 projection, show a sharp increase in expected electricity consumption largely attributed to data center growth.[8] This surge in projected load has been used to justify significant expansion of energy infrastructure, including natural gas capacity.

DEC similarly overestimated its ten-year forecasts for the years 2006-2013 (see Figure 3). The DEC forecasts after 2015 have included more modest CAGRs and time will tell whether those ten-year forecasts will be close to the actual load growth. Most notably, like GPC, DEC's 2023 forecast returns to steeper load growth. DEC's 2023 forecasted CAGR for load growth is more than 6 times higher than the 0.27% long term historical growth rate.

8. Bipartisan Policy Center & Koomey Analytics. Electricity Demand Growth and Data Centers: A Guide for the Perplexed. Feb. 2025, p. 8, Figure 3. https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2025/02/BPC-Report-Electricity-Demand-Growth-and-Data-Centers-A-Guide-for-the-Perplexed.pdf. Accessed 15 Sept. 2025.

Photo by Philipp Katzenberger on Unsplash

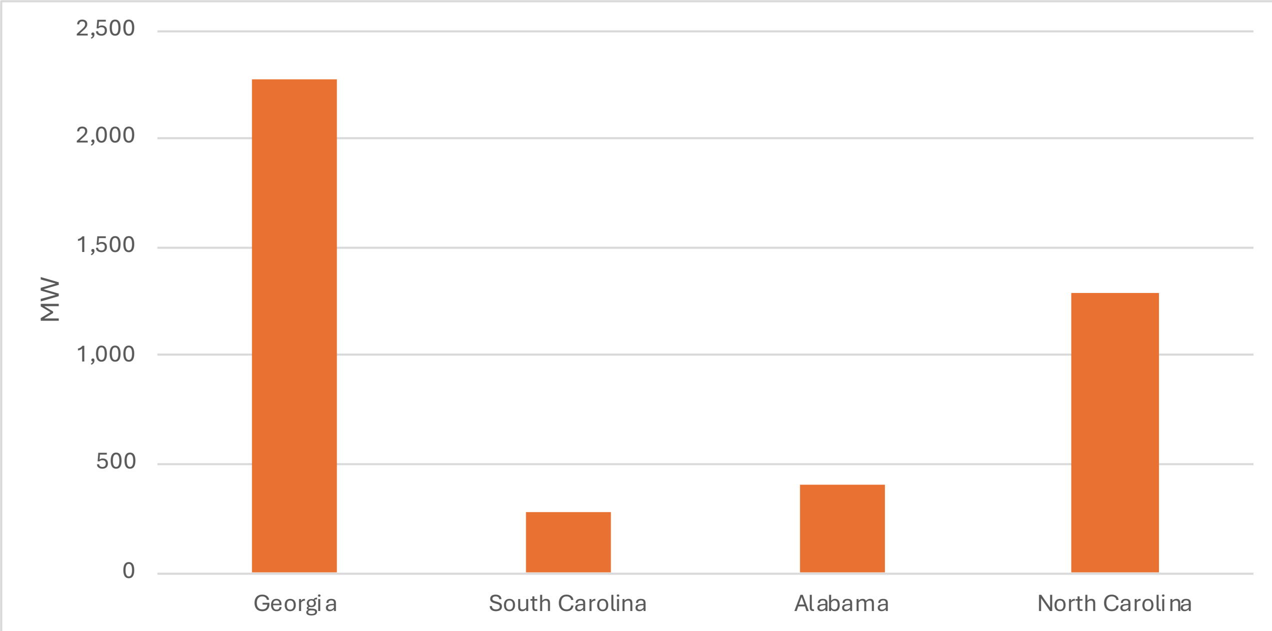
FIGURE 3 DUKE ENERGY CAROLINAS' PEAK DEMAND FORECASTS



2.2 Data Center Demand Forecasts for the Southeast Region

Recently, projected data center loads have become one of the primary and most essential factors in energy resource planning across the Southeast and the nation. Forecasted load growth remains highly variable due to several compounding factors, including: the rapid expansion of the data center industry, sheer size and scale of proposed projects, limited transparency around existing and projected data center demand, and ongoing volatility in domestic and global markets.

FIGURE 4 DATA CENTER ELECTRICITY DEMAND BY STATE FROM S&P ANCHORED ESTIMATES



2.2.1 CURRENT STATUS: DATA CENTER DEMAND IN THE SOUTHEAST

Before projecting future data center loads, a foundational step is to understand the current status of Southeastern data centers. Figure 4 illustrates our best estimate of present electricity demand of data centers across the Southeastern states examined.

There is no standardized reporting platform or centralized database that reliably tracks current data center load at the utility level. We looked at three ways of estimating current data center load (as of the end of 2024). First, from the utilities themselves, we reviewed news articles, fact sheets, and IRP documents. We include some of the most salient utility information in Appendix H. Based on this limited, but publicly available information, our interpretation of the utility's data is that somewhere between 5.1 and 6.7 GW of current load in the Southeast is attributable to data center demand.

A second source, Aterio, indicates Southeast data center load being 2.9 GW.[9]

The third way, is detailed in Appendix G, mostly derived from an estimate from S&P Global Market Intelligence's "Largest Datacenter Utility Demand Center Regions." In June 2025, S&P published the top 15 states (GA & NC included).[10] To obtain estimates for SC and AL this analysis calculated a reasonable estimate for SC and AL demand based on S&P's published demand for GA.[11] Adding the published and estimated values for all four states led to an aggregate estimate of 4.3 GW of current demand (henceforth called our S&P-anchored 2025 Southeastern data center load).

Based on this review, the S&P-anchored estimate of 4.3 GW was selected as the most reasonable starting point for the MC modeling, given S&P's credibility and that it was neither the highest nor lowest value identified.

---

9. Aterio, "Data Centers in the United States." Aterio Website, Accessed 16 July 2025, https://www.aterio.io/insights/us-data-centers.

10. Data Source: S&P Global Market Intelligence. 451 Research Datacenter KnowledgeBase. https://www.spglobal.com/market-intelligence/en/solutions/datacenter-knowledgebase. Accessed June 2025. Although the 451 Research Datacenter KnowledgeBase is proprietary and requires a subscription, S&P Global previously and periodically updated a chart highlighting the top 15 regions with the highest data center utility demand (measured in MW) and made it publicly available. That chart included GA and NC, but not SC and AL. The findings presented in this report are derived from data gathered in June 2025.

11. To approximate the data center loads for South Carolina and Alabama, absent from the KnowledgeBase bar chart, we used Aterio data to calculate each state's ratio relative to Georgia. We then applied these ratios to Georgia's demand of 2,279 MW to estimate the corresponding loads for South Carolina and Alabama. The full methodology to estimate the current data is explained in Appendix G. Unlike utility estimates, our estimates are statewide and likely slightly higher than those of the relevant utilities in those states.

2.2.2 FUTURE FORECASTS: POTENTIAL CUMULATIVE GROWTH

In recent years, the potential cumulative growth of data center load has been a recurring topic in state energy forums, committee meetings, and IRP proceedings. In their official forecasts, some utilities such as GPC have not publicly disclosed the attributions of data centers to load growth in terms of megawatts (MW).

To estimate expected data center load growth for the Southeast utilities over the next decade, we collected utilities' demand forecasts, interpreted the individual utilities' public statements to estimate the percentage due to data centers, and then approximated the potential cumulative growth attributed to data centers as shown in Figure 5.

In GPC's 2025 projections, roughly 80% of its new power generation over the next 5 years is anticipated to be consumed by data centers.[12,13] Based on publicly available datapoints and statements, we applied an 80% factor to the projected total winter peak load growth.[14]

Across North and South Carolina, Duke Energy (both DEC and DEP) provided estimates that approximately 45% of their large-load growth is attributable to data centers in the evidentiary hearing on the Biennial Consolidated Carbon Plan and Integrated Resource Plans in August 2024.[15] As the CEO mentioned in the hearing, his statement was based on their 2024 supplemental analysis. We applied the 45% factor to the large-site load growth [16] presented in that analysis.

Santee Cooper projects that data centers could account for 70–80%[17] of its anticipated load growth. We applied a 75% factor to its total load growth[18] to estimate the data center load growth.

The exact percentage of total load attributable to data centers for Dominion Energy South Carolina (DESC) is not explicitly stated in its public 2025 IRP document. In March 2024, DESC issued an update

---

12. Dunlap, Stanley. "Georgia Power's Plan to Support Potential Data Center Surge with Fossil Fuel Energy Faces Scrutiny." Georgia Recorder, 1 June 2025, https://georgiarecorder.com/2025/06/01/georgia-powers-plan-to-support-potential-data-center-surge-with-fossil-fuel-energy-faces-scrutiny. Accessed 29 Sept. 2025.

13. Institute for Energy Economics and Financial Analysis. Data Centers Drive Buildout of Gas Power Plants and Pipelines in the Southeast. Jan. 2025, p. 15. https://ieefa.org/resources/data-centers-drive-buildout-gas-power-plants-and-pipelines-southeast. Accessed 15 Sept. 2025; Butler, Georgia. "Georgia Power Increases Power Capacity by 1.4GW with Fossil Fuels to Meet Data Center Demand." Data Center Dynamics, April 17, 2024, https://www.datacenterdynamics.com/en/news/georgia-power-increases-power-capacity-by-14gw-with-fossil-fuels-to-meet-data-center-demand. Accessed 2 Oct, 2025.

14. Georgia Power Company. 2025 Integrated Resource Plan. Georgia Power, Jan. 2025, p. 35, fig. 5A. https://www.georgiapower.com/content/dam/georgia-power/pdfs/company-pdfs/2025-Integrated-Resource-Plan.pdf. Accessed 29 Sept. 2025.

15. North Carolina Utilities Commission, In the Matter of: Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c), Hearing Transcript, vol. 24, p. 213. 5 Aug. 2024. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=b3f65f27-eaba-4a2e-aa69-00c2d190bf7a. Accessed October 16, 2025; Climate Power. "Amid Rising Energy Costs, Senator Tillis Must Protect Energy Supply Needed to Power Our Global Tech Edge." Climate Power, 11 June 2025, https://climatepower.us/news/amid-rising-energy-costs-senator-tillis-must-protect-energy-supply-needed-to-power-our-global-tech-edge/ (See the second bullet point of this article).

16. Duke Energy. Supplemental Planning Analysis: Carolinas Resource Plan. Duke Energy, 2024, Table SPA 2-2 in p. 16. https://www.duke-energy.com/-/media/pdfs/our-company/carolinas-resource-plan/supplements/supplemental-planning-analysis.pdf?rev=f134d62ba6d645ccb3de2bc227a0d42d. Accessed 29 Sept. 2025.

17. 70-80% (Special Committee Meeting on South Carolina's Energy Future, August 22, 2024). https://www.scstatehouse.gov/video/archives.php. An estimate of data center-related load growth was mentioned around the 1:14 mark of the recorded meeting, where it was described as the lion's share, roughly 70–80% of anticipated growth. The video was previously available in the South Carolina Statehouse Video Archives as of March 28, 2025, but is no longer accessible as of Oct. 2025. See also Collins, Jeffrey. "South Carolina Considers Its Energy Future Through State Senate Committee." AP News. 22 Aug. 2024. https://apnews.com/article/energy-bill-south-carolina-senate-hearings-0a5ffcf06c76868c1eeb0d81186c040b (summarizing meeting, including that Santee Cooper's CEO "estimated about 70% of Santee Cooper's increased demand is from data centers").

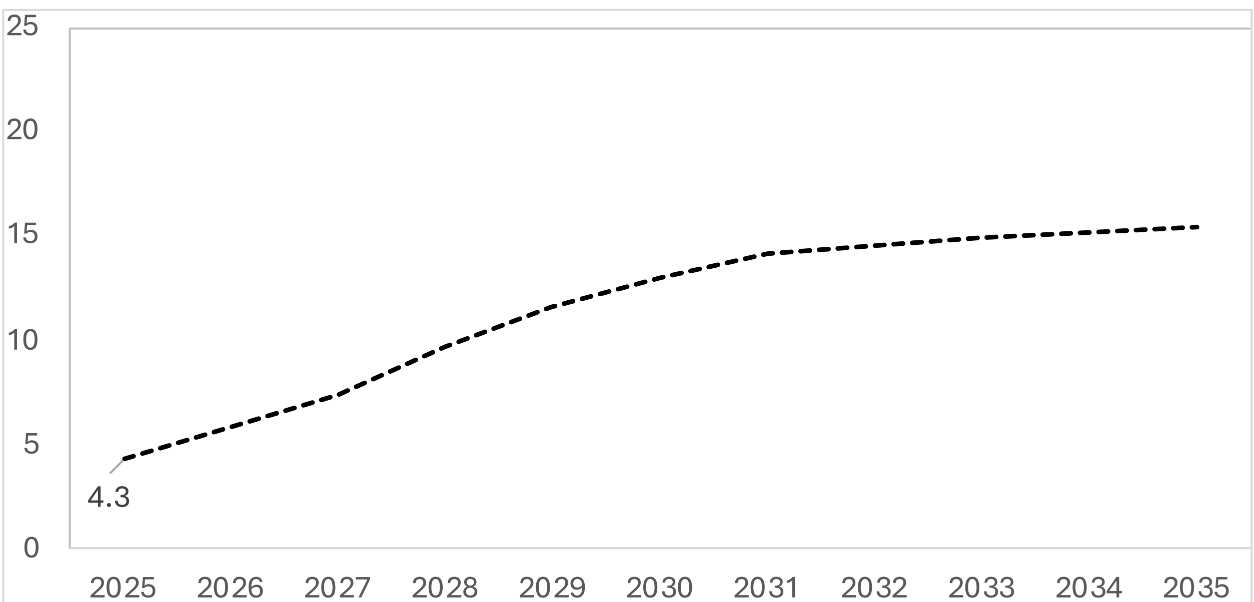
18. Santee Cooper. Integrated Resource Plan 2024 Update. Public Service Commission of South Carolina, 16 Sept. 2024. Pg. 28, https://www.santeecooper.com/About/Integrated-Resource-Plan/Reports-and-Materials/Santee-Cooper-2024-IRP-Update.pdf. Accessed 29 Sept. 2025.

to its IRP, revealing the addition of two major new customers whose combined electricity demand would reach 256 MW by 2032.[19] Based on the publicly available data, we assumed that DESC would supply an additional 256 MW of power for data centers by 2032 and then plateau.

APC has not explicitly outlined the total data center load growth (neither in MW nor as a percentage) in its latest IRP documents. However, according to an HData analysis based on APC's earnings call transcripts and their IRPs, APC had signed agreements totaling 1 GW of data center capacity as of May 2025.[20] APC has publicly announced a partnership with Meta for a new $800 million data center facility, expected to be operational by the end of 2026, though it has not specified the facility's power requirements.[21] Overall, we assumed that APC would supply 1 GW of additional power for data center operations by 2030.

Starting from an estimated currently existing data center load of 4.3 GW (S&P-anchored) in 2025, Figure 5 illustrates the projected growth trajectory based on utilities' expectations for future demand in the Southeast. This projection represents a data center demand outlook grounded in the utilities' resource planning perspective as outlined above. In contrast, Section 3 introduces a probabilistic forecast developed using MC simulations, incorporating insights from market and technology experts. While both approaches begin with the same 4.3 GW existing, 2025 load baseline to ensure comparability, the MC analysis produces a range of possible outcomes reflecting technology and market experts' insights, offering a broader perspective on uncertainty and potential variability in future data center demand in the Southeast.

FIGURE 5 SOUTHEAST DATA CENTER FORECAST (S&P-ANCHORED 2025 BASE WITH APPROXIMATE UTILITIES' DATA CENTER GROWTH FORECASTS)[22]



19. Institute for Energy Economics and Financial Analysis (IEEA). Data Centers Drive Buildout of Gas Power Plants and Pipelines in the Southeast. Jan. 2025, p. 9. https://ieefa.org/resources/data-centers-drive-buildout-gas-power-plants-and-pipelines-southeast. Accessed 26 Oct. 2025.

20. Kelly, Brendan. "Analysis: Where to Colocate a Data Center with an Underutilized Power Plant." HData Blog, 7 May 2025, https://blog.hdata.com/data-center-power-plant-colocation. Accessed 21 Oct. 2025.

21. Underwood, Jerry. "Meta Plans to Build $800 Million, Next-Generation Data Center in Montgomery, Alabama." Alabama News Center, 2 May 2024, https://alabamanewscenter.com/2024/05/02/meta-plans-to-build-800-million-next-generation-data-center-in-montgomery-alabama/.

22. Starting from S&P's current data center load forecast of 4.3 GW as of June 2025, we project future electricity demand by applying growth projections we estimated from the publicly available data points and statements, which reflect utility company forecasts. This approach helps estimate how data center load is expected to evolve over time.

Photo by Yashowardhan Singh on Unsplash

3. Uncertainty Analysis in Data Center Electricity Demand

Utilities in the Southeast are projecting large capacity additions largely attributed to data center demand growth. Section 2 shows that these same utilities have historically tended to overestimate demand growth, and today's demand attribution to data centers is significant but imprecisely measured (often behind closed doors). The next step is to quantify a credible range for future data-center-driven load in the Southeast and to benchmark utility projections against that range.

In this section, we turn to a comparative, quantitative analysis in the form of probabilistic forecasted ranges contextualized to the Southeast region. Aside from the utilities, very few independent or third-party organizations have generated region-specific demand forecasts. Our approach seeks to help fill this gap by first identifying and systematically analyzing critical factors that influence data center demand growth and demonstrating how generalized market estimates can be applied to the Southeast market. Second, we identify market experts' forecasts and use those in an MC simulation to produce a 'high-end' growth scenario. Third, we identify advances in energy efficiency and use those to run an MC model that creates a 'low-end' growth scenario.

3.1. Factors Impacting Data Center Load Growth

The market for data centers is global, and data centers are not uniformly distributed. Data travels to and from these centers at the speed of light; thus, unlike traditional business services, most data centers need not be located near businesses or transport hubs. With few location restraints, prospective data center developers submit multiple bids across different locations – ultimately choosing the location that presents the best combination of resource availability, utility rates, tax incentives, and favorable zoning. The submission of redundant proposals further contributes to speculative demand, which can overinflate estimated load growth. Market forces, available power, and community acceptance are universal drivers of the ultimate placement, construction, and operation of individual data centers. We discuss each of these trends and then their applicability to the Southeast region.

3.1.1 EXISTING MARKET

What is the Southeast Market Share?

In 2023, Boston Consulting Group (Boston Consulting) predicted that the Southeast would be 13% of the U.S. data center market by 2027,[23] and more recent reports more or less confirm Boston Consulting's prediction. CBRE, a global real estate service, lists Atlanta, GA as a high-growth hotspot, and Charlotte, NC as an emerging secondary market. Of the 16 hotspots CBRE is monitoring, Atlanta and Charlotte/Raleigh comprise 13% of the current national capacity.[24] Aterio shows that AL, GA, NC, and SC have 7% of current domestic capacity, 13% of under construction capacity, and 18% of announced capacity.[25] We have identified no other demand forecasts explicitly focused on the Southeast since the Boston Consulting report in 2023.

3.1.2 A GROWING SOUTHEASTERN MARKET?

Recent Emerging Markets

Data centers require a lot of power, and a 2024 trend report by CBRE stated that nationwide construction completion is being delayed due to "a shortage of available power and longer lead times for electrical infrastructure."[26] CBRE's latest trend report in 2025 highlights the same trends: limited power availability, delaying construction completion and driving to new markets.[27] This confirms that data centers seek out inexpensive electricity, water, and land with good broadband access,[28] and when the available resources are gone, they do not wait for utilities to build more capacity but move onto the next market.

Below, a map of data center markets shows the spread of data centers from primary markets (black dots) to secondary markets (dark blue) to emerging markets (lighter blue).[29] As of 2024, Georgia is considered a secondary market, and North Carolina, South Carolina, and Alabama are emerging markets. Most predictions assume that these states will continue to attract data center developers. The most important considerations are whether this load growth will stay high, both in general and relative to other locations.

---

23. Lee, Vivian. "The Impact of GenAI on Electricity: How GenAI Is Fueling the Data Center Boom in the US." LinkedIn Post, Boston Consulting Group (BCG), 13 Sept 2023, https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee. Accessed 29 Sept. 2025. Based on the map included with its report, BCG considers the "Southeast" to include Tennessee, Mississippi, Alabama, Georgia, North Carolina, South Carolina, and Florida.

24. "North America Data Center Trends H2 2024." CBRE Website, CBRE, 26 Feb 2025. https://www.cbre.com/insights/reports/north-america-data-center-trends-h2-2024; "Global Data Center Trends 2025." CBRE Website, CBRE, 24 Jun 2025. https://www.cbre.com/insights/reports/global-data-center-trends-2025. Accessed 29 Sept. 2025. Calculated by adding the current capacity for Atlanta and Charlotte/Raleigh and dividing by the total capacity of all 16 markets CBRE is monitoring.

25. Aterio. Data Centers in the United States. https://www.aterio.io/insights/us-data-centers. Accessed 16 July 2025. The findings presented in this report are derived from data gathered in July 2025.

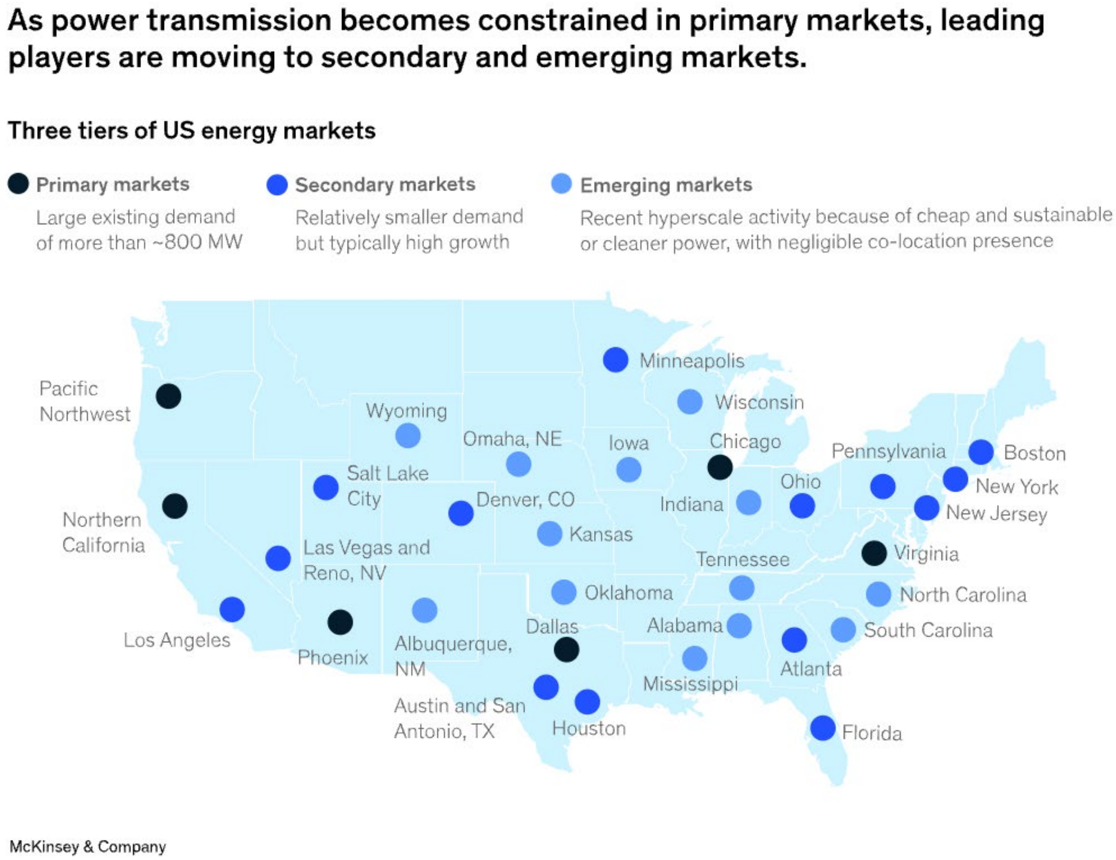
26. "North America Data Center Trends H1 2024." CBRE Website, CBRE, 19 Aug 2024. https://www.cbre.com/insights/reports/north-america-data-center-trends-h1-2024.

