The Load Factor Effect:

A Backcast of Data Centers' Impact on Historical Dominion Virginia Rates

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Authors & Acknowledgments

Project Team

Energy and Environmental Economics, Inc. (E3) is a leading economic consultancy focused on the power and broader energy sector in North America. For over 30 years, E3's data driven analysis and unbiased recommendations have been utilized across the power industry by the utilities, regulators, government agencies, project developers, investors, and nonprofit entities. E3 has offices in San Francisco, Boston, New York, Chicago, Denver, and Calgary.

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Table of Contents

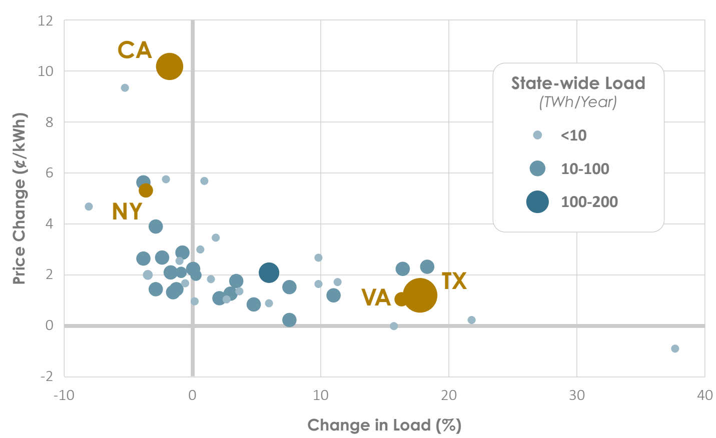
Introduction

After decades of relatively static electric load, the United States is experiencing rapid load growth, driven in large part by data centers. Lawrence Berkeley National Laboratory's (LBNL) 2024 Data Center Energy Usage Report found that annual data center load increased by about 100 TWh between 2018 to 2023, reaching 4.4% of total annual load in 2023 up from 1.9% in 2018.[1]

One of the most hotly debated topics around data center load growth is the effect it has on residential electricity rates. The discourse is centered on the fact that the electric system is maintained through large-scale infrastructure, the costs and benefits of which are shared by all interconnected customers. As such, there exists a risk that customers who consume more energy and require more infrastructure may receive an implicit subsidy from other customers if they do not pay their fair share of costs they create.

A growing body of literature suggests that large loads have historically paid for the costs that they cause to the system, and in some cases may have led to downward pressure on rates for other customers. E3's recent report, "Understanding the Drivers of Rising Electricity Rates and the Role of Data Centers," found no historical correlation between load growth and increased electricity rates.[2] Similarly, a 2026 LBNL study finds a correlation between states that experienced load growth and states that experienced an overall reduction in retail rate levels between 2019-2025.

Figure 1[3]



E3 has been contracted by CloudHQ to expand on this body of research by modeling the Dominion Virginia system with and without historical data center load growth. Rather than identifying broad trends across utilities, this analysis zooms in on a single service territory to illuminate the specific mechanisms that produce those trends. Specifically, it estimates the impact of data center load growth in Dominion's Virginia service territory on 2023 residential retail rates.

[1] 2024 United States Data Center Energy Usage Report. Lawrence Berkeley National Laboratory. December 2024.
[2] Are Data Centers Driving Up Electricity Rates? A New E3 Whitepaper Examines the Quantitative Evidence. Energy and Environmental Economics (E3). May 18, 2026.
[3] Retail Electricity Price Trends and Drivers: Data Update, 2026 Edition (slide 47). Lawrence Berkeley National Laboratory. March 2026.

