Industrials/Multi-Industry

Deep Dive: On-site power for data centers; grid resiliency implication

Industry Overview

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Equity
Americas
Industrials/Multi-Industry

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On-site power generation: starting up

On-site power generation has never been common for US data centers. Diesel generators are only for backup, not prime, power. However, a survey of utilities shows the earliest time for a grid connection is 2028-29. Supply is lagging further and further behind. US power generation projects going live in 2024 took a median of 4.5 years to connect to the grid. As a result, data center developers are turning to bring your own power solutions while waiting for firm grid connections (i.e., bridge-to-grid solutions).

A look at real world case studies…

We look at seven case studies of on-site power generation. Before artificial intelligence growth kicked off (OpenAI's ChatGPT released Nov. 2022), on-site power was aimed at reducing usage during peak periods. This evolved to bridge-to-grid use cases as early as 2023. This further transitioned to behind-the-meter power generation with air permits that would allow for 24x365 operations in 2024-25. Most recently, xAI's use of rental power generation suggests an even faster speed-to-power use case of on-site power. Both hyperscalers and colocation developers have used on-site power generation.

…as gigawatt-scale behind-the-meter deals announced

In July, GE Vernova won an order for 29 gas turbines to provide 1.0 gigawatts (GW) of power for the Oracle/Crusoe Stargate data center in Texas. In August, Caterpillar (CAT, covered by our colleague Michael Feniger) announced an initiative for multiple gigawatt (GW) orders for behind-the-meter power for data center developer Joule in Utah. In October, VoltaGrid announced an agreement to deploy 2.3GW of power to Oracle via natural gas reciprocating engines.

BofA view: the grid was not built for this

On July 10th, 2024, at 6:58pm, a transmission line in Northern Virginia saw a disturbance lasting a few milliseconds. This was long enough for 1.5 GW of electricity demand (equivalent to 1.3mn homes) to drop, as diesel generators at 60 data centers simultaneously kicked in. Grid operators had seconds to reduce power generation before the resulting power surge would have caused blackouts. We see regulators looking to make data centers more "grid aware" via demand response agreements, such as the recent Texas law (Senate Bill 6).

Stock implications: power gen + grid equipment

The obvious implication from more on-site power generation is to buy on-site power equipment providers, like Buy-rated GE Vernova (GEV) and Caterpillar (CAT). However, we think that grid-related equipment providers will also benefit. One does not simply "plug in" dozens of reciprocating gas engines and expect high-quality electricity output. Data center developers (or their independent power producer partners) will need to buy medium- and high-voltage grid equipment to complete on-site power generation solutions. These include Buy-rated Eaton (ETN) and GE Vernova (GEV).

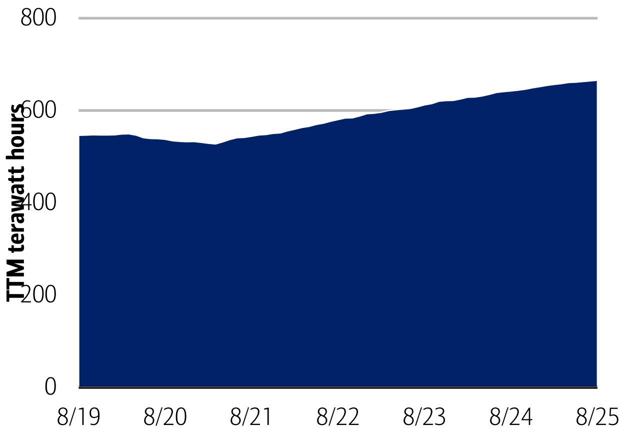
How did we get here?

Demand surged, in particular new large-load requests

According to Wood Mackenzie, US utilities have already committed to 160 GW of new large-load demand, or ~22% of peak demand in 2024. These large loads come from new data centers, but also manufacturing plants and commercial construction.

The US has lagged in adding transmission capacity. This makes the location and density of the load growth important. US load growth has been concentrated in a handful of states – either for data centers (Virginia, Ohio, Oregon), industrial (New Mexico, Tennessee, Louisiana), or both (Texas, Arizona, Georgia, Oregon).

Exhibit 1: Commercial electricity demand: top 15 data center states
Growing at a 3.3% CAGR through COVID-19 recession



Source: Energy Information Administration
Note: Electricity supplied to commercial customers in Virginia, Texas, Ohio, Oregon, Washington, Georgia, Arizona, Oklahoma, South Carolina, Utah, Nevada, Florida, North Dakota, Nebraska, Wyoming