27. "Global Data Center Trends 2025." CBRE Website, CBRE, 24 Jun 2025, https://www.cbre.com/insights/reports/global-data-center-trends-2025.

28. Uncertainty and Upward Bias are Inherent in Data Center Electricity Demand Projections. prepared for Southern Environmental Law Center by London Economics International LLC, 7 Jul, 2025. p. 10. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf. Accessed 29 Sept. 2025.

29. "How data centers and the energy sector can sate AI's hunger for power." McKinsey & Company Website, McKinsey & Company, 17 Sept, 2024, https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power#/. Accessed 29 Sept. 2025.

FIGURE 6 US DATA CENTER MARKETS.
SOURCE: DATA CENTERS AND AI: HOW THE ENERGY SECTOR CAN MEET POWER DEMAND (MCKINSEY, 2024)



3.1.3 HEADWINDS TO SOUTHEASTERN AND BROADER MARKET GROWTH

Speculative Demand

Forecasts based on proposed data centers may be inaccurate because there are few curbs on speculative demand. There is no penalty for, and little to no transparency around, companies submitting competing bids in multiple markets to identify the most favorable conditions.[30] These duplicative requests for interconnection across jurisdictions without firm commitments create "phantom load" in utility planning.

A recent analysis by London Economic International (LEI) found that it is highly improbable that the significant growth attributable to data centers in utility forecasts will come to fruition. Practically speaking, LEI's analysis serves as a 'sanity check' on the forecasted load in the United States. The report compares U.S. demand projections to global semiconductor chip supply capacity and finds that forecasts assume a highly unrealistic share of global output—nearly 90% of incremental global chip supply through 2030 would have to be directed to U.S. data centers alone. Given that the U.S. historically accounts for less than half of global chip demand, demonstrates it is highly improbable, if not impossible, for all the proposed facilities to be built.[31]

Yet, although this demand may never materialize, it is being included in utilities' energy planning. For example, Georgia Power assumes that 93% of all data centers in its pipeline (data centers that have

30. Uncertainty and Upward Bias are Inherent in Data Center Electricity Demand Projections. prepared for Southern Environmental Law Center by London Economics International LLC, 7 Jul, 2025. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf. Accessed 29 Sept. 2025.

31. Uncertainty and Upward Bias are Inherent in Data Center Electricity Demand Projections. prepared for Southern Environmental Law Center by London Economics International LLC, 7 Jul, 2025. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf. Accessed 29 Sept. 2025.

reached out to explore power service but have not signed a contract or started construction) will become loads on the grid. This seems to be a gross overestimate; over half of the prospective large load customers identified in Georgia Power's 2023 IRP had dropped out of the utility's load queue by May 2025.[32]

Market Skepticism: Economic Demand for Data Centers

In the past few years, AI has become the new business trend, driving data center growth. While many businesses are exploring AI's utility, if meaningful value does not follow the initial hype, demand for computing power would most likely diminish.[33] As large technology companies announce pauses on data center investments, recent articles, as well as tech executives themselves, caution that the data center demand might be the next bubble.[34] Speculative growth without any accompanying business demand may lead to swaths of unused data center (and consequently unneeded power generation) infrastructure, which has already happened to an extent elsewhere.[35] A bursting bubble would create universal downward pressure on growth.

Data Center Growth without Peak Growth: Behind-the-Meter Generation and Demand Scheduling

As the data center market grows, developers are exploring behind-the-meter power generation such as small nuclear reactors and geothermal to overcome the lack of available power.[36] Behind-the-meter load growth does not increase the utility's load. Therefore, the data center market could continue to grow with relatively less utility load growth than has occurred to date.

---

32. Hotaling, Chelsea. "Direct Testimony of Chelsea Hotaling on behalf of Georgia Interfaith Power & Light and Southface Energy Institute to be filed in Docket No. 56002 and 56003." Submitted May 2, 2025. https://psc.ga.gov/search/facts-docket/?docketId=56002, Doc. No. 222504. 93% likelihood on p. 12, line 13-16: " Georgia Power estimates a 93% likelihood that all data centers in its pipeline in technical review (meaning, who have not yet signed a request for service with Georgia Power) will eventually sign a contract for service in Georgia. None of those projects are under construction." Over half pulled out, p.17, Table 8 and lines 12-14. Lines 8-14: " Table 8 shows Georgia Power's reporting of the customers that dropped out of the 2023 IRP model. Out of the original 51 projects in the 2023 IRP model, 27 projects—over half—left the queue. Based on the drop rate for each of the Project Success levels reported by Georgia Power, there is an even more significant risk (70% dropout) for projects that have been assigned anything other than a 100% Project Success Probability by Georgia Power."

33. McKinsey & Company. The cost of compute: a $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers. Accessed 29 Sept. 2025.

34. Bloomberg, Sara. "AI bubble 'will burst,' Databricks CEO says at San Francisco tech conference." San Francisco Business Times. 06 May, 2025. https://www.bizjournals.com/sanfrancisco/news/2025/05/06/ai-bubble-burst-databricks-ceo-gic-bridge-forum.html?utm_source=st&utm_medium=en&utm_campaign=inno&utm_content=innontlf; Farrell, Maureen. "Wall St. Is All In on A.I. Data Centers. But Are They the Next Bubble?" New York Times. 2 June, 2025. https://www.nytimes.com/2025/06/02/business/ai-data-centers-private-equity.html; Frisch, Ian. "What Wall Street Sees in the Data Center Boom." New York Times, 20 Sept, 2025. https://www.nytimes.com/2025/09/20/business/dealbook/data-centers-ai.html; Gorelick, Evan. "Is AI a Bubble?" The New York Times. 27 Oct, 2025. https://www.nytimes.com/2025/10/27/briefing/is-ai-a-bubble.html; Kunkel, Cathy and Wamsted, Dennis. "Risk of AI-driven, overbuilt infrastructure is real." Institute for Energy Economics and Financial Analysis. 03 June, 2025. https://ieefa.org/resources/risk-ai-driven-overbuilt-infrastructure-real; Martucci, Brian. "DeepSeek called a net positive for data centers despite overcapacity worries." Facilities Drive. 20 Feb, 2025. https://www.facilitiesdive.com/news/deepseek-called-a-net-positive-for-data-centers-despite-overcapacity-worrie/740501/. Accessed 29 Sept. 2025.

35. Chen, Caiwei, China built hundreds of AI data centers to catch the AI boom. Now many stand unused. MIT Technology Review. 26 Mar., 2025 (outlining boom and bust cycle in China, and noting Chinese outlets reporting that "up to 80% of China's newly built computing resources remain unused). https://www.technologyreview.com/2025/03/26/1113802/china-ai-data-centers-unused (Last accessed Oct. 16, 2025).

36. Sharma, Prakash. "Artificial intelligence and the future of energy." The Edge, 27 June, 2024. https://research.alpha-sense.com/doc/WEB-ef381ae62ad36ba79bd67239c9cdb8df. Accessed 29 Sept. 2025.

Back to Table of Contents

A recent report from Duke University[37] highlighted another possible dampener: demand scheduling, where AI can be used to optimize compute resource scheduling in data centers. If data centers voluntarily engage in efficient scheduling to reduce their power draw during system peaks, significant load growth could occur without a corresponding increase in the system peak and new capacity needed. This technique holds promise as another dampener on power demand; however, demand scheduling may impact Service Level Agreements. Without accompanying policy changes, or different Service Level Agreements, there would be financial penalties for implementing this technology.

Community Opposition

Nationwide, community opposition to data center development is growing.[38] Data center facilities may disrupt the visual appeal of the landscape, create resource shortages,[39] and negatively impact human health.[40] Additionally, data centers are typically wooed to a location by local economic incentives, including tax breaks; a recent report from Good Jobs First estimated that at least 10 states are losing over $100 million per year in tax revenue as a result.[41] On a local level, once residents begin to express opposition, development may take longer, the regulatory environment may become less favorable, and tax incentives may be removed. Then, data centers are apt to look for more welcoming locations.

For example, in Georgia, tax breaks[42] are used to attract companies, but the tide appears to be turning against data centers. No formal listing exists, but at least 12 localities are considering, or have passed, moratoriums or ordinances limiting data

---

37. Norris, Tyler, et al. Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems. Durham, NC: Nicholas Institute for Energy, Environment & Sustainability, Duke University. 2025. https://nicholasinstitute.duke.edu/publications/rethinking-load-growth. Accessed 29 Sept. 2025.

38. $64 billion of data center projects have been blocked or delayed amid local opposition." Data Center Watch Website. Accessed 09 Sept, 2025. https://www.datacenterwatch.org/report; Eanes, Zachery. "Data centers will cause higher electricity prices, study finds." Axios Raleigh. 28 Aug, 2025. https://www.axios.com/local/raleigh/2025/08/28/data-centers-will-cause-higher-electricity-prices-study-finds-north-carolina-state; Herring, Garrett and Dlin, Susan. "US datacenter power draw to double by 2028; states tackle cost, supply concerns." S&P Global Online. 10 July, 2025. https://www.spglobal.com/market-intelligence/en/news-insights/articles/2025/7/us-datacenter-power-draw-to-double-by-2028-states-tackle-cost-supply-concerns-91382267; Queen, Alice. "One local official says data centers not 'top priority'." The Citizens. 1 Sept, 2025. https://www.newsbreak.com/the-citizens-299113683/4208767822405-one-local-official-says-data-centers-not-top-priority (discussing a proposed data center project in Georgia); Warnke, Lucinda. "Residents sue Georgia county over data center plans." Government Technology. 29 Sept, 2025. https://www.govtech.com/products/residents-sue-georgia-county-over-data-center-plans; Worland, Justin. "The backlash to high electric bills could transform U.S. politics." Time Magazine. 27 Aug, 2025. https://time.com/7311613/ai-electricity-bills-georgia-politics/.

39. Fleury, Michelle and Jimenez, Nathalie. "'I Can't Drink the Water' – Life Next to a US Data Centre." BBC News. 10 July, 2025. https://www.bbc.com/news/articles/cy8gy7lv448o. Accessed 29 Sept. 2025.

40. Although there are no direct studies, noise from data centers and pollution from backup generators are two factors of concern. In general, noise and PM2.5 can have negative impacts on human health. Biddle, Jennifer. "How noise pollution quietly affects your health." Center for Occupational and Environmental Health. 2 June, 2025. https://coeh.ucdavis.edu/research/how-noise-pollution-quietly-affects-your-health; Dominici, Francesca. Report: Balico Proposal Impact Analysis. Prepared for SELC 12 Apr, 2025. https://www.selc.org/wp-content/uploads/2025/04/2025.04.12-Public-Health-Impacts-Analysis-Balico-Gas-Plant-FINAL-REPORT.pdf; "Health and Environmental Effects of Particulate Matter (PM)." US EPA Website. https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm. Accessed 1 Oct, 2025; Khomenko, Sasha, et al. "Impact of road traffic noise on annoyance and preventable mortality in European cities: A health impact assessment." Environment International 162 (2022): 107160. https://www.sciencedirect.com/science/article/pii/S0160412022000861; Mailloux, Nicholas, et al. "Nationwide and Regional PM2.5-Related Air Quality Health Benefits From the Removal of Energy-Related Emissions in the United States." GeoHealth. 16 May, 2022. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022GH000603; Wierman, Adam and Ren, Shaolei. "We Need to Talk About AI's Impact on Public Health." IEEE Spectrum. 1 May, 2025. https://spectrum.ieee.org/data-centers-pollution.

41. LeRoy, Greg and Tarczynska, Kasia. Cloudy With a Loss of Spending Control: How Data Centers Are Endangering State Budgets. Good Jobs First. April 2025. p. 4. https://goodjobsfirst.org/wp-content/uploads/2025/04/Cloudy-with-a-Loss-of-Spending-Control-How-Data-Centers-Are-Endangering-State-Budgets.pdf. Accessed 29 Sept. 2025.

42. Code Section 48-8-3 of the Official Code of Georgia Annotated, paragraph (68.1). https://law.justia.com/codes/georgia/title-48/chapter-8/article-1/part-1/section-48-8-3/.

centers and crypto mines.[43] City and county council meetings often draw large numbers of citizens opposed to yet another data center request.[44] In 2025, the Georgia General Assembly considered several bills about data centers and created a special committee related to understanding, addressing, and mitigating resource use and growth.[45] The recent Public Service Commission elections in Georgia saw a 25+ point margin of victory for challengers to two sitting Commission members,[46] which many have pegged as a referendum on rising electricity bills that were linked to data centers.[47] Rising community opposition in the Southeast is yet another sign and factor that much of the projected data center load may not come online.

3.1.4 How These Factors Fit Together

While the Southeast has been a hot spot for data center growth, there is no inherent reason to think that data centers need to be sited in the Southeast. While there has been above-average growth in the Southeast recently, there are indicators of dampening growth in the future. For example, in Georgia, the largest growth area, there are signs of the beginning of negative market pressure resulting from lack of inexpensive excess power supply and

43. Moratoria: Clayton County, Georgia. https://www.claytoncountyga.gov/news/clayton-county-board-of-commissioners-approves-moratorium-on-new-data-centers-in-clayton-county/; Coweta County, Georgia. https://www.coweta.ga.us/government/planning-development-ordinances/data-center-ordinance; DeKalb County, Georgia. https://www.decaturish.com/business/dekalb-county-commission-approves-data-center-moratorium/article_7c42f850-bef9-4e51-a1ae-426810f83bb5.html; Douglas County, Georgia. https://www.douglascountysentinel.com/douglasville_sentinel/data-center-moratorium-extended-to-determine-impact-on-ratepayers/article_3d610d7f-cec8-5be2-a4dc-9f3591440adc.html; Troup County, Georgia. https://www.ledger-enquirer.com/news/environment/article312150132.html.

Ordinances: City of Atlanta, Georgia. Sec 16-36-011. https://library.municode.com/ga/atlanta/codes/code_of_ordinances?nodeId=PTIIICOORANDECO_PT16ZO_CH36BEOVDIRE_S16-36.011SILI; City of Ellijay, Georgia. Sec 20-4. https://library.municode.com/GA/Ellijay/codes/code_of_ordinances?nodeId=PTIICOOR_APXAZO_ART20TEMOSIPE_S20-4STCOCRMIOP ; City of Hampton, Georgia. Public Hearing and Regular Council Meeting. 11 Feb 2025. Pg 33-50. https://www.hamptonga.gov/AgendaCenter/ViewFile/Agenda/_02112025-446; City of Hiawassee, Georgia. Ordinance No. 2022-03-01. https://library.municode.com/ga/hiawassee/ordinances/code_of_ordinances?nodeId=1146794; Gilmer County, Georgia. Chapter 28. https://library.municode.com/ga/gilmer_county/codes/code_of_ordinances?nodeId=SP1GEOR_CH28CRDAMI_S28-1PE; Lumpkin County, Georgia. Section 27-7. Chapter 9. https://library.municode.com/ga/lumpkin_county/codes/code_of_ordinances?nodeId=PTIICOOR_CH27LAUSPEZO_ARTIVACRECOUSAP_CH9COCE; Union County, Georgia. Article III. Sec 44-150 through Sec 44-156. https://library.municode.com/ga/union_county/codes/code_of_ordinances?nodeId=PTIICOOR_CH44LAUS_ARTIIICRDAMI

44. Murphy, Ryan and Feng, Emily. "Why more residents are saying 'No' to AI data centers in their backyard." GPB. 20 July, 2025. ; Murphy, Tommy. "Citizens raise concerns over data centers in town hall meeting." LaGrange Daily News. 9 Sept, 2025. https://www.lagrangenews.com/2025/09/09/citizens-raise-concerns-over-data-centers-in-town-hall-meeting/; Warnke, Lucinda. "Monroe County, Ga., officials shoot down new data center." Government Technology. 06 Aug, 2025. https://www.govtech.com/products/monroe-county-ga-officials-shoot-down-new-data-center; Watson, Niamoni. "Coweta County holds public hearing on data center ordinance." Atlanta News First. 11 Sept, 2025. https://www.atlantanewsfirst.com/2025/09/12/coweta-county-holds-public-hearing-data-center-ordinance/https://www.gpb.org/news/2025/07/18/why-more-residents-are-saying-no-ai-data-centers-in-their-backyard; Murphy, Tommy. "Citizens raise concerns over data centers in town hall meeting." LaGrange Daily News. 9 Sept, 2025. https://www.lagrangenews.com/2025/09/09/citizens-raise-concerns-over-data-centers-in-town-hall-meeting/; Warnke, Lucinda. "Monroe County, Ga., officials shoot down new data center." Government Technology. 06 Aug, 2025. https://www.govtech.com/products/monroe-county-ga-officials-shoot-down-new-data-center; Watson, Niamoni. "Coweta County holds public hearing on data center ordinance." Atlanta News First. 11 Sept, 2025. https://www.atlantanewsfirst.com/2025/09/12/coweta-county-holds-public-hearing-data-center-ordinance/

45. SB 34. https://www.legis.ga.gov/legislation/69551; SB 94. https://www.legis.ga.gov/legislation/69896; HB 528. https://www.legis.ga.gov/legislation/70511; HB 559. https://www.legis.ga.gov/legislation/70610. Georgia House Committee on Special Committee on Resource Management. https://www.legis.ga.gov/committees/house/205.

46. Nov 4, 2025 – Municipal Gener / Special Election (PSC). Office of the Georgia Secretary of State. https://results.sos.ga.gov/results/public/Georgia/elections/MunicipalGeneralSpecialElectionPSC11042025.

47. Chen, David W. "In an Upset, Democrats Oust Two Republicans on Georgia's Utility Board." New York Times. 04 Nov. 2025.

https://www.nytimes.com/2025/11/04/us/georgia-election-utility-board-results.html?searchResultPosition=1; Kann, Drew and Kristi E. Swartz. "What the Democrats PSC wins will and won't mean for your power bills." The Atlanta Journal-Constitution. 06 Nov, 2025. https://www.ajc.com/business/2025/11/what-georgia-democrats-psc-wins-will-and-wont-mean-for-your-power-bills/

community opposition. In the next section, we discuss why we can reasonably assume that the Southeast's data center demand growth is in line with national market demand growth trends.

In Section 3.2, we produce a Southeast data center load forecast range. This range considers demand growth forecasts generated by government and private experts. We identified 15 different subject matter experts' growth estimates. These estimates are analyses of market and technical conditions that would possibly impact load growth of data centers. All 15 of these forecasts predict data center growth.

In Section 3.3, we consider the potential impact on energy consumption of data centers that would occur due to technological advancements. Hardware and software designers are always looking for new methods to make technology better, faster, and cheaper, and we endeavor to account for the impact of new technologies on the market

3.2. Southeast Market Forecast Range

3.2.1 ALIGNMENT BETWEEN SOUTHEASTERN AND WIDER DATA CENTER LOAD GROWTH

Anticipating data center load growth in the Southeastern is inherently challenging due to the scarcity of region-specific research and precedent studies. International, national, and regional markets are highly interdependent and integrated, reflecting common demand drivers of the data center market. As such, regional load growth patterns generally track broader global trends. This analysis relies on national and global data center projections as proxies for Southeastern growth. Doing so reflects a conservative and transparent modeling assumption.

Developers evaluate multiple regions when selecting data center sites, prioritizing locations that offer favorable economics and build-readiness, particularly those with existing excess electrical capacity. Unlike traditional infrastructure, developers are not tied to economic hubs; thus developers are free to invest in whatever location has the best combination of competitive cost structures, policy support, and available infrastructure. In recent years, the Southeast has emerged as a prime location for data center development, but past performance does not guarantee future growth. Other regions could become more favorable as market conditions evolve.

As described in Section 3.1 there are plausible scenarios under which growth in the Southeast could exceed the national average (continued accelerating growth), lag behind the national average (constrained by saturation or community opposition), or remain in line with the national average. For this Monte Carlo analysis, we assume Southeastern growth mirrors global demand trajectories. This central-case assumption avoids analytically risky pairings (e.g., low local growth with high global demand, or vice versa) that require additional, speculative justifications.

Industry dynamics further support this approach of aligning regional growth to national and global trends. Data center deployment relies on globally integrated supply chains for equipment, construction, and energy infrastructure, creating strong interdependencies that tend to align regional trends with broader patterns. Pressures related to deployment timing, energy costs, and sustainability targets reinforce the need for forecasting methods that reflect these systemic interdependencies. Leveraging national and global data provides a transparent, reasonable foundation for the Southeastern growth assumptions used in this model.

3.2.2 LOAD GROWTH FORECASTS FOR 2030 AND 2035

According to the International Energy Agency (IEA), the US portion of the global datacenter market was approximately 43% in 2024 and will be about 44% in 2030.[48] As these rates remain a consistent fraction of one another, we assume that global and domestic growth rate and trend data can be looked

48. "Energy and AI." International Energy Association (IEA). IEA, April 2025, at 258 https://www.iea.org/reports/energy-and-ai. Calculated from Table A.2 p.259. 2024 (42GW/97GW)=43%, (100GW/226GW)=44%

at interchangeably, as this implies the U.S. and global markets may be expanding at approximately the same speed.

To evaluate the potential global and domestic market trends, we first reviewed data center demand forecasts from two highly trusted bodies: the International Energy Agency (IEA) and Lawrence Berkley National Labs (LBNL). The IEA report released in 2025 calculated four different global projections: a base case, a lift-off case, a high efficiency case, and a headwinds case. Due to the uncertainty in predicting data center demand growth beyond 2030, IEA split all of its forecasts into near-term (2025-2030) and long-term (2031-2035).[49] The LBNL report was released in 2024 and calculated maximum growth and minimum projected U.S. national growth for the years 2024-2028 based on multiple variables.[50]

We then gathered forecasts from five consulting and investment companies: Boston Consulting (domestic), Enverus Intelligence Research (Enverus) (domestic), Goldman Sachs (two global forecasts: base case and conservative), McKinsey & Company (McKinsey) (three global forecasts: accelerated demand, continued momentum, and constrained momentum), and S&P Global (domestic).[51]

It is worth noting that over the span of seven months, McKinsey released three different trend reports, and in that time, the growth rate trends all shifted downward, from an initial estimate of 22%, to a range of 19-27%, to, more recently, 13-24%.[52]

"We believe that data center load estimates across the U.S. are overstated," [Riley Prescott, analyst at Enverus] said. "Our model contains more realistic projections for each significant load segment using an unbiased and consistent methodology across the entire U.S."[53]

49. "Energy and AI." International Energy Association (IEA). IEA, April 2025, at 258 https://www.iea.org/reports/energy-and-ai.

50. Shehabi, Arman, et al. "2024 United States data center energy usage report." Lawrence Berkeley National Lab (LBNL), LBNL, Dec 2024, https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report_1.pdf. Numbers from pp 5-7.