Methodology

The goal of this analysis is to estimate what retail electricity rates for residential customers would have been in the absence of data center load growth. While rate design involves numerous detailed processes of allocating revenue requirements across functional categories and customer classes, we simplify the analysis by calculating average retail rates for each class using the following formula:

$$\text{Average Retail Rates}\left(\frac{\$}{kWh}\right) = \frac{\text{Total Revenue Requirement } (\$) \times \text{Rate Class Allocator } (\%)}{\text{Energy Consumption in Each Class } (kWh)}$$

This approach makes the data center question tractable. Dominion Virginia serves several customer classes, including residential and various commercial industrial classes, and data center load is primarily reflected in the GS-4 class.[4] Removing data center load growth affects residential rates through two channels: first, less load growth reduces required capital investments; second, less data center load shifts cost allocation across classes, since allocation factors are based on each class's share of total energy consumption and peak load. The following section describes the methodology used to quantify these effects.

Step 1: Calculate Baseline Average Rates by Class

The starting point is Dominion's Virginia jurisdictional revenue requirement, which we derived from the Rate of Return Statement filed in Dominion's 2023 Biennial Review proceeding before the Virginia State Corporation Commission. The filing reported cost-of-service operating revenues of $7.6 billion for the 2022 test year, which we use as a proxy for the revenue requirement.[5]

Energy consumption, peak load, and allocation factors by customer class are sourced directly from Dominion's 2025 rate case testimony, which provided 2023 Average & Excess (A&E) allocation factors.[6] A&E factors allocate fixed costs across customer classes based on two components: each class's average hourly energy consumption over the year and each class's contribution to system peak demand above that average. The first component captures how much of the shared infrastructure each class uses on a typical basis; the second captures how much each class drives the need for capacity to be built for peak conditions, which is the primary cost driver in a capital-intensive utility system. These inputs are summarized in Table 1.

The average rate for each class is then calculated as its allocation of the revenue requirement divided by class-level energy consumption. This yields an **average residential rate of $0.134/kWh**, consistent with the average 2023 residential rate published by Dominion Energy Virginia.[7]

Table 1

	Residential	GS-1	GS-2	GS-3	GS-4	Churches
Energy Consumption (MWh)	28,799,124	3,612,285	10,645,355	11,719,730	21,946,092	210,766
Non-Coincident Peak (MW)	8,164	866	2,215	1,894	2,813	67
Class Allocation	50.7%	5.4%	13.8%	11.9%	17.7%	0.4%

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[4] These are the rate classes that were active in 2023; Dominion has since introduced the GS-5 class for large loads.

[5] Rate of Return Statement, Test Year Ended 12/31/2022. Dominion Energy Virginia, 2023 Biennial Review (Case No. PUR-2023-00101), Virginia SCC. Filed 2023.

[6] Direct Testimony of C. Alan Givens. Dominion Energy Virginia, 2025 Biennial Review (Case No. PUR-2025-00058), Virginia SCC. March 31, 2025.

[7] Dominion Energy Company Update. Dominion Energy, presented to Ashland Town Council. January 16, 2024.

Step 2: Calculate Average Rates Without Data Center Load

Estimate Data Center Load

To isolate the effect of data center load growth, we compared two PJM DOM Zone load forecasts for year 2023: the forecast published in 2018 and the forecast published in 2023.[8] The 2018 forecast projected 2023 load at 20.3 GW, and the 2023 forecast for the same year was at 21.9 GW: a difference of 1.6 GW. We attribute this gap entirely to data center growth that was not anticipated in 2018 and assume that had this load not materialized, it would have meaningfully changed resource and transmission investment decisions.

Estimate Avoidable Investments

We identify three categories of costs that could have been avoided without data center growth:

+ **Gas generation:** For every 1 GW of data center load removed, we assume 1.2 GW of gas combined-cycle capacity could have been avoided, reflecting a typical reserve margin. Avoided costs include capital costs, fixed O&M, and pipeline costs.
+ **Transmission:** Avoided transmission investment is valued on a $/MW basis and assumed to scale proportionally with the data center load removed.
+ **Solar:** Virginia's RPS standard required that 20% of total generation come from renewable resources in 2023.[9] We estimate the solar capacity that would have been needed to meet this requirement and include the associated cost in our estimate of data center load growth costs.