51. Vivian Lee. The Impact of GenAI on Electricity: How GenAI is Fueling the Data Center Boom in the U.S. Boston Consulting Group. 13 Sept, 2023. https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee/; Enverus. Returning to growth: US power demand forecast highlights impact of data centers, EVs, and solar. 16 Jul, 2024. https://www.enverus.com/newsroom/returning-to-growth-us-power-demand-forecast-highlights-impact-of-data-centers-evs-and-solar/ numbers from "Key Takeaways"; Goldman Sachs. AI to drive 165% increase in data center power demand by 2030. 4 Feb, 2025. https://www.goldmansachs.com/insights/articles/ai-to-drive-165-increase-in-data-center-power-demand-by-2030 (International market numbers: 59 GW current and 122 GW by 2030); McKinsey & Company. The cost of compute: A $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers (Numbers from Exhibit 1 and Exhibit 2); Hering, Garrett and Dlin, Susan. "US datacenter power draw to double by 2028; states tackle supply cost, supply concerns." S&P Global Online. 10 Jul, 2025. https://www.spglobal.com/market-intelligence/en/news-insights/articles/2025/7/us-datacenter-power-draw-to-double-by-2028-states-tackle-cost-supply-concerns-91382267

52. McKinsey & Co. How data centers and the energy sector can sate AI's hunger for power. 17 Sept, 2024. https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power#/ (numbers from exhibit 1); McKinsey & Co. AI Power: Expanding data capacity to meet growing demand. 29 Oct, 2024. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand (numbers from Exhibit 1); McKinsey & Company. The cost of compute: A $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers; (numbers from Exhibit 1 and Exhibit 2)

53. Enverus. Returning to growth: US power demand forecast highlights impact of data centers, EVs, and solar. 16 Jul, 2024. https://www.enverus.com/newsroom/returning-to-growth-us-power-demand-forecast-highlights-impact-of-data-centers-evs-and-solar/

A summary of the growth rates is listed in Table 1 below. Forecasts that predict past 2030 (including the IRPs for South Carolina, North Carolina, and Alabama[54] – which were not included in the MC) show that after 2030, demand plateaus and grows at a much smaller rate. To obtain a 10-year growth projection for those that did not have such projections, we took the 5-year growth projections and halved them for the years 2030-2035. Halving the numbers likely overestimates growth, as the IEA models typically predict that growth slows by at least two-thirds after 2030.[55]

TABLE 1 ESTIMATES OF DATA CENTER LOAD GROWTH ACROSS DOMESTIC AND GLOBAL MARKETS.

Percentages are Compound Annual Growth Rates (CAGRs) that were directly stated or calculated from the reported estimated start points and end points. For full calculations, please see Appendix I: Calculations for Table 1

Forecast Name	2024-2030 CAGR	2030-2035 CAGR	Modeling Location
IEA Base	15%	5%	Global
IEA Lift Off	20%	6%	Global
IEA High Efficiency	11%	4%	Global
IEA Headwinds	8%	1%	Global
LBNL – low	13%	6.7%*	US
LBNL – high	27%	13.5%*	US
Boston Consulting – 2023	15%	7.5%*	US
Enverus - (flat)	7%	7%	US
Enverus (curved)	15%**	6%**	US
Goldman Sachs	13%	6.5%*	Global
Goldman Sachs – Conservative	11%	5.5%*	Global
McKinsey – V2 – constrained	13%	6.5%*	Global
McKinsey – V2 – sustained	18%	9%*	Global
McKinsey – v2 – accelerated	24%	12%*	Global
S&P Global	18%	9%	US

* Estimated by halving the previous range's estimates.

** The Enverus report stated an estimated demand for 2050, which was used to generate a flat CAGR from 2024 until 2050. We then also calculated growth that assumes approximately double the flat CAGR from now until 2030   and then halving that growth rate after 2030.

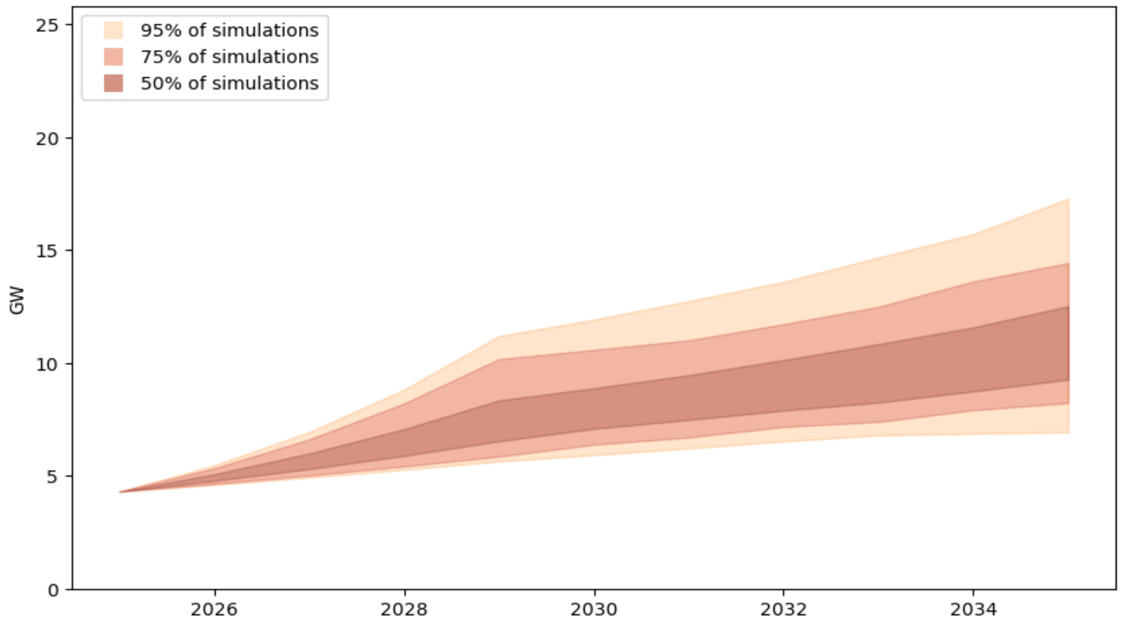
Note: When analyzing the difference in growth rates between the earlier and later years, we observed significant variation across sources. We observed 1 rate from Enverus (flat), 1/2 rate from S&P, 1/3 rate from IEA, and 1/6 rate from the utilities (Figure 5, the CAGR is 25% for 2026–2030 and 4% for 2031–2035).

Based on our comparative analysis, we observed that the CAGR in the later years ranges from roughly one-tenth to one-half of the earlier years' rate. To incorporate a conservative assumption in our MC simulations, we applied half of the earlier years' CAGR.

54. See section 2.2.2

55. "Energy and AI." International Energy Association (IEA). IEA, April 2025, Paris, https://www.iea.org/reports/energy-and-ai. Table A.1 pg 258.

FIGURE 7 DATA CENTER LOAD IN THE SOUTHEAST IS PROJECTED TO INCREASE TWO- TO THREEFOLD OVER THE NEXT DECADE, DRIVEN BY THE EXPANSION OF DOMESTIC AND GLOBAL MARKETS[56]



Each MC simulation randomly chooses a CAGR from Table 1 and then applies that to the starting point of 4.3 GW (S&P anchored, as explained in section 2.2.1) to produce a demand growth curve. We ran the MC simulation 100,000 times to produce a forecast set of "many future situations," which are then used to quantify the probability distribution range seen in Figure 7 (an illustration of the MC process is shown in Appendix A).

Figure 7 illustrates a future where data center load growth in the Southeast would follow the same trajectory as overall market trends. The darkest shaded band shows outcomes that occurred in the central 50% of the simulations; the lighter pink bands delineates where results appeared less than 50% of the time, but more than 25% (i.e. the darkest + lighter shaded bands combine to make the 75% range); and the lightest pink bands shows outcomes that occurred less than 75% of the time, but more than 5% (i.e. all the bands together combine to make the 95% range).

Table 2 presents the year-over-year lower and upper bound levels. For example, in 2031, the expert-based simulations indicate a 50% likelihood of between 7.5 and 9.5 GW of load, 75% likelihood between 6.7 and 11.0 GW, and a 95% likelihood of between 6.2 and 12.7 GW of data center load. The 50% range corresponds the darkest band in Figure 7 and represents the central range of outcomes. The 75% and 95% ranges are progressively wider, capturing less likely but still plausible higher- and lower-growth trajectories.

TABLE 2 LIKELIHOOD RANGES OF DATA CENTER LOAD GROWTH IN THE SOUTHEASTERN REGION (GW),FROM FIGURE 7

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
95% (upper bound)	4.3	5.5	6.9	8.8	11.2	11.9	12.7	13.6	14.7	15.7	17.3
75% (upper bound)	4.3	5.3	6.6	8.2	10.2	10.6	11.0	11.7	12.5	13.6	14.4
50% (upper bound)	4.3	5.1	6.0	7.1	8.3	8.9	9.5	10.1	10.8	11.6	12.5
50% (lower bound)	4.3	4.8	5.3	5.9	6.5	7.1	7.5	7.9	8.2	8.7	9.3
75% (lower bound)	4.3	4.6	5.0	5.4	5.9	6.4	6.7	7.2	7.4	7.9	8.2
95% (lower bound)	4.3	4.6	4.9	5.3	5.6	5.9	6.2	6.5	6.8	6.9	6.9

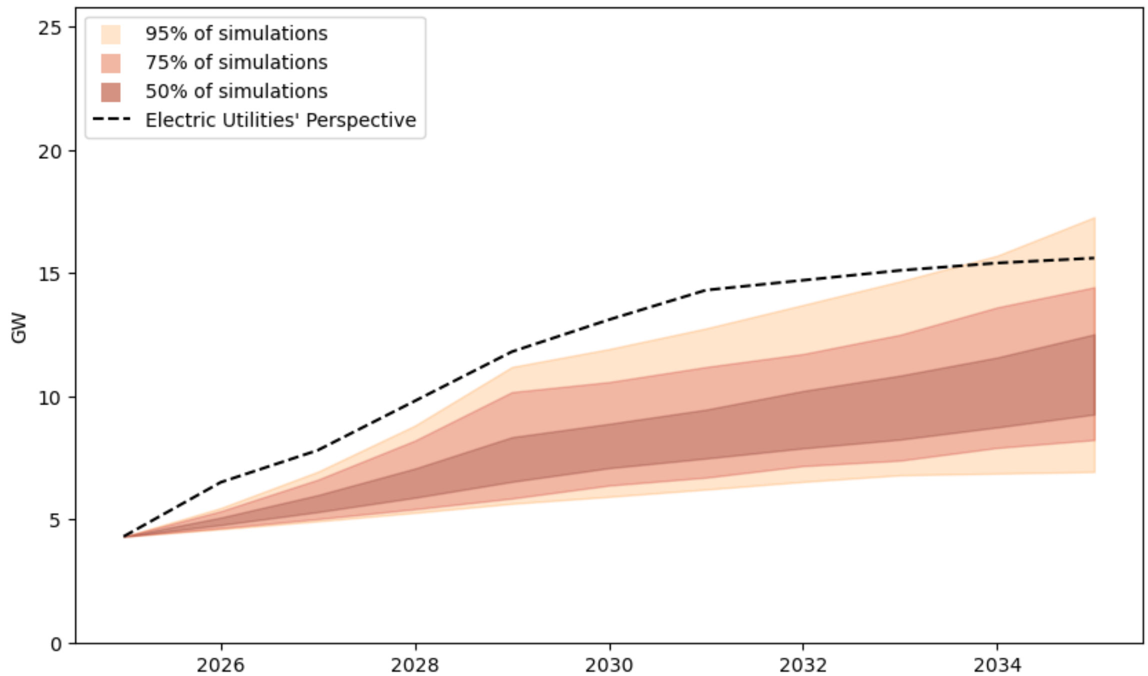
56. Starting from the S&P-anchored data center load forecast (4.3 GW) as of June 2025, we project future electricity demand by applying the CAGR estimated from the literature reflecting market experts' view.

Back to Table of Contents

This forecast in Figure 7 projects data center load growth of 2.4 GW (75% lower bound) to 6.7 GW (75% upper bound) in the Southeast over the next five to six years (2025–2031). Statistically speaking, the range between upper and lower 75 percentage is generally considered to represent the most plausible outcomes. In contrast, utilities project a significantly higher growth of approximately 10 GW between 2025 and 2031.

Figure 8 illustrates the overlay of the utilities' resource planning numbers and the MC simulations grounded in market experts' assessments. The dotted line is a forecast from the aggregated utilities' perspective, as calculated for Figure 5 in Section 2.2.2. This aggregated forecast for 2031 shows about 14.2 GW of data center load. However, in the expert-based MC simulations, the projected forecast exceeds 14.2 GW only 218 times out of 100,000. This suggests that the confidence of the aggregated utilities' prediction occurring is about 1 in 500, or 0.22%.

FIGURE 8 COMPARISON OF UTILITIES' (DOTTED LINE, FROM FIGURE 5) AND EXPERT- BASED MC SIMULATIONS



3.3. Impact of Technological Advancements

The potential for data center improvements, specifically in hardware or software energy efficiency, is a critical factor in determining the scale of energy demand associated with data centers. After establishing our initial demand growth projections in section 3.2, we explored the possibility of technological advancements that would lower power consumption, thus reducing overall energy demand.

We now introduce an additional MC simulation that incorporates potential technological advancements aimed at reducing the energy consumption of future data centers. However, the resulting MC range should be interpreted as a best case for energy savings, or lower-bound estimate. These optimistic assumptions are subject to several important caveats. First, some technologies may never reach commercial viability due to cost, market conditions, or other unforeseen barriers. Second, the rebound effect (also referred to as Jevons' Paradox) may offset efficiency gains. To account for this, we excluded from the MC analysis technological improvements that would be negated by the rebound effect (a full accounting of technologies and their inclusion/exclusion are in Appendices E and F). Still, in some cases, rebound effect may creep in.[57] Third, some of the demand growth forecasts in Section 3.2 already reflect some

57. See Appendix E – where rebound effect was accounted for in calculating efficiency gains.

of these improvements. However, only 3 of the 15 models in section 3.2 account for any power savings, with only one of those incorporating "aggressive" power-savings technology, thus minimizing risk of double-counting.[58]

Nonetheless, this additional MC run is valuable. A significant amount of academic and industry research focuses on power-saving technology. Hardware and software developers are aware that data centers are large users of power and water. They are not sitting idly during this boom; instead, they are researching and innovating new hardware and software technology that can meet demand while using fewer resources.[59]

By way of a relevant historical example, in the late 1990s, the technology industry faced a similar challenge to data centers, in that single-core processors were reaching a heat and power consumption cliff, endangering the entire server and personal computer market. In 1996, IBM started working in earnest on this problem and found that a new chip architecture, a multi-core processor, would provide a solution. The Power 4 multi-core processor was introduced commercially in servers in 2001, and multi-core processors hit the mainstream PC market in 2005.[60] This new technology enabled computers to advance in their computing power without becoming extreme power and water users. Multi-core processors are the reason laptops and personal computers are powerful, yet not power hogs. Today, researchers are looking for similar advancements in data center technology.

Below, we discuss some possibilities being explored that will enable computers to become more powerful and AI more plentiful, but without the predicted untenable strain on resources. Improvements can be made to both hardware and software technology to change power demand. We quantify the impact of proposed technological advancements via a standardized methodology.

3.3.1 METHODOLOGY TO COMPUTE OVERALL ENERGY IMPACT FROM TECHNOLOGICAL IMPROVEMENTS

To accurately model the impact on power demand, it is essential to evaluate whether emerging technologies would reach commercial deployment, estimate their market entry timeline, and assess the duration required for widespread adoption. New technologies are not adopted all at once. Thus, when power savings technology emerges, the impact on overall power demand changes over time. To model this variability, we assumed a standard technology market adoption curve (shown in Figure 9), which measures how an emerging technology gains traction from early adopters (the first to try anything new) to laggards (those who transition only when they have no other choice).[61]

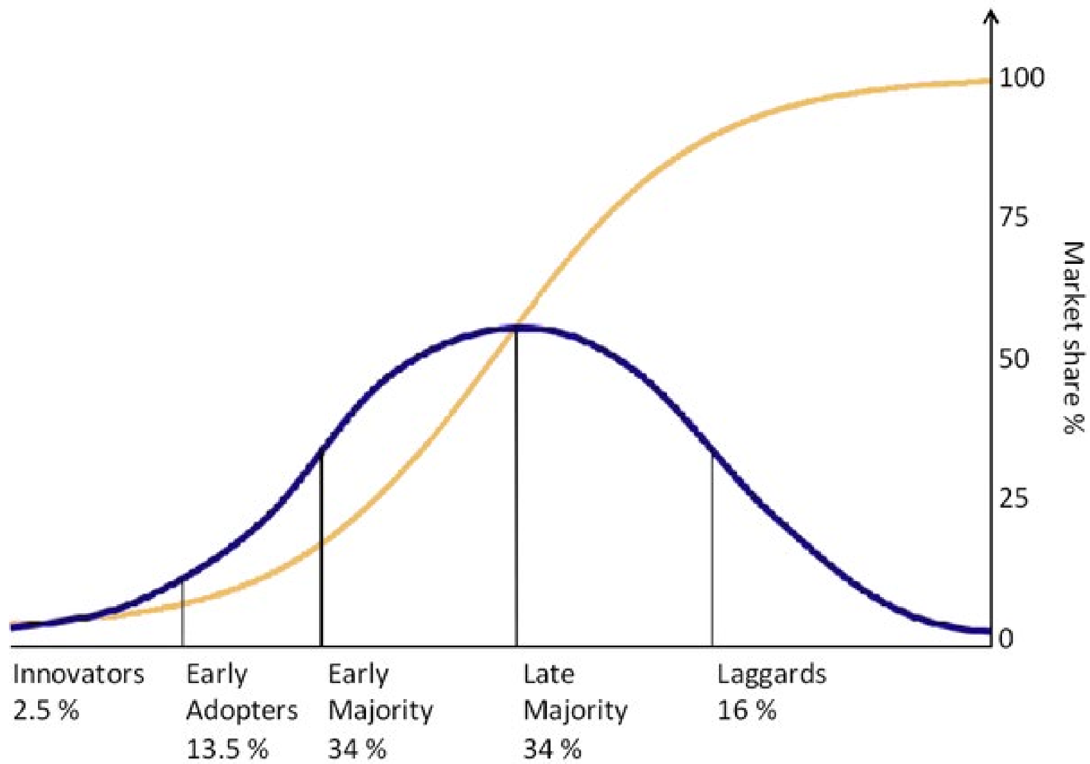
58. The IEA High Efficiency model is the only model to use "aggressive" power savings. The IEA report mentions a number of power savings technologies, several of which we explore in more detail to create our hardware and software power savings estimates (Figure D-1 in Appendix D shows a table from the IEA report outlining some potential technological advances).
The other two models do not utilize any aggressive measures. The McKinsey model is based on a proprietary algorithm accounting for downward pressure from the supply chain, resource constraints, market forces, and energy improvements. Given that they utilize multiple downward pressure reasons, and only one of them being energy improvements, we can assume any hardware and software improvements are probably a small fraction of their overall consideration. The LBNL models utilize Power Use Efficiency (PUE) as an estimation factor. PUE is an imperfect estimator of overall power savings, as it measures the amount of compute power vs. total facility power. In LBNL's reasoning, a very energy-efficient center will have a PUE close to 1, which does not realize energy savings; it just assumes servers use a majority of the power.

59. Bourzac, Katherine. "Fixing AI's energy crisis." Nature. 17 Oct, 2024. https://www.nature.com/articles/d41586-024-03408-z; Ramachandran, Karthik, et al. "As generative AI asks for more power, data centers seek more reliable, cleaner, energy solutions." Deloitte Center for Technology Media & Telecommunications. 19 Nov, 2024. https://www.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2025/genai-power-consumption-creates-need-for-more-sustainable-data-centers.html.

60. "The IBM Power 4." IBM. https://www.ibm.com/history/power. Accessed 29 Sept, 2025; Dual Core Era Begins, PC Makers Start Selling Intel-Based PCs. Intel News Release. 18 Apr, 2005. https://www.intel.com/pressroom/archive/releases/2005/20050418comp.htm.

61. On Digital Marketing, "The 5 Customer Segments of Technology Adoption." https://ondigitalmarketing.com/learn/odm/foundations/5-customer-segments-technology-adoption/. Accessed 29 Sept, 2025.

FIGURE 9. TECHNOLOGY MARKET ADOPTION CURVE[62]



In Figure 9, the blue line indicates the percentage of users who fall into each market segment. The yellow line indicates the overall rate of market share – as more people begin to use the technology, the greater the market saturation.

To effectively model the impact on overall power consumption, it is necessary to define four key parameters for each technology under consideration:

1. Likelihood of the technology ever reaching the market beyond the "innovators" stage. This sets the probability of accounting for the power savings impact from this technology for any given MC run.
2. Start time. When the new technology will first appear on the market (e.g., now, 5 years from now, 10 years from now). This defines when the power savings curve is first applied to the base case.
3. End time (time to full adoption). The time for a technology to reach market saturation (e.g., 1 year, 5 years, never).
4. Impact on power consumption. Overall data center energy power savings or power increase (e.g., 1%, 5%, 100%).

The MC simulation randomly chooses a CAGR from Table 1 and then applies that to the starting point of 4.3 GW to produce a demand growth curve. Then, for each power savings technology, the MC utilizes the likelihood of happening to determine if it gets selected at all (parameter 1 above). Then the simulation uses parameters 2-4 to create the associated power savings curve. Finally, the MC multiplies the demand growth curve by the power savings curve to obtain a new demand growth curve. The MC runs 100,000 iterations to create the distribution of the created demand curves (see Appendix A).

62. Reproduced from On Digital Marketing, "The Five Customer Segments of Technology Adoption." https://ondigitalmarketing.com/learn/odm/foundations/5-customer-segments-technology-adoption/. Accessed 29 Sept, 2025.

3.3.2 HARDWARE POWER SAVINGS

Hardware is a physical component. Implementation is dependent on available investment capital. Companies must ensure compatibility, order new components, build them, install them, power them, etc. Companies have standard hardware refresh cycles (e.g., at a typical workplace, employees get a new laptop every 3 years, and the printer/copier is replaced every 5 years).

Industry sources indicate that average hardware refresh cycles are between 4 and 6 years in data centers.[63] Thus, for hardware impacts on power savings, we decided that if a hardware technology is not already in an experimental (innovator) stage, it would most likely not make it to market in time to have a significant impact over the next 10 years. Because hardware technology options have been limited to hardware already in experimental stages, the start time for all hardware technologies has been set to 2025.

We identified three promising hardware innovations that may result in power savings: thermal innovations, compute proximity, and optics in networking. Other technologies were discounted due to lack of appreciable impacts, risk of double counting, and/or rebound effects. The four model variables are outlined in Table 3.

Thermal Innovations (Liquid Cooling and Others). As chip density and workloads increase, traditional air cooling is no longer enough to keep computer hardware cool. Companies are utilizing liquid-cooling techniques such as in-rack, direct-to-chip, rear-door heat exchanges, and immersion cooling to keep computing resources cool. These new technologies are already being implemented, and surveys have shown they have reached the "early majority" technology implementation stage and are predicted to reach the "late majority" in the next few years.[64]

Compute Proximity involves moving the data storage closer to the computer processors, which cuts down on moving data back and forth when utilizing and training AI and models. This technology is being tested by companies that can build their own custom hardware (e.g., Google) and is at the beginning of the market adoption curve (proof-of-concept/innovators stage).[65]

---

63. "Data center hardware refresh cutback by Microsoft – What's Next?" Data Center Knowledge. 25 Aug, 2022. https://www.datacenterknowledge.com/hyperscalers/data-center-hardware-refresh-cutback-by-microsoft-what-s-next-?. Accessed 29 Sept, 2025; "Navigating hardware refresh cycles in the data center." Horizon Technology. 9 Sept 2025. https://horizontechnology.com/news/data-center-hardware-refresh-cycles/. Accessed 29 Sept, 2025.

64. Alissa, Husam, et al. "Using life cycle assessment to drive innovation for sustainable cool clouds." Nature. 641, 331–338, 30 Apr, 2025. https://doi.org/10.1038/s41586-025-08832-3; Haghshenas, Kawsar, et al. "Enough Hot Air: The Role of Immersion Cooling." ARXIV. 9 May, 2022. https://arxiv.org/abs/2205.04257; Kleyman, Bill. "Liquid Cool: A Year in Review." Data Center Frontier. 18 Feb, 2025. https://www.datacenterfrontier.com/sponsored/article/55266938/liquid-cooling-a-year-in-review; Moore, Mike. "Overheating is a big problem for AI hardware as demand rises - and Dell thinks it might have the answer." Tech Radar. 26 May, 2025. https://www.techradar.com/pro/overheating-is-a-big-problem-for-ai-hardware-as-demand-rises-and-dell-thinks-it-might-have-the-answer; "Quantifying the Impact on PUE and Energy Consumption When Introducing Liquid Cooling Into an Air-cooled Data Center." Vertiv. 15 Feb, 2023. https://www.vertiv.com/en-emea/about/news-and-insights/articles/blog-posts/quantifying-data-center-pue-when-introducing-liquid-cooling/; Udinmwen, Efosa. "Microsoft, Google, and Meta have borrowed EV tech for the next big thing in data centers: 1MW watercooled racks." Tech Radar. 17 May, 2025. https://www.techradar.com/pro/microsoft-google-and-meta-have-borrowed-ev-tech-for-the-next-big-thing-in-data-center-1mw-watercooled-racks; Weston, Sabina. "Microsoft is submerging servers in boiling liquid to prevent Teams outages. IT Pro. 7 Apr, 2021. https://www.itpro.com/server-storage/data-centres/359129/microsoft-submerges-servers-in-boiling-liquid-to-prevent-teams

65. Ali, Mustafa, et, al. "Compute-in-Memory Technologies and Architectures for Deep Learning Workloads," IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 30, no. 11, pp. 1615-1630, Nov. 2022, doi:10.1109/TVLSI.2022.3203583. https://ieeexplore.ieee.org/document/9899381; Derbyshire, Katherine. "Increasing AI Energy Efficiency With Compute In Memory." Semiconductor Engineering Website. 16 Nov, 2023. https://semiengineering.com/increasing-ai-energy-efficiency-with-compute-in-memory; Khan, Asif Ali, et al. "The Landscape of Compute-near-memory and Compute-in-memory: A Research and Commercial Overview." arXiv preprint arXiv:2401.14428.24 Jan, 2024. arxiv.org/pdf/2401.14428v1; Falevoz, Yann and Legriel, Julien. "Energy Efficiency Impact of Processing in Memory: A Comprehensive Review of Workloads on the UPMEM Architecture." Lecture Notes in Computer Science, vol 14352. Springer, Cham. 14 Apr, 2024. https://doi.org/10.1007/978-3-031-48803-0_13; Fay, Maria, et al. "Disentangling the relationship between the adoption of in-memory computing and firm performance." European Conference on Information Systems. Istanbul, Turkey. Vol 24. Jun 2016. https://www.researchgate.net/publication/303792917_DISENTANGLING_THE_RELATIONSHIP_BETWEEN_THE_ADOPTION_OF_IN-MEMORY_COMPUTING_AND_FIRM_PERFORMANCE; "In Memory Computing Market Size And Forecast." Verified Market Research. Mar 2025. https://www.verifiedmarketresearch.com/product/global-

Optics in Networking. In addition to data being moved between storage and compute inside data centers, large quantities of data must also be uploaded to and downloaded from data centers. Smoother movement of data at the networking, routing, and switching level translates into energy savings. In the past few years, optics (using light signals instead of electric signals) have been shown to be more energy efficient and have started to be utilized in data centers. Current adoption is in a small number of hyperscale centers (the proof-of-concept stage).[66]

---

in-memory-computing-market/; "In memory Computing Market Size, Scope, Growth, Trends and By Segmentation Types, Applications, Regional Analysis and Industry Forecast (2025-2033)." Reports Insights. 24 Jul, 2025. https://www.reportsinsights.com/industry-forecast/in-memory-computing-market-700445; "In Memory Computing Market Size, Share, and Industry Analysis By Deployment (Solution and Services), By Application (Risk Management and Fraud Detection, Sentiment Analysis, Geospatial/GIS Processing, Sales and Marketing Optimization, Predictive Analysis, Supply Chain Management, and Others), By Deployment (On-premises and Cloud-based), By Enterprise Type (Large Enterprises and Small and Medium Enterprises), By Industry (BFSI, IT and Telecom, Retail and E-commerce, Healthcare, Transportation, Government, and Others), and Regional Forecast, 2025-2032." Fortune Business Insights. https://www.fortunebusinessinsights.com/in-memory-computing-market-112030. Accessed 29 Sept, 2025; "In-Memory Computing Market Size, Share & Segmentation, By Component, By Application (Fraud detection, Risk management, Real-time analytics, High-frequency trading), By Industry, By Region and Global Forecast 2024-2032." S&S Insider. Aug 2023. Pg 240. https://www.snsinsider.com/reports/in-memory-computing-market-3570; Reis, Dayane, et al. "Computing-in-Memory for Performance and Energy Efficient Homomorphic Encryption." IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 28, no. 11, pp. 2300-2313, Nov. 2020, https://ieeexplore.ieee.org/document/9179010; Singh, Gagandeep, et al. "Accelerating Weather Prediction using Near-Memory Reconfigurable Fabric." ACM Transactions on Reconfigurable Technology and Systems (TRETS), Volume 15, Issue 4. Article No.: 39, Pages 1 – 27. 06 June, 2022. https://dl.acm.org/doi/10.1145/3501804; Wright, Mark. "Compute-in-Memory Computational Devices." GSI Technology. https://gsitechnology.com/compute-in-memory-computational-devices/. Accessed 29 Sept, 2025; Wang, Xing, et al. "TRIFP-DCIM: A Toggle-Rate-Immune Floating-point Digital Compute-in-Memory Design with Adaptive-Asymmetric Compute-Tree." ASPDAC `25: Proceedings of the 30th Asia and South Pacific Design Automation Conference. Pg. 1223 – 1229. 4 Mar, 2025 https://doi.org/10.1145/3658617.3697577; Wolters, Christopher, et al. "Memory is all you need: An overview of compute-in-memory architectures for accelerating large language model inference." arXiv preprint arXiv:2406.08413. 12 June 2024. https://arxiv.org/pdf/2406.08413.

66. Chang, Yu-Han. "Co-Packaged Optics (CPO): Evaluating Different Packaging Technologies." IDTechEx.

22 Aug 2024. https://www.idtechex.com/en/research-article/co-packaged-optics-cpo-evaluating-different-packaging-technologies/31608; "Co-Packaged Optics." Broadcom. https://www.broadcom.com/info/optics/cpo. Accessed 29 Sept 2025; "Co-packaged Optics Market Size, Share and Growth Analysis." Markets and Markets. Oct 2023.

https://www.marketsandmarkets.com/Market-Reports/co-packaged-optics-market-28874835.html;

"Co-Packaged Optics Market Size and Forecast." Verified Market Research. Oct. 2025. https://www.verifiedmarketresearch.com/product/co-packaged-optics-market/; "Opportunities in networking optics: Boosting supply for data centers." McKinsey Direct: McKinsey & Company. June 2025. https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/opportunities%20in%20networking%20optics%20boosting%20supply%20for%20data%20centers/opportunities-in-networking-optics-boosting-supply-for-data-centers.pdf;

"Photonic Integrated Circuits Benefit Greatly From AI Data Center Demand, but Other Applications Are Now Emerging, Says IDTechEx." PR Newswire. 7 May, 2024. https://www.prnewswire.com/news-releases/photonic-integrated-circuits-benefit-greatly-from-ai-data-center-demand-but-other-applications-are-now-emerging-says-idtechex-302138360.html; Shekhar, Sudip, et al. "Roadmapping the next generation of silicon photonics." Nat Commun 15, 751 25 Jan, 2024. https://doi.org/10.1038/s41467-024-44750-0;

"Silicon Photonics: The Bright Future of AI Data Management." Open Tools. 31 Jan, 2025. https://opentools.ai/news/silicon-photonics-the-bright-future-of-ai-data-management. Accessed 29 Sept, 2025. Tate, Geoff. "Photonics Speeds Up Data Center AI." Semiconductor Engineering. 1 May 2025. https://semiengineering.com/photonics-speeds-up-data-center-ai/; Torza, Anthony. "Cisco Demonstrates Co-Packaged Optics (CPO) System at OFC 2023." Cisco Website. 7 Mar 2023. https://blogs.cisco.com/sp/cisco-demonstrates-co-packaged-optics-cpo-system-at-ofc-2023;

"What is Co-packaged Optics?" Ansys Blog. 29 Feb, 2024. https://www.ansys.com/blog/what-is-co-packaged-optics;

TABLE 3. HARDWARE TECHNOLOGY ADVANCEMENT MODELING VARIABLES.[67]

Hardware Technology	Likelihood of Happening	Start Time	Years to Full Adoption	Overall Energy Savings
Thermal Innovations	75%	2025	8-14	6%-36%
Compute Proximity	40%	2025	20	2%-18%
Optics in Networking	40%	2025	20	1.5%-3.5%

3.3.3 SOFTWARE TECHNOLOGY UPGRADES

According to McKinsey, in 2025, AI accounted for about 50% of data center workload and is expected to account for about 70% of workload in 2030.[68] Exploring more efficient AI algorithms can have a significant impact on data center power draw, because it will have an impact on a large majority of data center workload and consequently data center power draw.

A software change can happen via a totally new product (e.g., the first ever Windows Operating System) or as a version upgrade to an existing project (e.g., Windows 10 replacing Windows 7 & 8). Software can represent a sea change in how people work (e.g., ChatGPT, Kubernetes) or an optimization of an existing system (e.g., Salesforce replaced spreadsheets and Rolodexes for sales and marketing tracking). As such, market adoption speed can vary widely.[69] Herein, we define three types of software upgrades that will each have their own time-to-market and power savings potential.

We define **established algorithms** as software already on the market (e.g., ChatGPT, Google Gemini, Microsoft Copilot) that will integrate power-savings algorithms into their established products as version upgrades. These are implemented via software upgrades and new versions, which shorten deployment and uptake timelines. As companies are constantly innovating to stay competitive, we have given these improvements a high likelihood of occurring (80%), believing that an energy-saving algorithm could appear anytime in the next six years (2025-2031), and that once it is released, it would take 2 years for it to saturate the market.[70] For example, BERT was released in a paper in Oct 2018,[71] and by Oct 2019,[72] Google began using BERT in its production search algorithms. As AI algorithms grow in popularity, their pace of development has quickened.[73] We calculate the overall energy savings to be anywhere from 10-22%.[74]

67. A full explanation of table values can be found in Appendix E.

68. McKinsey & Company. The cost of compute: a $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers (Percentages calculated from Exhibit 1).

69. Batti, Khadim. "Technology Adoption Curve: 5 States of Adoption." Whatfix. 3 Oct, 2025. https://whatfix.com/blog/technology-adoption-curve/

70. Batti, Khadim. "Technology Adoption Curve: 5 States of Adoption." Whatfix. 30 Sept, 2025. https://whatfix.com/blog/technology-adoption-curve/; Accessed 1 Oct, 2025; Tang, Xuli, et al. "The pace of artificial intelligence innovations: Speed, talent, and trial-and-error." Journal of Informetrics 14.4 (Nov 2020): 101094. https://doi.org/10.1016/j.joi.2020.101094.

71. Devlin, Jacob, et al. "BERT: Pre-training of deep bidirectional transformers for language understanding." Proceedings of the 2019 conference of the North American chapter of the association for computational linguistics: human language technologies, volume 1 (long and short papers). 2019. https://au1206.github.io/assets/pdfs/BERT.pdf.

72. Nayak, Pandu. "Understanding searches better than ever before." Google Blog. 25 Oct, 2019. https://blog.google/products/search/search-language-understanding-bert/. Accessed 1 Oct, 2025.

73. Mecke, John. "How has technology adoption life cycle been shortened in 2021?" Private Equity. 14 Oct, 2021. https://developmentcorporate.com/2021/10/14/how-has-technology-adoption-life-cycle-been-shortened-in-2021/. Accessed 1 Oct, 2025; Tang, Xuli, et al. "The pace of artificial intelligence innovations: Speed, talent, and trial-and-error." Journal of Informetrics 14.4 (Nov 2020): 101094. https://doi.org/10.1016/j.joi.2020.101094.

74. See Appendix F.

We define **emerging algorithms** as AI software that will emerge onto the market as a new product, such as the next AI software system (e.g., a new ChatGPT rival). Any new software product must break through into the mainstream market, giving it a lower likelihood of happening. Again, this is an area of active research, and a breakthrough could occur anytime in the next six years, and energy savings could range from 11-24%.[75] Given that it is not already established, we gave it a longer market adoption curve, 4 years, as organizations must justify time and expense (purchase agreements, employee training, etc.) to move to new software. As an example, ChatGPT was commercially launched in Nov 2022, rapidly expanded during 2023, and has reached late majority today, 3 years later.[76]

We define **highly experimental** software as software that is a radical departure from the norm. (For example, in another industry, Kubernetes established new workflows in DevOps.) This is software that is unlike things people have seen before. It disrupts current workflow or creates entirely new workflows and business models. Approximately 95% of all highly experimental products fail,[77] and those that succeed will take much longer to saturate the market, as they are based on a perceived new market segment or market demand. For example, Salesforce debuted in about 2000 and is reaching maturity now;[78] Kubernetes (a containerization platform) debuted in 2015 and is already reaching maturity now.[79] As such we set the time to adoption between 12 and 18 years, and the start time to 2025 (or it would take too long to make any appreciable impact). With these technologies, power savings range from 15%-30%.[80]

TABLE 4. SOFTWARE TECHNOLOGY ADVANCEMENT MC MODEL VARIABLES[81]

Software Algorithm	Likelihood of Happening	Start Time	Years to Full Adoption	Overall Energy Savings
Established Algorithms	80%	2025-2031	2	10% - 22%
Emerging Algorithms	30%	2025-2031	4	11% - 24%
Highly Experimental	5%	2025	12-18	15% - 30%

75. See Appendix F.

76. Asimsultan. "The Evolution of Transformers: A Journey Through the Milestones of Language Models." Medium. 27 Aug, 2024. https://medium.com/%40asimsultan2/the-evolution-of-transformers-a-journey-through-the-milestones-of-language-models-f4e8980c08f9. Accessed 1 Oct, 2025; Batti, Khadim. "Technology Adoption Curve: 5 States of Adoption." Whatfix. 3 Oct, 2025. https://whatfix.com/blog/technology-adoption-curve/; Clark, Scott. "The Era of AI: End of Year AI Recap." CMSWire. 21 Dec, 2023. https://www.cmswire.com/digital-experience/the-era-of-ai-end-of-year-ai-recap/. Accessed 1 Oct, 2025; Gonzalez de Villaumbrosia, Carlos. How the Technology Adoption Curve Influences Strategy. Product School. 08 Jul., 2025. https://productschool.com/blog/product-strategy/technology-adoption-curve; Radford, Alec, et al. "Improving Language Understanding by Generative Pre-Training." OpenAI, 2018. cdn.openai.com/research-covers/language-unsupervised/language_understanding_paper.pdf. Accessed 16 Sept. 2025.

77. "Why 95% of new products miss the mark (and how yours can avoid the same fate)" MIT Professional Education. https://professionalprograms.mit.edu/blog/design/why-95-of-new-products-miss-the-mark-and-how-yours-can-avoid-the-same-fate/. Accessed 1 Oct, 2025.

78. Batti, Khadim. "Technology Adoption Curve: 5 States of Adoption." Whatfix. 3 Oct, 2025. https://whatfix.com/blog/technology-adoption-curve/.

79. Casey, Kevin. "Kubernetes by the numbers, in 2020: 12 stats to see." The Enterprisers Project. 15 June, 2020. https://enterprisersproject.com/article/2020/6/kubernetes-statistics-2020. Accessed 1 Oct, 2025; Gienow, Michelle. "Kubernetes adoption trends: How real devs use K8s in production." Cockroach Labs. 24 Aug, 2021. https://www.cockroachlabs.com/blog/kubernetes-trends/. Accessed 1 Oct, 2025; Platform Engineers. "10 Years of Kubernetes: A Retrospective." Medium. 14 Nov, 2024. https://medium.com/%40platform.engineers/10-years-of-kubernetes-a-retrospective-c11b8fbd608c. Accessed 1 Oct, 2025.

80. See Appendix F

81. See Appendix F for full calculations of numbers in Table 4

Figure 10 illustrates a demand growth range that occurs when possible technological advancements are layered and implemented in the data center space (full analysis process is outlined in Appendix A). Emerging technology adoption adjusts the demand growth shown in Figure 7 downward. Again, the dotted line is the utilities' prediction, as calculated in Figure 5 (Section 2.2).

In this scenario, the modeling results indicate at 50% confidence that emerging technologies have the potential to keep data center energy demand nearly flat over the next decade. Moreover, in the expert-based MC simulations, the 2031 projected forecast exceeds 14.2 GW only 13 times out of 100,000. This suggests that the confidence of the aggregated utilities' prediction occurring is about 1 in 8,000, or 0.013%. Table 5 provides year-over-year lower and upper bound levels.

FIGURE 10. EMERGING TECHNOLOGIES COULD STABILIZE ENERGY DEMAND OVER THE NEXT DECADE

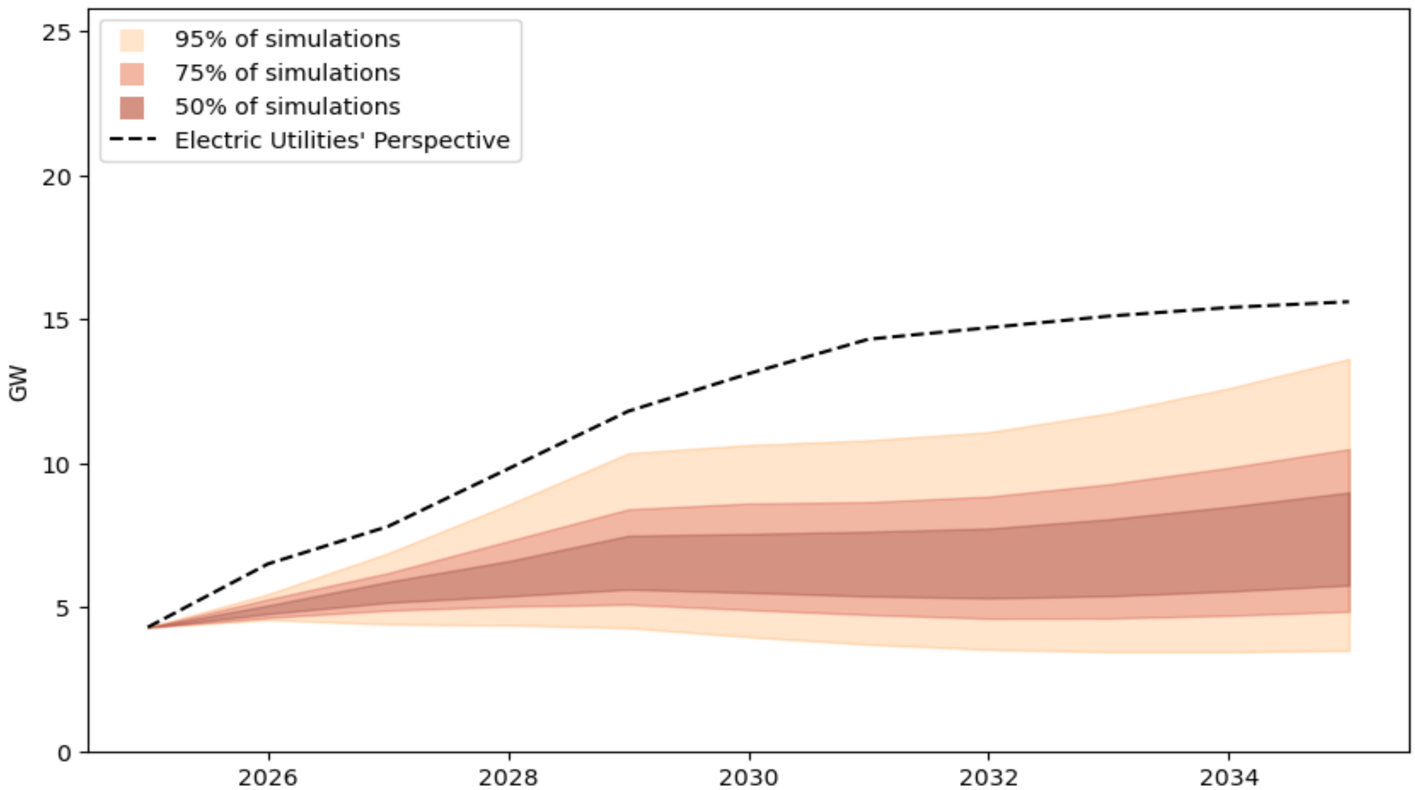


TABLE 5 LIKELIHOOD RANGES OF DATA CENTER LOAD GROWTH IN THE SOUTHEASTERN REGION (GW), FROM FIGURE 10

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
95% (upper bound)	4.3	5.5	6.9	8.6	10.4	10.6	10.8	11.1	11.8	12.6	13.6
75% (upper bound)	4.3	5.3	6.2	7.3	8.4	8.6	8.7	8.8	9.3	9.8	10.5
50% (upper bound)	4.3	5.1	5.9	6.6	7.5	7.6	7.6	7.7	8.1	8.5	9.0
50% (lower bound)	4.3	4.8	5.2	5.4	5.6	5.5	5.4	5.3	5.4	5.6	5.8
75% (lower bound)	4.3	4.6	4.9	5.0	5.1	4.9	4.7	4.6	4.6	4.7	4.9
95% (lower bound)	4.3	4.6	4.4	4.4	4.3	4.0	3.7	3.5	3.5	3.5	3.5

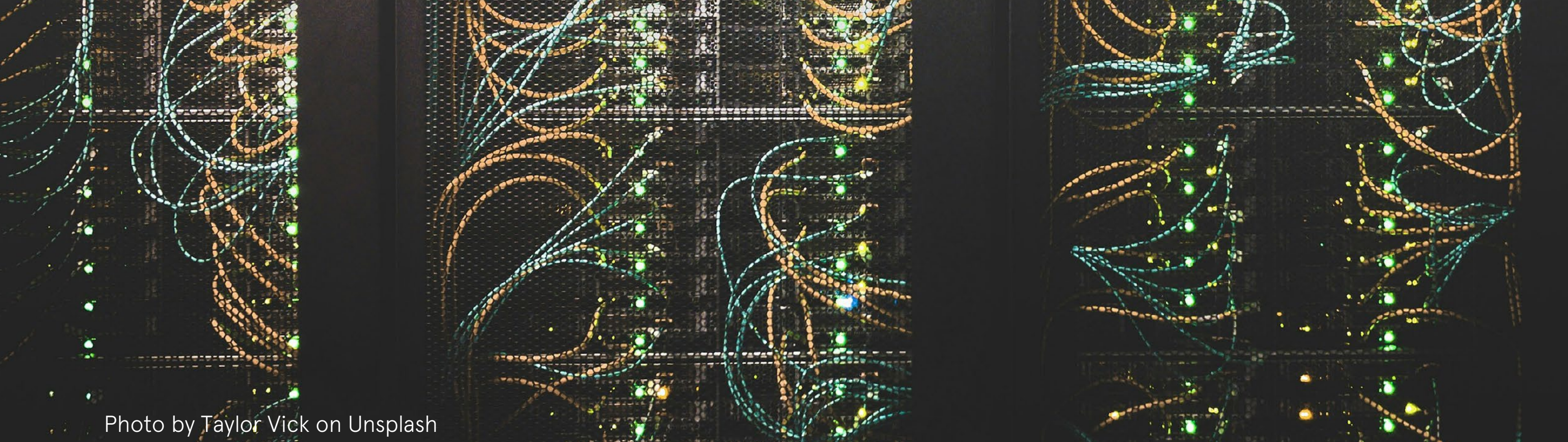


Photo by Taylor Vick on Unsplash

4. Conclusion

Based on a comprehensive review of utility data, expert forecasts (both national and international) on data center growth, and literature on technological advancements in machine learning and energy management technologies, this study evaluated the impacts of projected data center expansion and emerging uncertainties on power demand in the Southeast. This study compared the aggregated utilities' data center demand projections for the Southeast with our expert-based Monte Carlo simulations. The utilities' estimate falls at the highest end of the uncertainty range within the Monte Carlo simulations. This raises concerns about the credibility of the utilities' predictions.