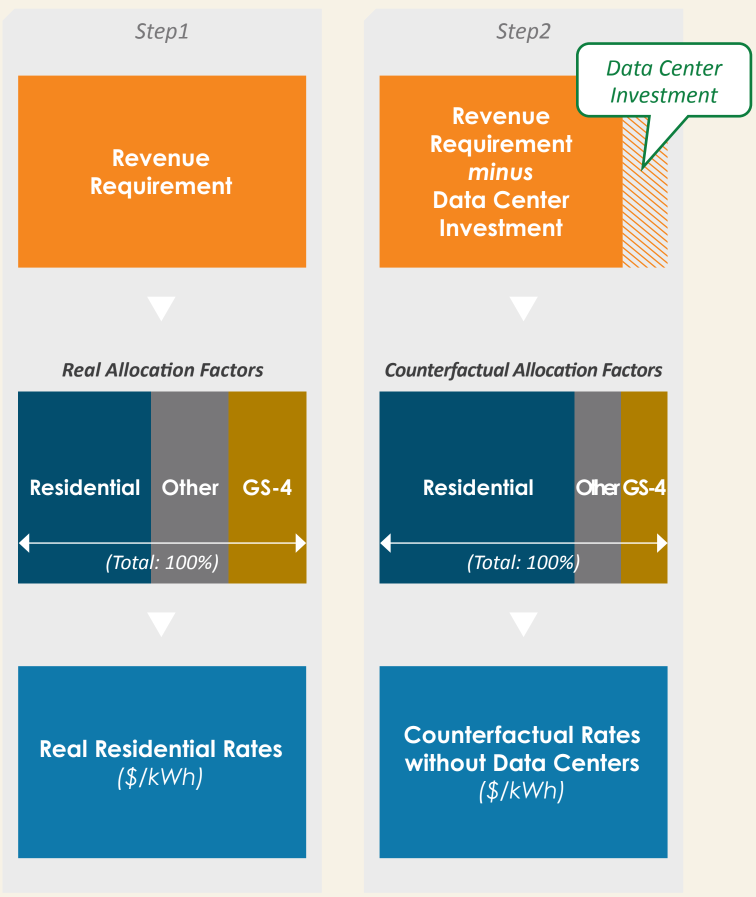
For each investment type, we calculate its impact on the revenue requirement. Specifically, we model the associated depreciation, operating and maintenances expenses, and return on rate base for each investment, and apply a gross revenue conversion factor to the resulting income deficiency to determine its impact on the revenue requirement including taxes.

Derive Adjusted Revenue Requirement and Rates

The total avoidable revenue requirement across these three categories are subtracted from the base revenue requirement to produce an adjusted, counterfactual revenue requirement.

To derive new average retail rates, A&E allocation factors are recalculated reflecting the removal of incremental data center load from the GS-4 class. Specifically, GS-4's non-coincident peak demand is reduced by the removed load, and GS-4's annual energy consumption is reduced by the removed load (converted to annual energy using the data center load factor assumption). System coincident peak demand is adjusted downward proportionally using the Coincident Peak to Non-Coincident Peak ratio assumption. With updated class-level demand and consumption figures, A&E factors are recalculated for all classes. New average retail rates are then calculated as each class's share of the adjusted revenue requirement divided by its energy consumption.

Figure 2



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[8] Load Forecast Development Process (Annual Load Forecast Reports, Table B-1). PJM Interconnection. Updated annually; no single date.

[9] Renewable Portfolio Standard (RPS). Dominion Energy Virginia. Current webpage; no fixed date.

Step 3: Sensitivity Analysis

To account for input uncertainty, we assess the sensitivity of results by varying each key parameter across a low, base, and high value as shown in Table 2. The parameters span both the demand side (e.g., volume of data center load growth) and the supply side (e.g., the costs of the gas, solar, and transmission investments that would have been avoided).