In the Southeast, we understand that the financial risk of overbuilding could be borne by ratepayers, while utilities are guaranteed cost recovery. Given that overestimations are both common and financially advantageous for utilities, it is essential to critically examine the assumptions behind these forecasts. To support our evaluation, we conducted a sophisticated uncertainty analysis incorporating 1) shifts in domestic and international data center markets, 2) advancements in hardware technology, and 3) improvements in computing algorithms.

This Monte Carlo modeling involved 100,000 simulations to estimate the likely range of energy savings. The MC simulation results indicate that the utilities' aggregated data center load forecast is consistently above the 99.7th percentile. This implies that utilities' planning decisions are being made based on scenarios that are statistically rare. If potential energy savings from emerging hardware and software technologies are commercialized and realized, the utilities' forecasts become even less plausible.


Photo by Michael Schwarz

References

- Ali, Mustafa, et, al. "Compute-in-Memory Technologies and Architectures for Deep Learning Workloads," IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 30, no. 11, pp. 1615-1630, Nov. 2022, doi: 10.1109/TVLSI.2022.3203583.
- Alissa, Husam, et al. "Using life cycle assessment to drive innovation for sustainable cool clouds." Nature. 641, 331–338, 30 Apr, 2025. https://doi.org/10.1038/s41586-025-08832-3
- Ansys Blog. "What is Co-packaged Optics?" 29 Feb, 2024. https://www.ansys.com/blog/what-is-co-packaged-optics
- Asimsultan. "The Evolution of Transformers: A Journey Through the Milestones of Language Models." Medium. 27 Aug, 2024. https://medium.com/%40asimsultan2/the-evolution-of-transformers-a-journey-through-the-milestones-of-language-models-f4e8980c08f9. Accessed 1 Oct, 2025.
- Aterio, "Data Centers in the United States." Aterio Website. https://www.aterio.io/insights/us-data-centers. Accessed16 July 2025,
- Bair, Chris. "Is There an AI Data Center Development Bubble?" Data Center Frontier Website, 27 Aug, 2025, https://www.datacenterfrontier.com/sponsored/article/55309951/is-there-an-ai-data-center-development-bubble
- Batti, Khadim. "Technology Adoption Curve: 5 States of Adoption." Whatfix. 30 Sept, 2025. https://whatfix.com/blog/technology-adoption-curve/
- Biddle, Jennifer. "How noise pollution quietly affects your health." Center for Occupational and Environmental Health. 2 June, 2025. https://coeh.ucdavis.edu/research/how-noise-pollution-quietly-affects-your-health
- Bipartisan Policy Center & Koomy Analytics. Electricity Demand Growth and Data Centers: A Guide for the Perplexed. Feb. 2025, p. 8, Figure 3. https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2025/02/BPC-Report-Electricity-Demand-Growth-and-Data-Centers-A-Guide-for-the-Perplexed.pdf. Accessed 15 Sept. 2025.
- Blankenship, Grant. "Rural Twiggs County approves rezoning for a data center with a city size appetite for power." GPB. 19 Sept, 2025. https://www.gpb.org/news/2025/09/19/rural-twiggs-county-approves-rezoning-for-data-center-city-sized-appetite-for-power
- Bloomberg, Sara. "AI bubble 'will burst,' Databricks CEO says at San Francisco tech conference." San Francisco Business Times. 06 May, 2025. https://www.bizjournals.com/sanfrancisco/news/2025/05/06/ai-bubble-burst-databricks-ceo-gic-bridge-forum.html?utm_source=st&utm_medium=en&utm_campaign=inno&utm_content=innontlf;
- Bourzac, Katherine. "Fixing AI's energy crisis." Nature. 17 Oct, 2024. https://www.nature.com/articles/d41586-024-03408-z
- Broadcom. "Co-Packaged Optics." https://www.broadcom.com/info/optics/cpo. Accessed 29 Sept, 2025.
- Butler, Georgia. "Georgia Power Increases Power Capacity by 1.4GW with Fossil Fuels to Meet Data Center Demand." Data Center Dynamics, April 17, 2024 https://www.datacenterdynamics.com/en/news/georgia-power-increases-power-capacity-by-14gw-with-fossil-fuels-to-meet-data-center-demand. Accessed 2 Oct, 2025.
- Capital B News Atlanta. How Many Data Centers Are There in Georgia? Capital B News, https://atlanta.capitalbnews.org/how-many-data-centers-are-there-in-georgia/. Accessed 28 Oct. 2025
- Casey, Kevin. "Kubernetes by the numbers, in 2020: 12 stats to see." The Enterprisers Project. 15 June, 2020. https://enterprisersproject.com/article/2020/6/kubernetes-statistics-2020. Accessed 1 Oct, 2025.

- CBRE. "Global Data Center Trends 2025." CBRE Website, 24 Jun 2025, https://www.cbre.com/insights/reports/global-data-center-trends-2025
- CBRE. "North America Data Center Trends H1 2024." CBRE Website,19 Aug 2024. https://www.cbre.com/insights/reports/north-america-data-center-trends-h1-2024
- CBRE. "North America Data Center Trends H2 2024." CBRE Website, 26 Feb 2025. https://www.cbre.com/insights/reports/north-america-data-center-trends-h2-2024
- Chang, Yu-Han. "Co-Packaged Optics (CPO): Evaluating Different Packaging Technologies." ID Tech Ex. 22 Aug 2024. https://www.idtechex.com/en/research-article/co-packaged-optics-cpo-evaluating-different-packaging-technologies/31608. Accessed 29 Sept. 2025.
- Cisco Website. "Cisco Demonstrates Co-Packaged Optics (CPO) System at OFC 2023." 7 Mar 2023. https://blogs.cisco.com/sp/cisco-demonstrates-co-packaged-optics-cpo-system-at-ofc-2023.
- Clark, Scott. "The Era of AI: End of Year AI Recap." CMSWire. 21 Dec, 2023. https://www.cmswire.com/digital-experience/the-era-of-ai-end-of-year-ai-recap/. Accessed 1 Oct, 2025.
- Climate Power, 11 June 2025, https://climatepower.us/news/amid-rising-energy-costs-senator-tillis-must-protect-energy-supply-needed-to-power-our-global-tech-edge/. Accessed 15 Sept. 2025.
- Data Center Knowledge. "Data center hardware refresh cutback by Microsoft – What's Next?" 25 Aug, 2022. https://www.datacenterknowledge.com/hyperscalers/data-center-hardware-refresh-cutback-by-microsoft-what-s-next-?. Accessed 29 Sept, 2025.
- Data Center Watch. "$64 billion of data center projects have been blocked or delayed amid local opposition." Website. Accessed 09 Sept, 2025. https://www.datacenterwatch.org/report. Accessed 29 Sept, 2025.
- Derbyshire, Katherine. "Increasing AI Energy Efficiency With Compute In Memory." Semiconductor Engineering Website. 16 Nov, 2023. https://semiengineering.com/increasing-ai-energy-efficiency-with-compute-in-memory. Accessed 29 Sept, 2025.
- Devlin, Jacob, et al. "Bert: Pre-training of deep bidirectional transformers for language understanding." Proceedings of the 2019 conference of the North American chapter of the association for computational linguistics: human language technologies, volume 1 (long and short papers). 2019. https://au1206.github.io/assets/pdfs/BERT.pdf. Accessed 29 Sept, 2025.
- Digital Marketing. "The 5 Customer Segments of Technology Adoption." https://ondigitalmarketing.com/learn/odm/foundations/5-customer-segments-technology-adoption/ Accessed 29 Sept, 2025. Accessed 29 Sept, 2025.
- Dominici, Francesca. Report: Balico Proposal Impact Analysis. Prepared for SELC 12 Apr, 2025. https://www.selc.org/wp-content/uploads/2025/04/2025.04.12-Public-Health-Impacts-Analysis-Balico-Gas-Plant-FINAL-REPORT.pdf. Accessed 29 Sept, 2025.
- Duke Energy. Supplemental Planning Analysis: Carolinas Resource Plan. Duke Energy, 2024, p. 16. https://www.duke-energy.com/-/media/pdfs/our-company/carolinas-resource-plan/supplements/supplemental-planning-analysis.pdf?rev=f134d62ba6d645ccb3de2bc227a0d42d.
- Accessed 29 Sept. 2025.
- Dunlap, Stanley. "Georgia Power's Plan to Support Potential Data Center Surge with Fossil Fuel Energy Faces Scrutiny." Georgia Recorder, 1 June 2025, https://georgiarecorder.com/2025/06/01/georgia-powers-plan-to-support-potential-data-center-surge-with-fossil-fuel-energy-faces-scrutiny. Accessed 29 Sept. 2025.
- Eanes, Zachery. "Data centers will cause higher electricity prices, study finds." Axios Raleigh. 28 Aug, 2025. https://www.axios.com/local/raleigh/2025/08/28/data-centers-will-cause-higher-electricity-prices-study-finds-north-carolina-state.Accessed 29 Sept. 2025.

Back to Table of Contents

- Europawire. "TUM Researchers Develop 100x Faster Method to Cut Energy Consumption in AI Neural Network Training." Press Release. 7 Mar, 2025. https://news.europawire.eu/tum-researchers-develop-100x-faster-method-to-cut-energy-consumption-in-ai-neural-network-training/eu-press-release/2025/03/07/11/31/01/149862/ Accessed 1 Oct, 2025.
- Falevoz, Yann and Legriel, Julien. "Energy Efficiency Impact of Processing in Memory: A Comprehensive Review of Workloads on the UPMEM Architecture." Lecture Notes in Computer Science, vol 14352. Springer, Cham. 14 Apr, 2024. https://doi.org/10.1007/978-3-031-48803-0_13. Accessed 29 Sept. 2025.
- Farrell, Maureen. "Wall St. Is All In on AI Data Centers. But Are They the Next Bubble?" New York Times. 2 June, 2025. https://www.nytimes.com/2025/06/02/business/ai-data-centers-private-equity.html
- Fay, Maria, et al. "Disentangling the relationship between the adoption of in-memory computing and firm performance." European Conference on Information Systems. Istanbul, Turkey. Vol 24. Jun 2016. https://www.researchgate.net/publication/303792917_DISENTANGLING_THE_RELATIONSHIP_BETWEEN_THE_ADOPTION_OF_IN-MEMORY_COMPUTING_AND_FIRM_PERFORMANCE.
- Federal Energy Regulatory Commission, FERC eForms Submission History, https://ecollection.ferc.gov/submissionHistory. Accessed March. 2025.
- Fleury, Michelle and Jimenez, Nathalie. "'I Can't Drink the Water' – Life Next to a US Data Center." BBC News. 10 July, 2025. https://www.bbc.com/news/articles/cy8gy7lv448o. Accessed 29 Sept. 2025.
- Fortune Business Insights. "In Memory Computing Market Size, Share, and Industry Analysis By Deployment (Solution and Services), By Application (Risk Management and Fraud Detection, Sentiment Analysis, Geospatial/GIS Processing, Sales and Marketing Optimization, Predictive Analysis, Supply ChainManagement, and Others), By Deployment (On-premises and Cloud-based), By Enterprise Type (Large Enterprises and Small and Medium Enterprises), By Industry (BFSI, IT and Telecom, Retail and E-commerce, Healthcare, Transportation, Government, and Others), and Regional Forecast, 2025-2032." https://www.fortunebusinessinsights.com/in-memory-computing-market-112030. Accessed 29 Sept. 2025.
- Frisch, Ian. "What Wall Street Sees in the Data Center Boom." New York Times, 20 Sept, 2025. https://www.nytimes.com/2025/09/20/business/dealbook/data-centers-ai.html.
- Georgia Power Company. 2025 Integrated Resource Plan. Georgia Power, 2025, p. 35, fig. 5A. https://www.georgiapower.com/content/dam/georgia-power/pdfs/company-pdfs/2025-Integrated-Resource-Plan.pdf. Accessed 29 Sept. 2025.
- Georgia Public Service Commission. Large Load Economic Development Report – Q2 2025. Docket 55378, Document ID 223705, https://psc.ga.gov/search/facts-document/?documentId=223705. Accessed 29 Sept. 2025. Accessed 29 Sept. 2025.
- Gienow, Michelle. "Kubernetes adoption trends: How real devs use K8s in production." Cockroach Labs. 24 Aug, 2021. https://www.cockroachlabs.com/blog/kubernetes-trends/. Accessed 1 Oct, 2025.
- Google Website. "Accelerate AI development with Google Cloud TPUs." https://cloud.google.com/tpu. Accessed 1 Oct, 2025.
- Grand View Research. "Data Center Liquid Cooling Market Summary." https://www.grandviewresearch.com/industry-analysis/data-center-liquid-cooling-market-report. Accessed 1 Oct, 2025.
- Haghshenas, Kawsar, et al. "Enough Hot Air: The Role of Immersion Cooling." ARXIV. 9 May, 2022. https://arxiv.org/abs/2205.04257.
- Herring, Garrett. "US datacenter power draw to double by 2028; states tackle supply cost, supply concerns." S&P Global Online. 10 29, 2025. https://www.spglobal.com/market-intelligence/en/news-insights/articles/2025/7/us-datacenter-power-draw-to-double-by-2028-states-tackle-cost-supply-concerns-91382267. Accessed 29 Sept. 2025.
- Horizon Technology. "Navigating hardware refresh cycles in the data center." 9 Sept 2025. https://horizontechnology.com/news/data-center-hardware-refresh-cycles/. Accessed 29 Sept, 2025.

- Hotaling, Chelsea. "Direct Testimony of Chelsea Hotaling on behalf of Georgia Interfaith Power & Light and Southface Energy Institute to be filed in Docket No. 56002 and 56003." Memo from SELC to Georgia PSC. Submitted May 2, 2025.
- IDTechEx. "AI Chips for Data Centers and Cloud 2025-2035: Technologies, Market, Forecasts." https://www.idtechex.com/en/research-report/ai-chips-for-data-centers-and-cloud/1095. Accessed 1 Oct, 2025.
- Institute for Energy Economics and Financial Analysis. Data Centers Drive Buildout of Gas Power Plants and Pipelines in the Southeast. Jan. 2025, pp. 5, 7–9, 12–13, 15. https://ieefa.org/resources/data-centers-drive-buildout-gas-power-plants-and-pipelines-southeast. Accessed 29 Sept. 2025.
- International Energy Association (IEA). "Energy and AI." IEA, April 2025, Paris, https://www.iea.org/reports/energy-and-ai. Accessed 29 Sept. 2025.
- Jouppi, Norm, et al. "Tpu v4: An optically reconfigurable supercomputer for machine learning with hardware support for embeddings." Proceedings of the 50th annual international symposium on computer architecture. 20 Apr, 2023. https://arxiv.org/abs/2304.01433. Accessed 29 Sept. 2025.
- Kelly, Brendan. "Analysis: Where to Colocate a Data Center with an Underutilized Power Plant." HData Blog, 7 May 2025, Kelly, Brendan. "Analysis: Where to Colocate a Data Center with an Underutilized Power Plant." HData Blog, 7 May 2025, https://blog.hdata.com/data-center-power-plant-colocation. Accessed 21 Oct. 2025.
- Khan, Asif Ali, et al. "The landscape of compute-near-memory and compute-in-memory: A research and commercial overview." arXiv preprint arXiv:2401.14428.24 Jan, 2024. arxiv.org/pdf/2401.14428v1.
- Khomenko, Sasha, et al. "Impact of road traffic noise on annoyance and preventable mortality in European cities: A health impact assessment." Environment international 162 (2022): 107160. https://www.sciencedirect.com/science/article/pii/S0160412022000861.
- Kleyman, Bill. ""Liquid Cool: A Year in Review." Data Center Frontier. 18 Feb, 2025. https://www.datacenterfrontier.com/sponsored/article/55266938/liquid-cooling-a-year-in-review.
- Knapp, Frank. "Protect SC Consumers from Data Center Costs." SC Daily Gazette, 12 Sept. 2024, https://scdailygazette.com/2024/09/12/protect-sc-consumers-from-data-center-costs. Accessed Oct. 2025.
- Korolov, Maria. "Data centers warm up to liquid cooling." Network World. 1 Apr, 2024. https://www.networkworld.com/article/2076039/data-centers-warm-up-to-liquid-cooling.html
- Kunkel, Cathy and Wamsted, Dennis. "Risk of AI-driven, overbuilt infrastructure is real." Institute for Energy Economics and Financial Analysis. 03 June, 2025. Risk of AI-driven, overbuilt infrastructure is real | IEEFA
- Lee, Vivian. "The impact of GenAI on electricity: how GenAI is fueling the data center boom in the US." LinkedIn Post, Boston Consulting Group (BCG), 13 Sept 2023, https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee/
- Lee, Seunghak, et al. "GreenDIMM: OS-Assisted DRAM Power Management for DRAM with a sub-array Granularity Power-Down State." MICRO'21: MICRO-54: 54th Annual IEEE/ACM International Symposium on Microarchitecture. 17 Oct, 2021. Pp 131-142. https://dl.acm.org/doi/10.1145/3466752.3480089
- LeRoy, Greg and Tarczynska, Kasia. Cloudy With a Loss of Spending Control: How Data Centers Are Endangering State Budgets. Good Jobs First. April 2025. goodjobsfirst.org/wp-content/uploads/2025/04/Cloudy-with-a-Loss-of-Spending-Control-How-Data-Centers-Are-Endangering-State-Budgets.pdf
- Linear Micro. "Using the ASIC card for data center and cloud computing applications." Linear Micro Systems. 8 Mar, 2024. https://linearmicrosystems.com/using-asic-cards-for-data-center-and-cloud-computing-applications/

- London Economics International LLC. Uncertainty and Upward Bias Are Inherent in Data Center Electricity Demand Projections. Southern Environmental Law Center, 7 July 2025, p. 8. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf. Accessed 29 Sept. 2025.
- London Economics International LLC. Uncertainty and Upward Bias are Inherent in Data Center Electricity Demand Projections. prepared for Southern Environmental Law Center by, 7 Jul, 2025. https://www.selc.org/wp-content/uploads/2025/07/LEI-Data-Center-Final-Report-07072025-2.pdf
- Luccioni, Alexandra Sasha, et al. "From efficiency gains to rebound effects: the problem of Jevons' Paradox in AI's polarized environmental debate." ARXIV. 13 Jun, 2025. The 2025 ACM Conference on Fairness, Accountability, and Transparency (FAccT '25), June 23--26, 2025, Athens, Greece. https://arxiv.org/pdf/2501.16548.
- Mailloux, Nicholas, et al. "Nationwide and Regional PM2.5-Related Air Quality Health Benefits From the Removal of Energy-Related Emissions in the United States." GeoHealth. 16 May, 2022. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022GH000603.
- Mann, Tobias. "More than a third of enterprise data centers expect to deploy liquid cooling by 2026." The Register. 22 Apr, 2025. https://www.theregister.com/2024/04/22/register_liquid_cooling_survey/.
- Mao, Yuyi, et al. "Green Edge AI: A Contemporary Survey," in Proceedings of the IEEE, vol. 112, no. 7, pp. 880-911, July 2024, doi: 10.1109/JPROC.2024.3437365
- Markets and Markets. "Co-packaged Optics Market Size, Share, and Growth Analysis." https://www.marketsandmarkets.com/Market-Reports/co-packaged-optics-market-28874835.html. Accessed 29 Sept. 2025.
- Market Data Forecast. "North America Data Center Liquid Cooling Market Report.' Last Updated July 2025. https://www.marketdataforecast.com/market-reports/north-america-data-center-liquid-cooling-market.
- Markets and Markets "Co-packaged Optics Market Share, Size, and Growth Analysis." Oct 2023.
- Martucci, Brian. "DeepSeek called a net positive for data centers despite overcapacity worries." Facilities Drive. 20 Feb, 2025. DeepSeek called a net positive for data centers despite overcapacity worries | Facilities Dive
- McKinsey & Company. "AI power: Expanding data center capacity to meet growing demand." McKinsey & Company. 29 Oct, 2024. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand#/. Accessed 1 Oct, 2025.
- McKinsey & Company. "How data centers and the energy sector can sate AI's hunger for power." McKinsey & Company Website, 17 Sept, 2024. https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power#/. Accessed 29 Sept. 2025.
- McKinsey & Company. "Opportunities in networking optics: Boosting supply for data centers." McKinsey Direct. June 2025. https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/opportunities%20in%20networking%20optics%20boosting%20supply%20for%20data%20centers/opportunities-in-networking-optics-boosting-supply-for-data-centers.pdf
- McKinsey & Company. The cost of compute: a $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers
- Miller, Rich. "Google shifts to liquid cooling for AI data crunching." Data Center Frontier. 8 May, 2018. https://www.datacenterfrontier.com/cloud/article/11430207/google-shifts-to-liquid-cooling-for-ai-data-crunching. Accessed 1 Oct, 2025.

- MIT Professional Education. "Why 95% of new products miss the mark (and how yours can avoid the same fate)" https://professionalprograms.mit.edu/blog/design/why-95-of-new-products-miss-the-mark-and-how-yours-can-avoid-the-same-fate/. Accessed 1 Oct, 2025.
- Moore, Mike. "Overheating is a big problem for AI hardware as demand rises - and Dell thinks it might have the answer." Tech Radar. 26 May, 2025. https://www.techradar.com/pro/overheating-is-a-big-problem-for-ai-hardware-as-demand-rises-and-dell-thinks-it-might-have-the-answer
- Muralidharan, Saurav, et al. "Compact language models via pruning and knowledge distillation." Advances in Neural Information Processing Systems 37 (2024): 41076-41102. https://proceedings.neurips.cc/paper_files/paper/2024/file/4822991365c962105b1b95b1107d30e5-Paper-Conference.pdf.
- Murphy, Ryan. "Why more residents are saying 'No' to AI data centers in their backyard." GPB. 18 July, 2025. https://www.gpb.org/news/2025/07/18/why-more-residents-are-saying-no-ai-data-centers-in-their-backyard
- Nayak, Paul. "Understanding searches better than ever before." Google Blog. 25 Oct, 2019. https://blog.google/products/search/search-language-understanding-bert/. Accessed 1 Oct, 2025.
- Norris, Tyler, et al. Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems. Durham, NC: Nicholas Institute for Energy, Environment & Sustainability, Duke University. 2025. https://nicholasinstitute.duke.edu/publications/rethinking-load-growth
- North American Electric Reliability Corporation. 2025 Summer Reliability Assessment, p. 42, fig. 5. NERC, 2025, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2025.pdf.
- North Carolina Utilities Commission, In the Matter of: Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c), Hearing Transcript, vol. 24, p. 213. 5 Aug. 2024. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=b3f65f27-eaba-4a2e-aa69-00c2d190bf7a. Accessed October 16, 2025.
- Open Tools. "Silicon Photonics: The Bright Future of AI Data Management." 31 Jan, 2025. https://opentools.ai/news/silicon-photonics-the-bright-future-of-ai-data-management. Accessed 29 Sept, 2025.
- Platform Engineers. "10 Years of Kubernetes: A Retrospective." Medium. 14 Nov, 2025. https://medium.com/%40platform.engineers/10-years-of-kubernetes-a-retrospective-c11b8fbd608c. Accessed 1 Oct, 2025.
- PR Newswire. "Photonic Integrated Circuits Benefit Greatly From AI Data Center Demand, but Other Applications Are Now Emerging, Says IDTechEx." 7 May, 2024. https://www.prnewswire.com/news-releases/photonic-integrated-circuits-benefit-greatly-from-ai-data-center-demand-but-other-applications-are-now-emerging-says-idtechex-302138360.html;
- Queen, Alice. "One local official says data centers not 'top priority'." The Citizens. 1 Sept, 2025. https://www.newsbreak.com/the-citizens-299113683/4208767822405-one-local-official-says-data-centers-not-top-priority
- Radford, Alec, et al. "Improving Language Understanding by Generative Pre-Training." OpenAI, 2018. cdn.openai.com/research-covers/language-unsupervised/language_understanding_paper.pdf. Accessed 16 Sept. 2025.
- Ramachandran, Karthik, et al. "As generative AI asks for more power, data centers seek more reliable, cleaner, energy solutions." Deloitte Center for Technology Media & Telecommunications. 19 Nov, 2024. https://www.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2025/genai-power-consumption-creates-need-for-more-sustainable-data-centers.html
- Reguero, Alvaro Domingo, et al. "Energy-efficient neural network training through runtime layer freezing, model quantization, and early stopping." Computer Standards & Interfaces. Volume 92. March 2025. 103906. https://doi.org/10.1016/j.csi.2024.103906.

- Reis, Dayane, et al. "Computing-in-Memory for Performance and Energy Efficient Homomorphic Encryption." IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 28, no. 11, pp. 2300-2313, Nov. 2020, doi: 10.1109/TVLSI.2020.3017595. 19 Aug 2020. https://doi.org/10.48550/arXiv.2005.03002
- Reports Insights. "In memory Computing Market Size, Scope, Growth, Trends and By Segmentation Types, Applications, Regional Analysis and Industry Forecast (2025-2033)." 24 Jul, 2025. https://www.reportsinsights.com/industry-forecast/in-memory-computing-market-700445
- Rinnovabili. "How energy-efficient is DeepSeek, China's AI distuptor?" 29 Jan, 2025. https://www.rinnovabili.net/business/markets/deepseeks-energy-consumption-ais-75-power-cut/. Accessed 1 Oct, 2025.
- Rózycki, Rafał, Dorota Agnieszka Solarska, and Grzegorz Waligóra. 2025. "Energy-Aware Machine Learning Models—A Review of Recent Techniques and Perspectives" Energies 18, no. 11: 2810. 28 May, 2025. https://doi.org/10.3390/en18112810
- S&P Global Market Intelligence. 451 Research Datacenter KnowledgeBase, https://www.spglobal.com/market-intelligence/en/solutions/datacenter-knowledgebase. Accessed June 2025.
- S&S Insider. "In-Memory Computing Market Size, Share & Segmentation, By Component, By Application (Fraud detection, Risk management, Real-time analytics, High-frequency trading), By Industry, By Region and Global Forecast 2024-2032." Aug 2023. Pg. 240. https://www.snsinsider.com/reports/in-memory-computing-market-3570
- Santee Cooper. Integrated Resource Plan 2024 Update. Public Service Commission of South Carolina, September 16, 2024. Pg. 28, https://www.santeecooper.com/About/Integrated-Resource-Plan/Reports-and-Materials/Santee-Cooper-2024-IRP-Update.pdf. Accessed 29 Sept. 2025.
- Sharma, Prakash. "Artificial intelligence and the future of energy." The Edge, 27 June, 2024. https://research.alpha-sense.com/doc/WEB-ef381ae62ad36ba79bd67239c9cdb8df
- Shehabi, Arman, et al. "2024 United States data center energy usage report." Lawrence Berkeley National Lab (LBNL), LBNL, Dec 2024, eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report_1.pdf
- Shekhar, Sudip, et al. "Roadmapping the next generation of silicon photonics." Nat Commun 15, 751 25 Jan, 2024. https://doi.org/10.1038/s41467-024-44750-0;
- Singh, Gagandeep, et al. "Accelerating Weather Prediction using Near-Memory Reconfigurable Fabric." ACM Transactions on Reconfigurable Technology and Systems (TRETS), Volume 15, Issue 4. Article No.: 39, Pages 1 – 27. https://dl.acm.org/doi/10.1145/3501804
- Sovie, Robbie. "Testimony before the Georgia House of Representative Special Committee on Resource Management". 17 July 2025. Timestamp 2:37:00 to 2:39:00. https://youtu.be/1owN50aEuAc?t=1117.
- Tang, Xuli, et al. "The pace of artificial intelligence innovations: Speed, talent, and trial-and-error." Journal of Informetrics 14.4 (Nov 2020): 101094. https://doi.org/10.1016/j.joi.2020.101094
- Tate, Geoff. "Photonics Speeds Up Data Center AI." Semiconductor Engineering. 1 May 2025. https://semiengineering.com/photonics-speeds-up-data-center-ai/
- Torza, Anthony. "The IBM Power 4." IBM Website. https://www.ibm.com/history/power. Accessed 29 Sept, 2025.
- Udinmwen, Efosa. "Microsoft, Google, and Meta have borrowed EV tech for the next big thing in data centers: 1MW watercooled racks." Tech Radar. 17 May, 2025. https://www.techradar.com/pro/microsoft-google-and-meta-have-borrowed-ev-tech-for-the-next-big-thing-in-data-center-1mw-watercooled-racks
- Underwood, Jerry. "Meta Plans to Build $800 Million, Next-Generation Data Center in Montgomery, Alabama." Alabama News Center, 2 May 2024, https://www.alabamapower.com/news/innovation/from-anonymity-to-montgomery-whitewater-winning-the-800-million-meta-data-center-took-alabama-teamwork.html

- US EPA. "Health and Environmental Effects of Particulate Matter (PM)." https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm. Accessed 1 Oct, 2025.
- Verdecchia, Roberto, et al. "Data-centric green ai an exploratory empirical study." 2022 international conference on ICT for sustainability (ICT4S). IEEE, June 2022. https://ieeexplore.ieee.org/abstract/document/9830097
- Verified Market Research "In Memory Computing Market Size and Forecast.". Mar 2024. https://www.verifiedmarketresearch.com/product/global-in-memory-computing-market/
- Verified Market Research. "Co-Packaged Optics Market Size and Forecast." Feb 2025. https://www.verifiedmarketresearch.com/product/co-packaged-optics-market/;
- Vertiv. "Quantifying the Impact on PUE and Energy Consumption When Introducing Liquid Cooling Into an Air-cooled Data Center." 15 Feb, 2023. https://www.vertiv.com/en-emea/about/news-and-insights/articles/blog-posts/quantifying-data-center-pue-when-introducing-liquid-cooling/
- Vincent, Matt. "Liquid Cooling Comes to a Boil: Tracking Data Center Investment, Innovation, and Infrastructure at the 2025 Midpoint." Data Center Frontier. 22 May, 2025. https://www.datacenterfrontier.com/cooling/article/55292167/liquid-cooling-comes-to-a-boil-tracking-data-center-investment-innovation-and-infrastructure-at-the-2025-midpoint
- Wang, Tianyu, et al. "An optical neural network using less than 1 photon per multiplication." Nature Communications 13.1. 10 Jan, 2022: 123. https://www.nature.com/articles/s41467-021-27774-8
- Wang, Xing, et al. "TRIFP-DCIM: A Toggle-Rate-Immune Floating-point Digital Compute-in-Memory Design with Adaptive-Asymmetric Compute-Tree." ASPDAC `25: Proceedings of the 30th Asia and South Pacific Design Automation Conference. Pg. 1223 – 1229. 4 Mar, 2025 https://doi.org/10.1145/3658617.3697577.
- Wang, Zhaohua, et al. "Measurement of energy rebound effect in households: Evidence from residential electricity consumption in Beijing, China." Renewable and Sustainable Energy Reviews 58 (2016): 852-861.
- Warnke, Lucinda. "Residents sue Georgia county over data center plans." Government Technology. 29 Sept, 2025. https://www.govtech.com/products/residents-sue-georgia-county-over-data-center-plans
- Watson, Namoi. "Coweta County holds public hearing on data center ordinance." Atlanta News First. 11 Sept, 2025. https://www.atlantanewsfirst.com/2025/09/12/coweta-county-holds-public-hearing-data-center-ordinance/
- Weston, Sabrina. "Microrosoft is submerging servers in boiling liquid to prevent Teams outages. IT Pro. 7 Apr, 2021. https://www.itpro.com/server-storage/data-centres/359129/microsoft-submerges-servers-in-boiling-liquid-to-prevent-teams
- Wierman, Adam and Shaolei, Ren. "We Need to Talk About AI's Impact on Public Health." IEEE Spectrum. 1 May, 2025. https://spectrum.ieee.org/data-centers-pollution
- Wolters, Christopher, et al. "Memory is all you need: An overview of compute-in-memory architectures for accelerating large language model inference." arXiv preprint arXiv:2406.08413. 12 Jun, 2024. https://arxiv.org/pdf/2406.08413
- Worland, Justin. "The backlash to high electric bills could transform US politics." Time Magazine. 27 Aug, 2025. https://time.com/7311613/ai-electricity-bills-georgia-politics/
- Wright, Mark. "Compute-in-Memory Computational Devices." GSI Technology. https://gsitechnology.com/compute-in-memory-computational-devices/. Accessed 29 Sept, 2025
- Yang, Tien-Ju, et al. "Designing energy-efficient convolutional neural networks using energy-aware pruning." Proceedings of the IEEE conference on computer vision and pattern recognition. 2017. https://arxiv.org/abs/1611.05128.

- Xu, Tenghi et al. "Control-free and efficient integrated photonic neural networks via hardware-aware training and pruning." Optics. Vol 11, iss 8, pp1039-1049 2024. (https://opg.optica.org/optica/fulltext.cfm?uri=optica-11-8-1039)
- Yarally, Tim, et al. "Uncovering energy-efficient practices in deep learning training: Preliminary steps towards green ai." arXiv preprint arXiv:2303.13972 24 Mar, 2023. https://arxiv.org/abs/2303.13972.

Moratoria

- Clayton County, Georgia. https://www.claytoncountyga.gov/news/clayton-county-board-of-commissioners-approves-moratorium-on-new-data-centers-in-clayton-county/;
- Coweta Co, Georgia. https://www.coweta.ga.us/government/planning-development-ordinances/data-center-ordinance;
- DeKalb County, Georgia. https://www.decaturish.com/business/dekalb-county-commission-approves-data-center-moratorium/article_7c42f850-bef9-4e51-a1ae-426810f83bb5.html;
- Douglas Co, Georgia. https://www.douglascountysentinel.com/douglasville_sentinel/data-center-moratorium-extended-to-determine-impact-on-ratepayers/article_3d610d7f-cec8-5be2-a4dc-9f3591440adc.html;
- Troup County, Georgia. https://www.ledger-enquirer.com/news/environment/article312150132.html;

Ordinances

- City of Atlanta. Sec 16-36-011. https://library.municode.com/ga/atlanta/codes/code_of_ordinances?nodeId=PTIIICOORANDECO_PT16ZO_CH36BEOVDIRE_S16-36.011SILI
- City of Ellijay. Sec 20-4. https://library.municode.com/GA/Ellijay/codes/code_of_ordinances?nodeId=PTIICOOR_APXAZO_ART20TEMOSIPE_S20-4STCOCRMIOP
- City of Hampton. Public Hearing and Regular Council Meeting. 11 Feb 2025. Pg 33-50. https://www.hamptonga.gov/AgendaCenter/ViewFile/Agenda/_02112025-446
- City of Hiawassee. Ordinance No. 2022-03-01. https://library.municode.com/ga/hiawassee/ordinances/code_of_ordinances?nodeId=1146794
- Gilmer County, GA. Chapter 28. https://library.municode.com/ga/gilmer_county/codes/code_of_ordinances?nodeId=SP1GEOR_CH28CRDAMI_S28-1PE
- Lumpkin County, GA. Section 27-7. Chapter 9. https://library.municode.com/ga/lumpkin_county/codes/code_of_ordinances?nodeId=PTIICOOR_CH27LAUSPEZO_ARTIVACRECOUSAP_CH9COCE
- Union County, GA. Article III. Sec 44-150 through Sec 44-156. https://library.municode.com/ga/union_county/codes/code_of_ordinances?nodeId=PTIICOOR_CH44LAUS_ARTIIICRDAMI

Appendix A: Monte Carlo Approach Explanation

To incorporate Insights from the Market Experts, the model randomly selects a compound annual growth rate (CAGR) from Table 1 for each Monte Carlo (MC) simulation. This rate is then applied to a starting point of 4.3 GW to generate a demand curve. The model runs 100,000 simulations to produce a wide range of possible future scenarios, which are used to quantify the probability distribution of data center energy demand growth.

To reflect insights from Technological experts, the model incorporates the effects of three hardware- and three software-based computational improvements and their possible reductions in power demand within each simulation, as outlined in the report, in Section 3.3. Each technology is assigned a probability of occurrence. For every MC run, the model randomly evaluates whether each improvement is implemented. Hardware and software improvements are treated as independent groups. However, within each group, if a given improvement is successfully implemented, the probability of the next improvement occurring is reduced by 50%. This adjustment reflects market dynamics, where successful technologies may attract more investment and attention, potentially limiting exploration of alternative solutions. To accurately model the impact of emerging technologies on overall power consumption, each emerging technology is defined using four key variables:

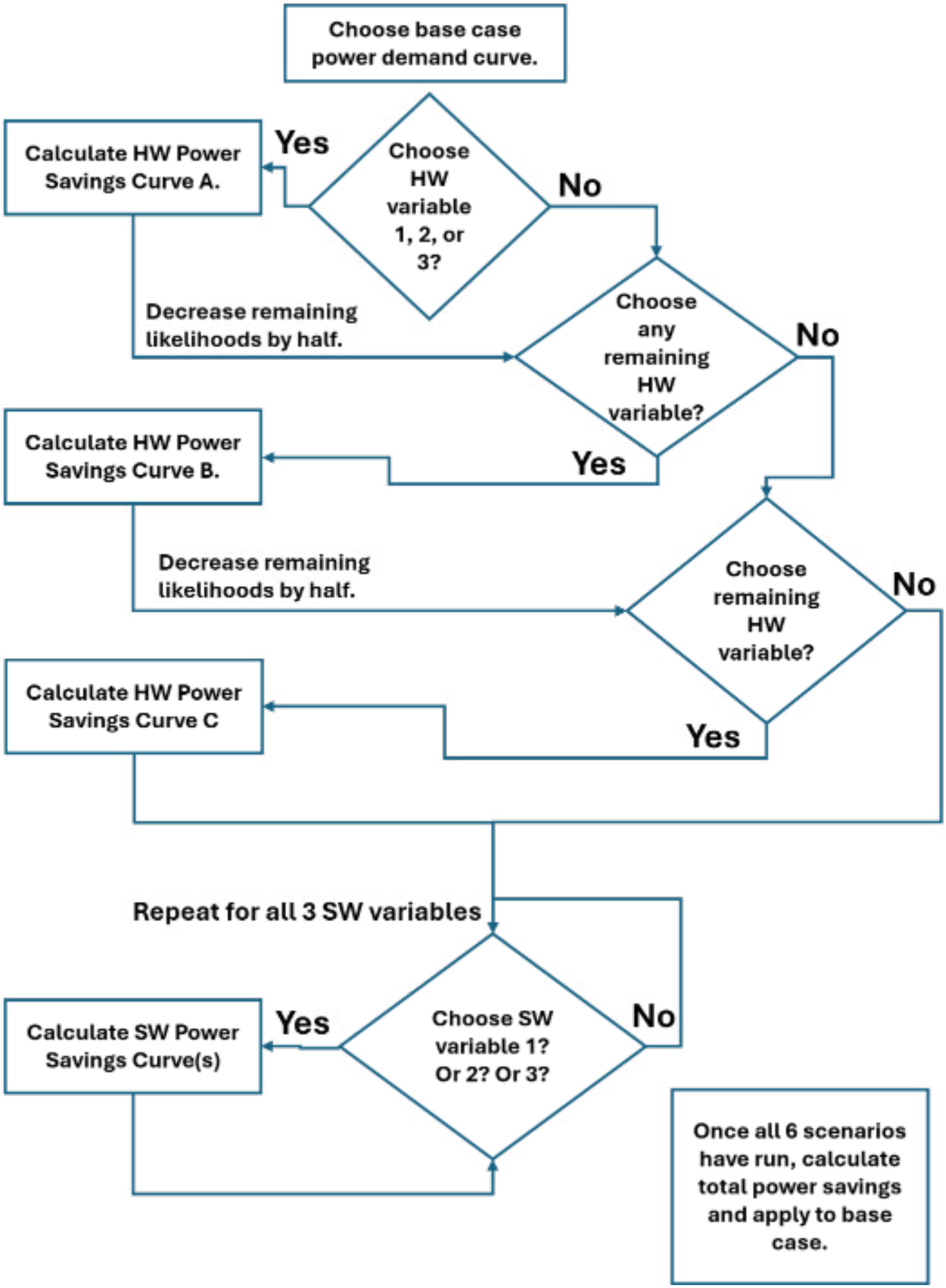
- Market Adoption Likelihood – Probability that the technology will move beyond the "innovators" stage.
- Start Time – When the technology first enters the market.
- End Time (Full Adoption) – Time required to reach market saturation.
- Impact on Power Consumption – Estimated change in energy use (e.g., 1%, 5%, 100%).

The decision tree in Figure A-1 shows how we chose which power savings technologies occurred in each MC run.

Photo by Michael Schwarz

FIGURE A-1. FULL POWER SAVINGS DECISION TREE

The full MC decision tree is as shown:



Appendix B: Computing Overall Power Savings

There are five main components to data center power usage.

1. Computing / Servers – processors (CPUs, GPUs, ASICs) that do computations (e.g., run AI models, spreadsheet calculations)
2. Storage – where the data is stored (e.g. consumer spending behavior, photos, streaming content)
3. Networking – connections between the computing processors, the data storage, and the outside world
4. Cooling – chip cooling and overall HVAC systems
5. Facilities – lights, security systems

Each component is unique. Energy-saving measures will typically have an impact on only one system which may have a small impact on the other systems. To compute overall power savings provided by a specific technology, we need to calculate the predicted energy savings on the specific component and then determine how that impacts the overall energy draw.

To convert 'x' reduction to percentage power savings:

Yx energy reduction = 1/Yth of present use.

[1 (baseline) – 1/Y] * 100 = percentage power savings.

Example:

Say a new technology provides a 12x reduction.

If the current technology uses 100W, this new technology would use 1/12 of that: 100W/12 = 8.3 W.

[100 W (old power use) - 8.3W (new power use)] / 100W (old power use) = 91.7% power reduction

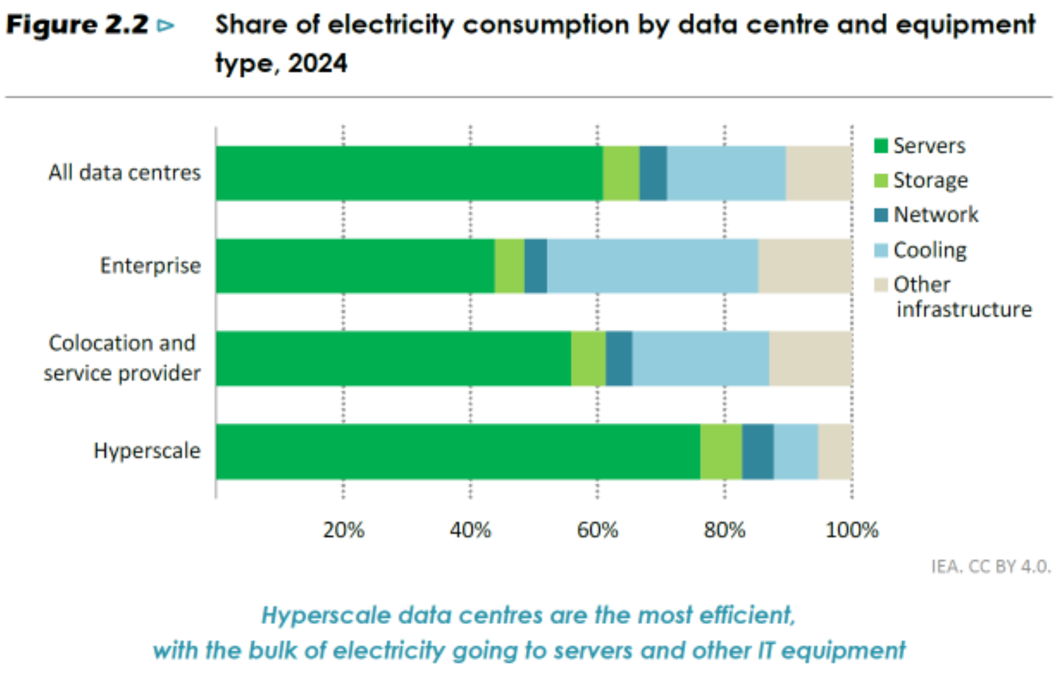
OR (1 – 1/12)* 100 = 91.7%

Photo by Michael Schwarz

Appendix C: Current and Predicted Energy Draw per Component

Energy draw by component depends on the type of facility, as shown in the figure below from the International Energy Agency (IEA) report Energy and AI.

FIGURE C-1. ENERGY CONSUMPTION BY COMPONENT, FROM IEA REPORT ENERGY AND AI.[82]



The underlying data for IEA Figure 2.2 was not listed in the report. Figure C-1roughly translates into Table C-1 power consumption percentages, by data center type:

TABLE C-1. DATA CENTER TYPES PRESENTED IN IEA'S ENERGY AND AI REPORT

	SERVERS	STORAGE	NETWORK	COOLING	OTHER
ALL	60%	5%	5%	20%	10%
ENTERPRISE	45%	5%	3%	32%	15%
COLOCATION	55%	6%	4%	22%	13%
HYPERSCALE	75%	7%	5%	7%	6%

According to the IEA report Energy and AI (table A.1), electricity consumption by hyperscale and collocation will remain within five percentage points of their current draw, with enterprise taking up slightly less of the market, and hyperscale and collocation taking up slightly more. See Table C-2 below, which lists worldwide installed capacity (in GW) of each type of data center, followed by each type of data center's percentage of total installed capacity.

82. "Energy and AI." International Energy Association (IEA). IEA, April 2025, Paris, https://www.iea.org/reports/energy-and-ai. p. 53, Figure 2.2.

TABLE C-2. IEA'S REPORT, ENERGY AND AI (FROM TABLE A.1)[83]

YEAR	2020	2024	2030	2035
TOTAL	60	97	226	277
HYPERSCALE	20	36	85	103
COLOCATION	19	35	86	116
ENTERPRISE	20	27	55	58
CALCULATED PERCENTAGES				
HYPERSCALE	33%	37%	38%	37%
COLOCATION	32%	36%	38%	42%
ENTERPRISE	33%	28%	24%	21%

Thus, we can estimate constant energy consumption per component over the next ten years. While more cloud-service providers are moving to hyperscale centers, at the same time, more companies are starting to develop and train their own AI models on in-house data (which would typically run on enterprise servers) and supply constraints are causing large cloud service providers (CSPs, e.g. Google, Microsoft, Amazon) to also then partner with colocation facilities (e.g. QTS). [84]


Photo by Michael Schwarz

83. "Energy and AI." International Energy Association (IEA). IEA, April 2025, Paris, https://www.iea.org/reports/energy-and-ai. Table A.1. Note: in table A.1 the total GW row does not exactly add up to the breakouts, we assume this is due to rounding. We utilized the "Base Case" for 2030 and 2035 projections. We calculated percentage by dividing the breakout number by the total listed.

84. McKinsey & Company. "AI power: Expanding data center capacity to meet growing demand." McKinsey & Company. 29 Oct, 2024. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand#/. Accessed 1 Oct, 2025.

Appendix D: Energy Savings Technologies Identified by IEA

This Appendix shows higher and lower energy savings potential. The table is copied from IEA's Energy and AI report.