Table 2

Parameters	Low	Base	High
Data center load to remove [10] *(MW)*	1,430	1,589	1,748
Data Center Coincident Peak to Non-Coincident Peak Ratio [11] *(%)*	80%	90%	100%
Data Center Load Factor [12] *(%)*	85%	90%	95%
Solar Capital Costs [13] *($/kW)*	1,579	1,754	1,929
Gas Capital Costs [14] *($/kW)*	929	1,032	1,135
Gas Build vs. Nameplate Load *(multiplier)*	115%	120%	125%
Transmission Costs [15] *($/kW)*	270	300	330

[10] Base case is the delta between the 2018 and 2023 forecasts for peak load in 2023. High/Low scenarios are ±10% of the Base Case.

[11] Reasonable assumptions based on observed data center operations.

[12] 90% is a standard load factor assumption for data centers; the observed load factor of GS-4 is 89%.

[13] Annual Technology Baseline. National Renewable Energy Laboratory (NREL). 2018 edition.

[14] Annual Technology Baseline. National Renewable Energy Laboratory (NREL). 2018 edition.

[15] Informed by review of PJM Transmission Expansion Advisory Committee (TEAC) filings. High/Low scenarios ±10% of Base Case.

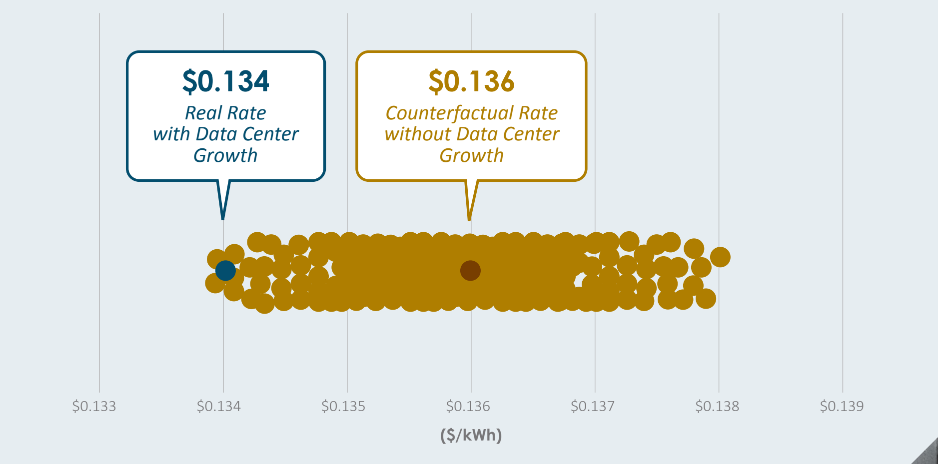
Results & Conclusion

Results

The real-world residential rate of $0.134/kWh was lower than 98% of the 2,187 counterfactual scenarios tested, which produced rates ranging from $0.134 to $0.138/kWh. This implies a typical residential customer using 1,000 kWh/month **saved $2 per month on average** due to incremental data center load growth. The primary driver: data centers' share of cost responsibility grew more than the total costs they imposed, putting downward pressure on rates for other classes, including residential.

The primary driver is the shift in cost allocation factors when data center load is removed. In the mid case, serving incremental data center growth cost Dominion about $704 million, while allocation factors assigned data centers roughly $763 million of the 2023 revenue requirement. In other words, the cost allocation process assigned more costs to data centers than they imposed on the system. As a result, data centers helped contribute to covering existing infrastructure costs, lowering rates for other classes.

Figure 3



Conclusion

The central finding of this analysis is that the rate impact of data center growth depends on the relationship between two effects:

+ The increase in total system costs attributable to data center load growth
+ The increase in the share of costs allocated to data centers

Put simply, rates come under downward pressure when data centers pay more into the system than it costs to serve them. The relationship between these values can vary significantly across utilities, driven by factors like cost allocation methodology, interconnection costs and processes, and the operational characteristics of new load, among others. This makes localized study essential for understanding how data center growth actually affects other ratepayers.