FIGURE D-1 CURRENT AND POTENTIAL 2030 ENERGY SAVINGS IN DATA CENTERS FROM KEY TECHNOLOGIES AND APPROACHES (COPIED FROM IEA'S "ENERGY AND AI" REPORT)[85]

Table 2.1 ▷ Current and potential 2030 energy savings in data centres from key technologies and approaches

Technology/approach	Current adoption	Expected adoption in 2030	Scale of energy savings potential
Hardware			
Low-power processors	●●	●●●	●●●●
AI accelerators	●●●	●●●●	●●
Task-optimised hybrid processors	●●	●●●	●●
Photonic integrated circuits	●	●●	●●●
Energy-efficient memory and storage	●●●	●●●●	●●
Memory proximity	●●	●●●	●●
Innovative cooling technologies	●●	●●●●	●●
Software			
Energy-efficient algorithms	●●	●●●●	●●●●
Task-specific models	●●	●●●●	●●●●
Model and code optimisation	●●	●●●	●●●
Cross-cutting			
Codesign of software/hardware	●●	●●●	●●
Edge computing	●●	●●●	●●●
Virtualisation	●●●●	●●●●	●●
Intelligent energy management	●●●	●●●●	●●
Quantum computing	●	●	●●●
Neuromorphic computing	●	●●	●●●●

Note: A greater number of dots indicates a higher scale.

85. "Energy and AI." International Energy Association (IEA). IEA, April 2025, Paris, https://www.iea.org/reports/energy-and-ai. p. 70, Table 2.1.

Appendix E: Hardware Savings Details and Calculations

Thermal Innovations (Liquid Cooling and Others)

As chip density and workloads increase, traditional air cooling is no longer enough to keep compute hardware cool. Companies are utilizing liquid-cooling techniques,[86] such as in-rack, direct-to-chip, rear-door heat exchanges, and immersion cooling, to keep computing resources cool.

NOTE: In hyperscale data centers, any energy gains achieved by liquid cooling are negated by increased compute density (the rebound effect). In other types of data centers, energy impacts from liquid cooling are being realized. In our following calculations for thermal innovation energy savings, we do not include the share of the market attributed to hyperscale.

In this case, liquid cooling innovations were reported at their overall data center power efficiency gains, not at the component level.

1. PS = Overall power efficiency gains from about 10% to 60% [87]
2. OES = market share of collocation (41%) and enterprise (19%) = 60% overall

Overall energy savings is 10%*.6 to 60%*.6 = 6% to 36%

These new technologies are already being implemented, and surveys have shown they have reached the "early majority" technology implementation stage (~20% are using a version of liquid cooling)[88] and are predicted to hit the "late majority" in the next few years. Using CAGRs of 32%,[89] 22%,[90] and 15%,[91] and a starting market share of 20% [92], thermal innovations will reach market saturation in 8, 10, and 14 years, respectively.

---

86. Udinmwen, Efosa. "Microsoft, Google, and Meta have borrowed EV tech for the next big thing in data centers: 1MW watercooled racks." Tech Radar. 17 May, 2025. https://www.techradar.com/pro/microsoft-google-and-meta-have-borrowed-ev-tech-for-the-next-big-thing-in-data-center-1mw-watercooled-racks.

87. Alissa, Husam, et al. "Using life cycle assessment to drive innovation for sustainable cool clouds." Nature. 641, 331–338, 30 Apr, 2025. https://doi.org/10.1038/s41586-025-08832-3 (15-20%); Haghshenas, Kawsar, et al. "Enough Hot Air: The Role of Immersion Cooling." ARXIV. 9 May, 2022. https://arxiv.org/abs/2205.04257 (up to 50%); Moore, Mike. "Overheating is a big problem for AI hardware as demand rises - and Dell thinks it might have the answer." Tech Radar. 26 May, 2025. https://www.techradar.com/pro/overheating-is-a-big-problem-for-ai-hardware-as-demand-rises-and-dell-thinks-it-might-have-the-answer (up to 60%); "Quantifying the Impact on PUE and Energy Consumption When Introducing Liquid Cooling Into an Air-cooled Data Center." Vertiv. 15 Feb, 2023. https://www.vertiv.com/en-emea/about/news-and-insights/articles/blog-posts/quantifying-data-center-pue-when-introducing-liquid-cooling/ (10.2-15.5%);

88. Korolov, Maria. "Data centers warm up to liquid cooling." Network World. 1 Apr, 2024. https://www.networkworld.com/article/2076039/data-centers-warm-up-to-liquid-cooling.html (22%); Mann, Tobias. "More than a third of enterprise datacenters expect to deploy liquid cooling by 2026." The Register. 22 Apr, 2024. https://www.theregister.com/2024/04/22/register_liquid_cooling_survey/ (20.1% as of 2024, 38.3% projected by 2026).

89. "North America Data Center Liquid Cooling Market Report." Market Data Forecast. Last Updated July 2025. https://www.marketdataforecast.com/market-reports/north-america-data-center-liquid-cooling-market. Accessed 1 Oct, 2025. (32.47% CAGR, 2024-2033).

90. "Data Center Liquid Cooling Market (2025-2030)." Grand View Research. https://www.grandviewresearch.com/industry-analysis/data-center-liquid-cooling-market-report. Accessed 1 Oct, 2025. (21.6% CAGR 2025-2030)

91. Korolov, Maria. "Data centers warm up to liquid cooling." Network World. 1 Apr, 2024. https://www.networkworld.com/article/2076039/data-centers-warm-up-to-liquid-cooling.html. Accessed 1 Oct, 2025. (15% CAGR 2023-2032).

92. Approximated from 22% in Korolov, Maria. "Data centers warm up to liquid cooling." Network World. 1 Apr, 2024. https://www.networkworld.com/article/2076039/data-centers-warm-up-to-liquid-cooling.html.

Compute Proximity

In traditional computers, data is stored in memory (i.e., a hard disk drive) and then moved to the central processing unit (CPU) when needed for calculations. AI algorithms and model training use such a large quantity of data that a significant amount of energy is expended when moving data from memory storage to the compute system for processing. Multiple new architectures and technologies have been proposed to move the compute and the data storage closer together, including Compute-in-Memory (CIM) and Compute-near-Memory (CNM)[93], which we grouped into *Compute Proximity*.

Variables needed to compute overall energy savings:

1. PS = Savings varied from 17% to 99% power reduction for compute-intensive operations.[94]
2. MA = For compute-intensive operations (AI), memory access accounts for about 40-60% of server power draw.[95]
3. CIP = About half a data center's compute operations can be considered compute-intensive.[96]
4. OP = Servers (CPUs) account for about 60% of overall data center power use.[97]

Overall energy savings = PS*MS*CIP*OP

TABLE E-1 ENERGY SAVINGS POTENTIAL CALCULATION

PS (%) / MA (%)	Overall Energy Savings for 40% of Server Draw	Overall Energy Savings for 60% of Server Draw
17	17*.4*.5*.6 = 2%	17*.6*.5*.6 = 3%
99	99*.4*.5*.6 = 12%	99*.6*.5*.6 = 18%

Thus, overall energy savings can range from 2% to 18%.

---

93. Ali, Mustafa, et al. "Compute-in-Memory Technologies and Architectures for Deep Learning Workloads," IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 30, no. 11, pp. 1615-1630, Nov. 2022, doi: 10.1109/TVLSI.2022.3203583. https://ieeexplore.ieee.org/document/9899381; Khan, Asif Ali, et al. "The landscape of compute-near-memory and compute-in-memory: A research and commercial overview." arXiv preprint arXiv:2401.14428. 24 Jan, 2024. https://arxiv.org/pdf/2401.14428v1; Wright, Mark. "Compute-in-Memory Computational Devices." GSI Technology. https://gsitechnology.com/compute-in-memory-computational-devices/. Accessed 29 Sept, 2025; Wolters, Christopher, et al. "Memory is all you need: An overview of compute-in-memory architectures for accelerating large language model inference." arXiv preprint arXiv:2406.08413. 12 Jun, 2024. https://arxiv.org/pdf/2406.08413.

94. Derbyshire, Katherine. "Increasing AI Energy Efficiency With Compute In Memory." Semiconductor Engineering Website. 16 Nov, 2023. https://semiengineering.com/increasing-ai-energy-efficiency-with-compute-in-memory (713x = 99%); Falevoz, Yann and Legriel, Julien. "Energy Efficiency Impact of Processing in Memory: A Comprehensive Review of Workloads on the UPMEM Architecture." Lecture Notes in Computer Science, vol 14352, pp.155–66. 14 Apr, 2024. https://doi.org/10.1007/978-3-031-48803-0_13 (17%-30%); Reis, Dayane, et al. "Computing-in-Memory for Performance and Energy Efficient Homomorphic Encryption." IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 28, no. 11, pp. 2300-2313, Nov. 2020, https://ieeexplore.ieee.org/document/9179010 (88.1x = 99%); Singh, Gagandeep, et al. "Accelerating Weather Prediction using Near-Memory Reconfigurable Fabric." ACM Transactions on Reconfigurable Technology and Systems (TRETS), Volume 15, Issue 4. Article No.: 39, pp.1 – 27. 6 June, 2022. https://dl.acm.org/doi/10.1145/3501804 (12x-35x = 91%-99%).

95. Ghose, Saugata et al. "What Your DRAM Power Models Are Not Telling You: Lessons from a Detailed Experimental

Study." Proc. ACM Meas. Anal. Comput. Syst. 13 Jul, 2018. https://arxiv.org/pdf/1807.05102 (mentions "over half" and 46%); Lee, Seunghak, et al. "GreenDIMM: OS-Assisted DRAM Power Management for DRAM with a sub-array Granularity Power-Down State." MICRO'21: MICRO-54: 54th Annual IEEE/ACM International Symposium on Microarchitecture. 17 Oct, 2021. Pp 131-142. https://dl.acm.org/doi/10.1145/3466752.3480089 (40-60%).

96. McKinsey & Company. The cost of compute: a $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers (Percentages derived from Exhibit 1).

97. Table C-1.

Compute Proximity is at the beginning of the market adoption curve (proof-of-concept/innovators stage). With an approximate 17% CAGR from 2024-2030/32[98] – using the current market percentage – this CAGR would predict 6% market adoption by 2030, still well in the innovators section; however, as technology moves through the adoption curve, it is utilized more frequently. Compute Proximity is now the focus of multiple trend reports,[99] and the IEA puts adoption[100] at 3-dots by 2030 (for comparison, they predict innovative cooling ["Thermal Innovations"] at 4-dots by 2030, and conservatively, that will reach full market adoption in 14 years)[101]. Given this, we estimate a 20-year timeline for full saturation for compute proximity technologies.

Optics in Networking

In addition to data being moved between storage and compute, large quantities of data must also be uploaded to and downloaded from data centers. Smoother movement of data at the networking, routing, and switching level translates into energy savings. In the past few years, optics (using light signals instead of electric signals) have been shown to be more energy efficient and are starting to be utilized in data centers.

Co-packaged optics (CPO) integrate optics and electronics, which makes it easier for energy-saving technology to be integrated into existing hardware stacks and workflows. This, in turn, should drive faster and more widespread market adoption.[102]

Variables needed to compute overall energy savings:

1. PS = power savings via using optical - the networking components can range from 25–70%.[103]

---

98. "In Memory Computing Market Size And Forecast." Verified Market Research. Mar 2024. https://www.verifiedmarketresearch.com/product/global-in-memory-computing-market/ (16.5%); "In-Memory Computing Market Size, Share & Segmentation, By Component, By Application (Fraud detection, Risk management, Real-time analytics, High-frequency trading), By Industry, By Region and Global Forecast 2024-2032." S&S Insider. Aug 2023. p. 240. https://www.snsinsider.com/reports/in-memory-computing-market-3570 (17.08%).

99. Fay, Maria, et al. "Disentangling the relationship between the adoption of in-memory computing and firm performance." European Conference on Information Systems. Istanbul, Turkey. Vol 24. Jun 2016. https://www.researchgate.net/publication/303792917_DISENTANGLING_THE_RELATIONSHIP_BETWEEN_THE_ADOPTION_OF_IN-MEMORY_COMPUTING_AND_FIRM_PERFORMANCE; "In Memory Computing Market Size, Share, and Industry Analysis By Deployment (Solution and Services), By Application (Risk Management and Fraud Detection, Sentiment Analysis, Geospatial/GIS Processing, Sales and Marketing Optimization, Predictive Analysis, Supply Chain Management, and Others), By Deployment (On-premises and Cloud-based), By Enterprise Type (Large Enterprises and Small and Medium Enterprises), By Industry (BFSI, IT and Telecom, Retail and E-commerce, Healthcare, Transportation, Government, and Others), and Regional Forecast, 2025-2032." Fortune Business Insights. https://www.fortunebusinessinsights.com/in-memory-computing-market-112030. Accessed 29 Sept, 2025.

100. Appendix D ("Memory proximity").

101. In Thermal Innovations above we estimated a 8-14 year total market saturation. Taking the longest time estimate of 14 years to full saturation.

102. Chang, Yu-Han. "Co-Packaged Optics (CPO): Evaluating Different Packaging Technologies." IDTechEx.

22 Aug 2024. https://www.idtechex.com/en/research-article/co-packaged-optics-cpo-evaluating-different-packaging-technologies/31608; "What is Co-packaged Optics?" Ansys Blog. 29 Feb, 2024. https://www.ansys.com/blog/what-is-co-packaged-optics.

103. Chang, Yu-Han. "Co-Packaged Optics (CPO): Evaluating Different Packaging Technologies." IDTechEx.

22 Aug 2024. https://www.idtechex.com/en/research-article/co-packaged-optics-cpo-evaluating-different-packaging-technologies/31608 (30-50% reduction); "Co-Packaged Optics." Broadcom. https://www.broadcom.com/info/optics/cpo. Accessed 29 Sept, 2025 (3.5x power savings = 71% savings);

Torza, Anthony. "Cisco Demonstrates Co-Packaged Optics (CPO) System at OFC 2023." Cisco Website. 7 Mar 2023. https://blogs.cisco.com/sp/cisco-demonstrates-co-packaged-optics-cpo-system-at-ofc-2023 (25-30% lower); "What is Co-packaged Optics?"

2. NPC = Networking accounts for about 5% of a data center's energy consumption.[104]

Overall energy savings is PS * NPC = 1.5% to 3.5%

Current adoption is mainly within hyperscale centers,[105] with predicted CAGRs of 8%[106] or ~27%,[107] and one source predicting total saturation by the mid-2030s[108] (more specifically, we interpret this as full market penetration within the hyperscale segment, not the entire data center market, by 2030, as McKinsey predicts 87% saturation in hyperscalers by 2029[109]). Again, as technology moves through the adoption curve, it is utilized more frequently and in other sectors.[110]

Given the predicted uptake in hyperscale that would drive this market, we place the midpoint range at 10 years, with full adoption at 20 years.

Specialized AI Processors

Specialized AI Processors (using chips other than GPUs, such as ASICs) are being explored by multiple companies because they improve computing efficiency.[111] They achieve energy savings in two ways: one,

---

Ansys Blog. 29 Feb, 2024. https://www.ansys.com/blog/what-is-co-packaged-optics (30–50%).

104. Table C-1.

105. "Co-Packaged Optics Market Size and Forecast." Verified Market Research. Feb 2025. https://www.verifiedmarketresearch.com/product/co-packaged-optics-market/; Shekhar, Sudip, et al. "Roadmapping the next generation of silicon photonics." Nature Communications 15, 751. 25 Jan, 2024. https://doi.org/10.1038/s41467-024-44750-0.

106. "Silicon Photonics: The Bright Future of AI Data Management." Open Tools. 31 Jan, 2025. https://opentools.ai/news/silicon-photonics-the-bright-future-of-ai-data-management. Accessed 29 Sept, 2025.

107. "Co-Packaged Optics Market Size and Forecast." Verified Market Research. Feb 2025. https://www.verifiedmarketresearch.com/product/co-packaged-optics-market/ (27.5% CAGR from 2025-2032); "Co-packaged Optics Market Share, Size, and Growth Analysis." Markets and Markets. Oct 2023.

https://www.marketsandmarkets.com/Market-Reports/co-packaged-optics-market-28874835.html (26.5% CAGR from 2023-2028).

108. Tate, Geoff. "Photonics Speeds Up Data Center AI." Semiconductor Engineering. 1 May 2025. https://semiengineering.com/photonics-speeds-up-data-center-ai/.

109. "Opportunities in networking optics: Boosting supply for data centers." McKinsey Direct: McKinsey & Company. June 2025. p. 2. https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/opportunities%20in%20networking%20optics%20boosting%20supply%20for%20data%20centers/opportunities-in-networking-optics-boosting-supply-for-data-centers.pdf ("87% of back-end optics by 2029")

110. "Photonic Integrated Circuits Benefit Greatly From AI Data Center Demand, but Other Applications Are Now Emerging, Says IDTechEx." PR Newswire. 7 May, 2024. https://www.prnewswire.com/news-releases/photonic-integrated-circuits-benefit-greatly-from-ai-data-center-demand-but-other-applications-are-now-emerging-says-idtechex-302138360.html

111. "Accelerate AI development with Google Cloud TPUs." Google Website. https://cloud.google.com/tpu. Accessed 1 Oct, 2025; "AI Chips for Data Centers and Cloud 2025-2035: Technologies, Market, Forecasts." IDTechEx. https://www.idtechex.com/en/research-report/ai-chips-for-data-centers-and-cloud/1095. Accessed 1 Oct, 2025; "Using the ASIC card for data center and cloud computing applications." Linear Micro Systems. 8 Mar, 2024. https://linearmicrosystems.com/using-asic-cards-for-data-center-and-cloud-computing-applications/; Jouppi, Norman, et al. "Tpu v4: An optically reconfigurable supercomputer for machine learning with hardware support for embeddings." Proceedings of the 50th annual international symposium on computer architecture. 20 Apr, 2023. https://arxiv.org/abs/2304.01433; Luccioni, Alexandra Sasha, et al. "From efficiency gains to rebound effects: the problem of Jevons' Paradox in AI's polarized environmental debate." ARXIV. 13 Jun, 2025. The 2025 ACM Conference on Fairness, Accountability, and Transparency (FAccT '25), June 23--26, 2025, Athens, Greece. https://arxiv.org/pdf/2501.16548;

Miller, Rich. "Google shifts to liquid cooling for AI data crunching." Data Center Frontier. 8 May, 2018. https://www.datacenterfrontier.com/cloud/article/11430207/google-shifts-to-liquid-cooling-for-ai-data-crunching. Accessed 1 Oct, 2025.

more efficient processing lowers actual compute energy needs,[112] and two, reducing overall heat from processors, which lowers cooling needs.[113]

We therefore choose not to account for Specialized AI Processors in our models for two reasons. One, the rebound effect, where energy savings achieved by more efficient processing will be used to do even more processing, negates any gains. And two, lowering overall heat is already being accounted for by "liquid cooling" energy savings discussed above. We did not want to risk double counting gains.

Photo by Michael Schwarz

112. Jouppi, Norman, et al. "Tpu v4: An optically reconfigurable supercomputer for machine learning with hardware support for embeddings." Proceedings of the 50th annual international symposium on computer architecture. 20 Apr, 2023. https://arxiv.org/abs/2304.01433.

113. Miller, Rich. "Google shifts to liquid cooling for AI data crunching." Data Center Frontier. 8 May, 2018. https://www.datacenterfrontier.com/cloud/article/11430207/google-shifts-to-liquid-cooling-for-ai-data-crunching. Accessed 1 Oct, 2025.

Appendix F: Software Savings Details and Calculations

Overall energy savings from algorithm improvements would mainly come from improvements to AI and modeling algorithms. McKinsey estimates that 50% of the data center workload is from AI.[114] Servers, which perform computations, are 60% of a data center's power usage.[115] 50% of 60% is 30%. Thus, the overall energy savings would be 30% of the energy savings realized by an algorithmic improvement.

Energy savings range from 36%[116] to 160x (99.3%).[117] This translates to 11% (30% of 36%) to 30% (30% of 99.3%) overall energy savings.

The low end of the range is from 1.6x to 3.7x[118] (37.5% to 73%). This is approximately the same range as early reporting on DeepSeek's energy savings, which range from 40% to 75% energy savings on computation. [119]

30% of 37.5% is 11%

30% of 73% is 22%

We are estimating 11 to 22% as the Established Algorithms range.

Photo by Michael Schwarz

114. McKinsey & Company. The cost of compute: a $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers (Percentages derived from Exhibit 1). Of note – McKinsey expects the percentage of AI workload to increase in the next several years; thus, using 50% as the workload percentage will result in these estimates being conservative. Energy savings realized in a higher percentage of workload would result in a higher overall energy savings.

115. Appendix C.

116. Mao, Yuyi, et al. "Green Edge AI: A Contemporary Survey," in Proceedings of the IEEE, vol. 112, no. 7, pp. 880-911, July 2024, doi: 10.1109/JPROC.2024.3437365. https://ieeexplore.ieee.org/document/10637271. (Table V. 36%, 50.9%, 66%, 69%, 73%, 78.2% listed for various methods).

117. Xu, Tenghi et al. "Control-free and efficient integrated photonic neural networks via hardware-aware training and pruning." Optica. Vol 11, iss 8, pp. 1039-1049. 2024. (https://opg.optica.org/optica/fulltext.cfm?uri=optica-11-8-1039). ("with 160 times power reduction" = 99.3%).

118. Yang, Tien-Ju, et al. "Designing energy-efficient convolutional neural networks using energy-aware pruning." Proceedings of the IEEE conference on computer vision and pattern recognition. 2017. https://arxiv.org/abs/1611.05128. (1.6x to 3.7x = 37.5%-73%).

119. Of note – DeepSeek is so new that peer-reviewed numbers are difficult to obtain and most numbers are based off of incomplete information. "How energy-efficient is DeepSeek, China's AI disruptor?" Rinnovabili. 29 Jan, 2025. https://www.rinnovabili.net/business/markets/deepseeks-energy-consumption-ais-75-power-cut/. Accessed 1 Oct, 2025 (75% lower consumption). Joshi, Satyadhar. "A Technical Review of DeepSeek AI: Capabilities and Comparisons with Insights from Q1 2025." Preprints 2025. Posted 21 Apr, 2025. https://www.preprints.org/manuscript/202504.1676 (40% lower consumption).

Emerging algorithms. The Green Edge AI: A Contemporary Survey[120] encompassed a range of 36% to 78%. Edge computing is emerging, as people want to run algorithms on their cell phones, but it is not yet mainstream. And Energy-Aware Machine Learning Models—A Review of Recent Techniques and Perspectives,[121] noted 80-95% improvements. Taken together, 36% to 80% is a conservative estimate for algorithms that are not yet mainstream but still mentioned in survey papers.

30% of 36% is 11%

30% of 80% is 24%

With highly experimental algorithms, the sky is the limit. Studies mention 100x (99% savings)[122] and 160x (99.3%)[123] and speak of using less than 1 photon per calculation.[124] We set the low end of highly experimental at 50%.

30% of 50% is 15%

30% of 99.3% is 30%

Photo by Michael Schwarz

120. Mao, Yuyi, et al. "Green Edge AI: A Contemporary Survey," in Proceedings of the IEEE, vol. 112, no. 7, pp. 880-911, July 2024, doi: 10.1109/JPROC.2024.3437365. https://ieeexplore.ieee.org/document/10637271. (Table V. 36%, 50.9%, 66%, 69%, 73%, 78.2% listed for various methods).

121. Różycki, Rafał, Dorota Agnieszka Solarska, and Grzegorz Waligóra. "Energy-Aware Machine Learning Models—A Review of Recent Techniques and Perspectives." Energies 18, no. 11: 2810. 28 May, 2025. p. 22. https://doi.org/10.3390/en18112810. (Knowledge distillation "reduces energy by factor of 19x" 19x = 95%, early stopping on models: 80% reduction).

122. "TUM Researchers Develop 100x Faster Method to Cut Energy Consumption in AI Neural Network Training." Press Release. Europawire. 7 Mar, 2025. https://news.europawire.eu/tum-researchers-develop-100x-faster-method-to-cut-energy-consumption-in-ai-neural-network-training/eu-press-release/2025/03/07/11/31/01/149862/ Accessed 1 Oct, 2025.

123. Xu, Tenghi et al. "Control-free and efficient integrated photonic neural networks via hardware-aware training and pruning." Optica. Vol 11, iss 8, pp1039-1049 2024. (https://opg.optica.org/optica/fulltext.cfm?uri=optica-11-8-1039). ("with 160 times power reduction" = 99.3%)

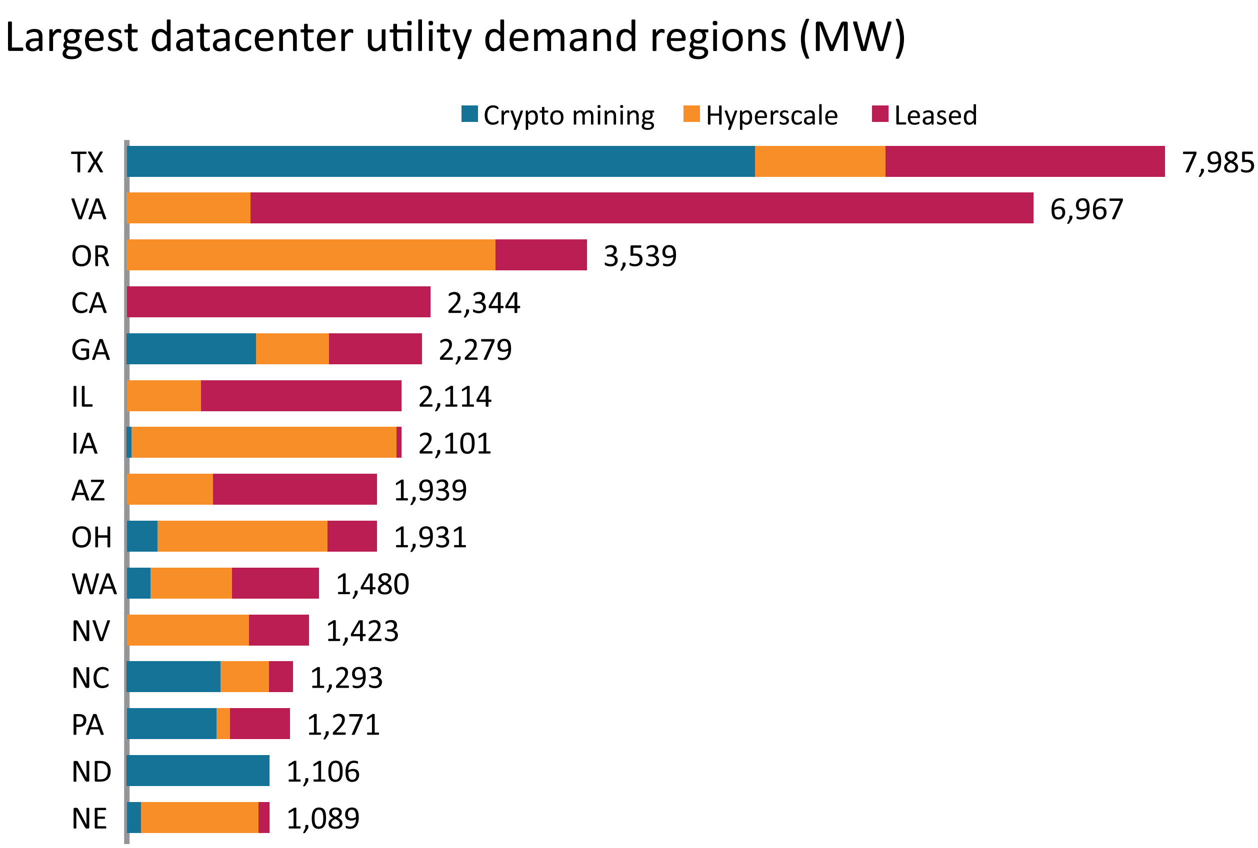
124. Wang, Tianyu, et al. "An optical neural network using less than 1 photon per multiplication." Nature Communications 13.1. 10 Jan, 2022: 123. https://www.nature.com/articles/s41467-021-27774-8.

Appendix G: Data Center Utility Demand Collected by S&P Global

There is no public, authoritative dataset of data center load by state or utility. Even basic facts—how many facilities exist, where they are, and how much grid power they draw—are not systematically reported or publicly published. Recent Georgia-focused reporting underscores the gap: the state has no comprehensive database of data centers, and civil-society groups have been forced to assemble partial counts from open sources.[125] At a national and international level, leading reviews reach the same conclusion, namely that published estimates of data center energy use diverge widely because underlying data is scarce and methods differ. These conditions require a defensible, moderate baseline built from credible sources rather than a single 'official' figure (as there is none).

Although the 451 Research Datacenter KnowledgeBase is proprietary and requires a subscription, Figure G-1, copied from a periodically updated S&P Global newsletter, highlights the top 15 regions with the highest data center utility demand (measured in MW) and made it publicly available. The findings presented in this report were derived from data gathered in June 2025 from the publicly available chart.

FIGURE G-1 S&P'S DATACENTER DEMAND (MW) ESTIMATE BY STATE: TOP 15 STATES



Data compiled June 23, 2025.

Excludes enterprise-owned datacenters.

Utility power represents actual and forecast total electricity supplied to datacenters from the power grid, including IT equipment, cooling, lighting, offices and security systems as of the market monitor release date.

Source: S&P Global Market Intelligence 451 Research Datacenter Services & Infrastructure Market Monitor & Forecast: US focused realeased June 18, 2025.

---

125. Johnson, Alyssa. "Georgia's Data Centers Are Multiplying Fast — and Largely Untracked." Capital B News. 14 Oct, 2025. https://atlanta.capitalbnews.org/how-many-data-centers-are-there-in-georgia/. Accessed 28 Oct. 2025.

As South Carolina and Alabama were not included in S&P Global's publicly available chart, we approximated their current data-center loads using relative ratios from the Aterio dataset.[126] Specifically, we applied each state's load as a percent relative to Georgia's Aterio-reported load. Applying these ratios to Georgia's demand of 2,279 MW, we estimated South Carolina's load at 285 MW (12% of Georgia's) and Alabama's at 405 MW (18% of Georgia's). Instead of using Aterio's absolute values as-is, we scaled them up relative to Georgia to reduce potential errors. These errors could stem from differences in data collection methods and/or the timing of data acquisition. Given the lack of standardized data and transparency, as well as possible differences in each state's data center market composition, these estimates should be interpreted as mid-range indicators rather than precise measurements.

TABLE G-1 STATE-LEVEL DATA CENTER LOAD COLLECTED FROM ATERIO

	Georgia	South Carolina	Alabama
Aterio (2024)	1,834	229	326
Ratio relative to GA	1.00	0.12	0.18

Photo by Michael Schwarz

126. Aterio, "Data Centers in the United States." Aterio Website, 16 July 2025, https://www.aterio.io/insights/us-data-centers.

Appendix H: Current data center load estimates at the utility level

GPC: As of August 2025, the exact current load being served is not publicly disclosed in MW. The 2025 GPC IRP did not provide specific numbers associated with data centers. In an article published by Data Center Dynamics on April 14, 2024, GPC observed that an additional 6.2 GW of electricity demand has been added over the past several years, with approximately 80 percent of this value attributed to data centers. This suggests that data centers account for an estimated 4.96 GW of total demand.[127]

DEC and DEP: Duke Energy presented the large-scale developments in MW from 2025 and onward.[128] Approximately 45% of large-load customers accounted for in the analysis were data centers, as reported in the North Carolina Utilities Commission filing dated August 5, 2024 (Docket No. E-100, Sub 190).[129]

Santee Cooper: Santee Cooper reported the Potential Large Load forecasts in MW in its 2024 IRP Update.[130] However, the 2024 and 2025 values, i.e. current load, are not disclosed in Table 6 of the report.

DESC: As of August 2025, the exact current load being served is not publicly disclosed in MW.

APC: As of 2025, Alabama Power has not publicly disclosed the exact current data center load in MW.

127. Butler, Georgia. "Georgia Power Increases Power Capacity by 1.4GW with Fossil Fuels to Meet Data Center Demand." Data Center Dynamics, 17 Apr. 2024, https://www.datacenterdynamics.com/en/news/georgia-power-increases-power-capacity-by-14gw-with-fossil-fuels-to-meet-data-center-demand/. Accessed 29 Sept. 2025.

128. Duke Energy. Supplemental Planning Analysis: Carolinas Resource Plan. Table SPA 2-2, p. 16, Duke Energy, 2023. https://www.duke-energy.com/-/media/pdfs/our-company/carolinas-resource-plan/supplements/supplemental-planning-analysis.pdf. Accessed 29 Sept. 2025.

129. North Carolina Utilities Commission, In the Matter of: Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c), Hearing Transcript, vol. 24, p. 213–14. 5 Aug. 2024. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=b3f65f27-eaba-4a2e-aa69-00c2d190bf7a. Accessed October 16, 2025.

130. Santee Cooper. (2024, September 16). 2024 Integrated Resource Plan Update, pp. 26–30. Public Service Commission of South Carolina. 16 Sept. 2024. https://www.santeecooper.com/About/Integrated-Resource-Plan/Reports-and-Materials/Santee-Cooper-2024-IRP-Update.pdf. Accessed 29 Sept. 2025.

Appendix I: Calculations for Table 1

CAGR Calculation

The formula for Compound Annual Growth Rate (CAGR) is:

$$CAGR = \left(\frac{Ending\ Value\ (Capacity\ in\ GW\ final\ year)}{Beginning\ Value\ (Capacity\ in\ GW\ starting\ year)}\right)^{1/number\ of\ years} - 1$$

IEA Numbers[131]

The CAGR for IEA was calculated using the numbers from Table A.1 World Data Centres by Case (Page 258).

TABLE I-1 ESTIMATED CAGR FOR IEA

Case	2024 Capacity (GW)	2030 Capacity (GW)	CAGR 2024-2030	2035 Capacity (GW)	CAGR 2031-2035
Base	97	226	15%	277	5%
Lift Off	97	305	20%	404	6%
High Efficiency	97	185	11%	221	4%
Headwinds	97	158	8%	160	1%

LBNL Numbers[132]

LBNL directly calculated the CAGR in its report:

"The results presented here indicate that the electricity consumption of U.S. data centers is currently growing at an accelerating rate. Figure ES-1 shows a compound annual growth rate of approximately 7% from 2014 to 2018, increasing to 18% between 2018 and 2023, and then ranging from 13% to 27% between 2023 and 2028." – Page 7

Boston Consulting Numbers[133]

"This growth in demand for data center services, particularly for GenAI, is driving up power usage and density. Data center electricity consumption was 2.5% of the U.S. total (~130 TWh) in 2022 and is expected to triple to7.5% (~390 TWh) by 2030." – paragraph 2

CAGR = (390/130)^(1/8)-1 = 15%

131. "Energy and AI." International Energy Association (IEA). IEA, April 2025, at 258 https://www.iea.org/reports/energy-and-ai.

132. Shehabi, Arman, et al. "2024 United States data center energy usage report." Lawrence Berkeley National Lab (LBNL), LBNL, Dec 2024, eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report_1.pdf Number from pp 5-7

133. Vivian Lee. The Impact of GenAI on Electricity: How GenAI is Fueling the Data Center Boom in the U.S. Boston Consulting Group. 13 Sept, 2023. https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee/;

Enverus Numbers[134]

The Enverus Intelligence Research ("EIR") report predicts that data centers' load growth will add 153 GW by 2050 and that the Southeast will experience a high level of growth.

"We believe that data center load estimates across the U.S. are overstated," Riley Prescott, analyst at EIR said. "Our model contains more realistic projections for each significant load segment using an unbiased and consistent methodology across the entire U.S."

EIR did not mention how it arrived at its load forecast.

CAGR Flat Growth Calculation:

Started with an assumed capacity of 25 GW in 2024[135].

25GW + 153GW = 178GW by 2050.

Flat growth to 178 GW:

CAGR = (178/25)^(1/26)-1 = 8% growth

CAGR Curved Growth Calculation:

Most models are assuming a more rapid rise until 2030, and then flattening out. With that, we assumed a 15% CGAR (approximately double the straight line CAGR) from now until 2030 – which yields 57.8 GW of capability.

Then the CAGR from 2030 to 2050 would be: (178/57.8)^(1/20)-1 = 6% growth

Goldman Sachs Numbers[136]

"The current global market capacity of data centers is approximately 59 GW."

"Goldman Sachs Research estimates that there will be around 122 GW of data center capacity online by the end of 2030."

"This baseline scenario could, however, be affected by a deceleration in usage by AI — for example, if the transition to AI-driven work and AI monetization doesn't develop as quickly as anticipated. In such muted scenarios, demand could diverge from the baseline estimate by 9-13 GW." For the Conservative we then subtracted 11 GW (halfway between 9-13) from 122GW.

The Goldman Sachs model comes mainly from cloud computing and AI workload estimates. Goldman Sachs points out that there are already constraints on growth including transmission capacity and now regulatory bottlenecks.

CAGR Calculation:

Steady: 122/59^(1/6)-1 = 13%

Conservative: 111/59^(1/6)-1 = 11%

---

134. Enverus. Returning to growth: US power demand forecast highlights impact of data centers, EVs, and solar. 16 Jul, 2024. https://www.enverus.com/newsroom/returning-to-growth-us-power-demand-forecast-highlights-impact-of-data-centers-evs-and-solar/ numbers from "Key Takeaways";

135. Based on 2024 starting value of 25GW from McKinsey & Company. "How data centers and the energy sector can sate AI's hunger for power." McKinsey & Company Website, 17 Sept, 2024. https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power#/. Accessed 29 Sept. 2025.

136. Goldman Sachs. AI to drive 165% increase in data center power demand by 2030. 4 Feb, 2025. https://www.goldmansachs.com/insights/articles/ai-to-drive-165-increase-in-data-center-power-demand-by-2030 (International market numbers: 59 GW current and 122 GW by 2030);

McKinsey Numbers[137]

McKinsey's report focuses on where companies will obtain trillions of dollars in capital to invest, and how aggressively they should invest, to capitalize on the surging demand for AI.

McKinsey assumes that most efficiency gains will be negated by increases in compute power. Its proprietary growth model is based on semiconductor supply constraints, AI adoption rates, efficiency improvement, and regulatory challenges.

McKinsey presents multiple models for growth.

All models assume that non-AI demand will grow from 38GW to 64GW from 2025 to 2030. – From Exhibit 1.

For the starting total capacity in 2025, for all models, Exhibit 1 has: 38 GW (non-AI) + 44GW (AI) = 82 GW

Then, for AI workload, McKinsey presents the following in Exhibit 1 and Exhibit 2:

1. Accelerated Demand: 205GW of growth – Exhibit 2
2. Continued Momentum: in Exhibit 1 McKinsey shows AI going from 44GW in 2025 to 156GW in 2030. 156-44 is 112 GW of growth. But McKinsey calls this 124 GW of growth in Exhibit 2, because it says that the 44 GW in Exhibit 1 includes 12GW of growth from 2024-2025. Thus, for all stated growth numbers, we must subtract 12 GW.
3. Constrained Demand: 78 GW of growth – Exhibit 2

TABLE I-2 ESTIMATED CAGR FOR MCKINSEY

	2030 stated growth for AI: Exhibit 2	2030 AI growth minus the 12 GW of "built in" from 2 above	2030 AI Capacity: starting capacity of 44 GW + calculated growth	2030 total capacity: AI capacity + non-AI capacity (64GW)	CAGR Starting value: 82 Ending Value: 2030 total capacity
Constrained	78	78-12 = 66	44 + 66 = 110	110 + 64 = 174	(174/82)^(1/6) – 1 = 13%
Sustained	124	124-12 = 112	44 + 112 = 156	156 + 64 = 220	(220/82)^(1/6) – 1 = 18%
Aggressive	205	205-12 = 193	44 + 193 = 237	237 + 64 = 301	(301/82)^(1/6) – 1 = 24%

S&P Global Numbers[138]

"Utility power provided to hyperscale, leased and crypto-mining datacenters will hit roughly 58 GW in 2025, up 23% from 47.4 GW in 2024, and double 2024 levels to nearly 95 GW in 2028, 451 Research said in its updated Datacenter Services & Infrastructure Market Monitor & Forecast, released in June."

CAGR = (95/58)^(1/3)-1 = 18%

---

137. McKinsey & Company. The cost of compute: A $7 trillion race to scale data centers. 28 Apr, 2025. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers (Numbers from Exhibit 1 and Exhibit 2);

138. Herring, Garrett and Dlin, Susan. "US datacenter power draw to double by 2028; states tackle supply cost, supply concerns." S&P Global Online. 10 Jul, 2025. https://www.spglobal.com/market-intelligence/en/news-insights/articles/2025/7/us-datacenter-power-draw-to-double-by-2028-states-tackle-cost-supply-concerns-91382267

451 Research is a part of S&P Global Market Intelligence.

Addendum

Recent developments underscore the urgency of evaluating data-center-driven load-growth claims. On Dec 10, 2025, Georgia Power and Georgia Public Service Commission Public Interest Advocacy Staff filed a stipulation[139] authorizing procurement on the order of approximately 10 GW of resources within Georgia Power's territory, which was characterized in the Atlanta Journal Constitution as "an unprecedented expansion that's mostly to serve data centers."[140] **This development does not alter the results and conclusions in this report**, which model load uncertainty. It is important to note that approved resources are not a one-to-one proxy for realized or contractual data-center load. However, as Georgia is asking for 10 GW in their state alone, and this report assumed the SE utilities were proposing a total expansion of 10 GW[141], this addendum has been added to provide additional context.

At the same time, the Georgia evidentiary record provides a concrete, contemporaneous example of the "speculative demand" problem analyzed in this report. Speculative demand can overinflate estimated load growth. On Dec 5, 2025, five days before the stipulation for ~10 GW was filed, Georgia PSC staff filed an exhibit titled "Excess Capacity Risk" (shown in the figure below) which showed over 4.3 GW of the capacity proposed as "Speculative Load Growth."[142]

After the stipulation was filed, Georgia PSC Staff reaffirmed that the data reflected in the figure remained "correct and accurate."[143] Staff testified that only a minority, or ~1.9 GW, of the requested new ~10 GW was supported by executed contracts under the new large-load framework, and that the remainder was speculative, including prospective customers who may never sign contracts or take service.[144] In rebuttal testimony, it was revealed that the ~1.9GW was soon to be approximately 3.3 GW.[145]

---

139. See Stipulated Agreement: Georgia Public Service Commission. In re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All-Source RFP, Dkt. No. 56298 & In re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Dkt. No. 56310. Document Filing #224772. 10 Dec. 2025. https://psc.ga.gov/search/facts-document/?documentId=224772.

140. Kann, Drew. Georgia Power, PSC staff strike deal for $16B expansion to power data centers, The Atlanta Journal Constitution. 10 Dec. 2025. https://www.ajc.com/news/2025/12/georgia-power-psc-staff-strike-deal-to-allow-historic-data-center-expansion/.

141. See Section 2.2.2.

142. Staff Demonstrative Exhibit PIAS-1. In re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All-Source RFP, Dkt. No. 56298 & In re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Dkt. No. 56310. Document Filing #224723. 5 Dec. 2025. https://psc.ga.gov/search/facts-document/?documentId=224723.

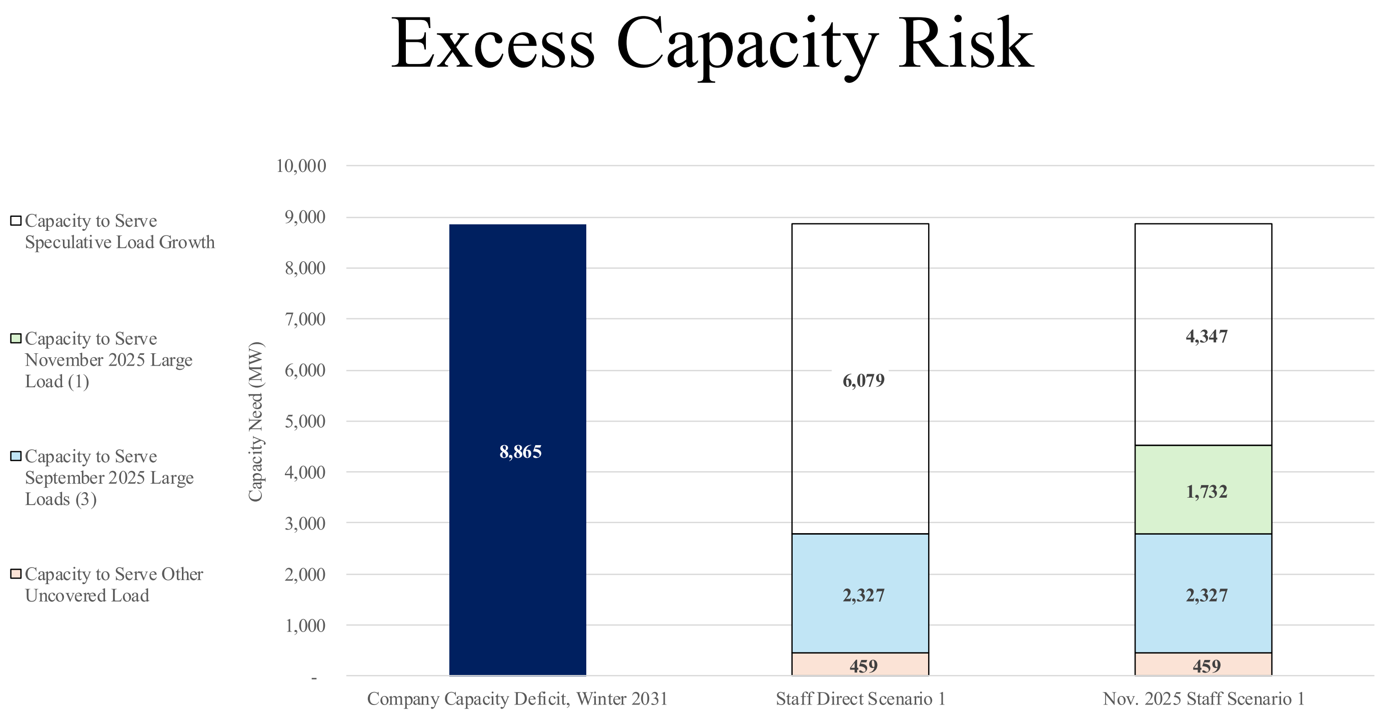
143. Hr'g Testimony of Robert Trokey. In re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All-Source RFP, Dkt. No. 56298 & In re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Dkt. No. 56310. 10 Dec. 2025. https://www.youtube.com/watch?v=FReyQJ9VL7k at 3:47:22.

144. Direct Testimony of Robert L. Trokey. In re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All-Source RFP, Dkt. No. 56298 & In re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Dkt. No. 56310. Document Filing #224483. 12 Nov. 2025. p.4. https://psc.ga.gov/search/facts-document/?documentId=224483.

145. Rebuttal Testimony of Kristin W. Curylo, Jeffrey R. Grubb, M. Brandon Looney, and Francisco Valle, On behalf of Georgia Power Company. In Re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All Source RFP, Docket No. 56298 and In Re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Docket No. 56310. 26 Nov, 2025. Pg 6, line 20. https://psc.ga.gov/search/facts-document/?documentId=224672

This study does not need to update its modeling assumptions to reflect any single docket outcome; it was conducted to provide an independent benchmark for assessing rapid, large-magnitude procurement decisions. The assumed 10 GW "utilities' forecast" for the Southeast region should be read as a conservative, time-bounded snapshot of utility planning assumptions, not an upper bound on what utilities may seek or certify in proceedings, which include speculative load expectations[146]

FIGURE A1. EXCESS CAPACITY RISK AS FILED ON DEC 5, 2025 BY THE GEORGIA PSC STAFF[146]



146. Staff Demonstrative Exhibit PIAS-1. In re: Georgia Power Company's Application for the Certification of Capacity from the 2029–2031 All-Source RFP, Dkt. No. 56298 & In re: Georgia Power Company's Application for the Certification of Capacity Supplemental Resources, Dkt. No. 56310. Document Filing #224723. 5 Dec. 2025. https://psc.ga.gov/search/facts-document/?documentId=224723 (emphasis added).