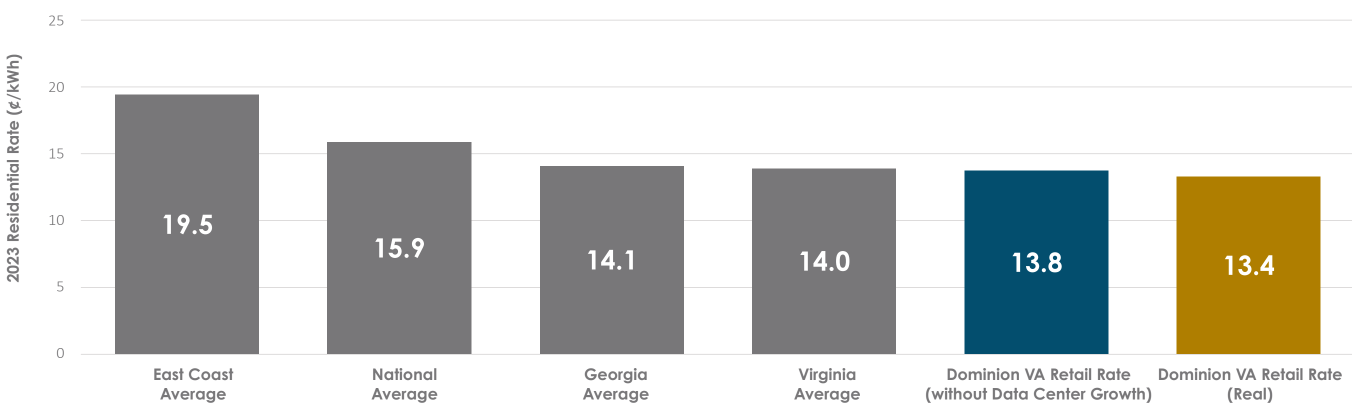
We focus this study on Dominion Energy, one of the leading utilities in serving data center load. Using reasonable assumptions, observed real-world energy consumption, and wide uncertainty bands, we find that for the period studied, the growth in Dominion's data center cost allocation share exceeded the growth in total system costs.

This finding is directionally consistent with Dominion's retail rates having historically been lower than peer utilities in the region and below the national average, as shown in Figure 4. More broadly, it illustrates how utilities can capture system efficiencies by serving customers with high load factors, spreading fixed costs across a larger base of energy consumption and reducing average rates for other classes.

This report's central finding — that data centers can put downward pressure on residential rates under specific circumstances — also depends on forecasted data centers actually materializing and operating at a high load factor. If projected load doesn't materialize, ratepayers face significant stranded cost risk and associated rate increases from infrastructure built in advance for load that never showed up. Many states and utilities are responding to this risk by adopting large load tariffs with long contract terms, steep exit fees, collateral requirements, and minimum demand charges. In E3's recent white paper, "An Empirical Analysis of Data Center Grid Utilization, Cost-of-Service and Revenue Contributions," we find that Dominion's new GS-5 rate incorporates all of these best practices and, in the worst-case scenario of load departure, allows the utility to recover the majority of stranded costs.[17] Tariff design elements like these can help utilities proactively integrate large loads and capture their rate benefits while protecting ratepayers from downside risk.

This case study doesn't settle the debate over data center cost allocation. Instead, it demonstrates that the direction and size of the rate impact turns on utility-specific choices: how allocation factors are constructed, how load growth is served by new capacity, how large-load tariffs price in stranded-cost protection, and how closely forecasted load tracks actual load. Regulators and stakeholders evaluating data center growth in other territories should treat Dominion's result as a demonstration of how large loads produce impacts on other rate classes, with the potential to drive rate reductions.

Figure 4[16]



[16] Table 5.6.A, Average Price of Electricity to Ultimate Customers by End-Use Sector. U.S. Energy Information Administration. Data released October 24, 2023, reflecting August 2023 rates. East Coast includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania, Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, and Virginia.

[17] Beyond the Headlines: An Empirical Analysis of Data Center Grid Utilization, Cost-of-Service and Revenue Contributions. Energy and Environmental Economics (E3), commissioned by CloudHQ, LLC. June 2026.