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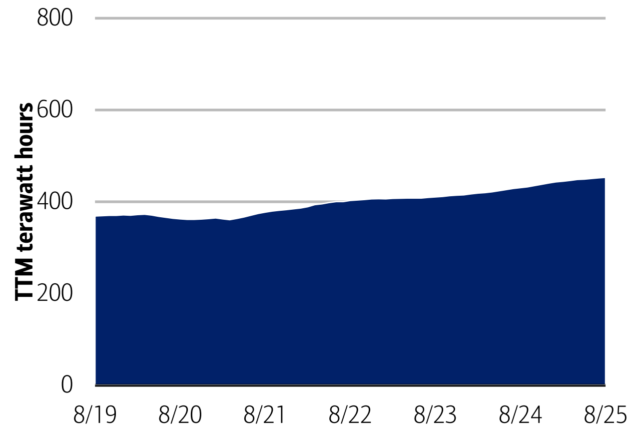
Exhibit 2: Industrial electricity demand: top 15 industrial states
Growing at a 3.5% CAGR through COVID-19 recession



Source: Energy Information Administration
Note: Electricity supplied to industrial customers in Texas, Louisiana, Georgia, Tennessee, Oklahoma, Arkansas, Florida, Oregon, Arizona, New Mexico, Nebraska, Idaho, North Dakota, South Dakota

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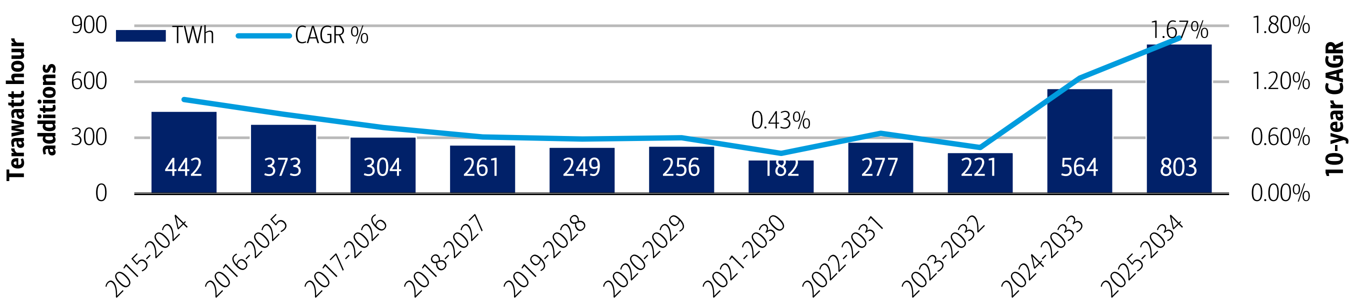
US electricity demand has grown by 222 terawatt hours since 2019, or a 1.0% CAGR. The top 15 states for data centers added 119 terawatt hours, while the top 15 states for industrial plants added 84 terawatt hours. US-wide residential demand, and commercial/industrial demand outside of these states grew by just 19 terawatt hours.

Data centers: the straw that broke the camel's back

In 2020, US utility planners forecast a 0.43% CAGR electrical load growth CAGR (2021-2030). By 2024, this was up to 1.67% CAGR (2025-2034). These load growth expectations are important because they inform power generation capacity planning. We expect when 2026 forecasts are published, they will again be revised up.

Exhibit 3: Utility planners forecasts for US electrical load growth are accelerating
US utility planners have consistently increased forward projections for electricity loads



Source: North American Electric Reliability Corporation (NERC)

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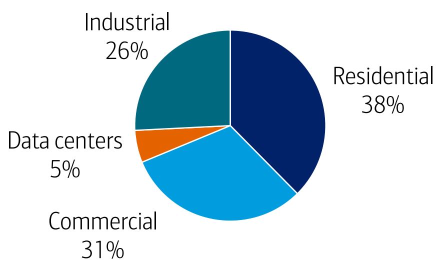
However, data centers remain a modest portion of overall US electrical loads. We estimate that data centers will comprise just 5% of total electricity usage in 2025E. Building electrification (replacing fossil fuel space heating, water heating, and cooking with electrical appliances) continues to be the single largest driver of US electrical load growth, in our view. Electric vehicle adoption is another driver of growth. For more details see Appendix 2 on page 13 or our November 10th report, Building electrification key undervalued driver for US electrical demand.

Exhibit 4: Data centers just 5% of US electrical load in 2025E
Data centers had 20+% y/y growth



Source: BofA Global Research

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Supply (and the grid) did not keep pace

Over roughly this same period (year-end 2019 to 2024), the US added over 160 gigawatts (GW) of renewable power generation assets. However, as solar only works with the sun is out and wind turbines only when there is sufficient wind, they have low effective capacity factors (i.e., portion of time actually generating electricity). For more information, please see Appendix 1: capacity factors.

Compounding this problem, utilities retired 59 GW of coal capacity, driving an overall 36 GW net decline in dispatchable power despite further natural gas turbine additions. Coal power plants have higher capacity factors versus most renewable power sources.

Exhibit 5: More renewable, less coal makes electrical capacity additions smaller than they appear
Intermittent power generation (e.g., solar, wind) generate electricity less often than dispatchable power

Nameplate capacity (GW)	2019	2024	% change
Dispatchable power	947	912	-4%
Intermittent	250	413	65%
Total	**1,198**	**1,325**	**11%**
Capacity factor			
Dispatchable power	58.8%	58.1%	
Intermittent	41.3%	34.8%	
Effective capacity			
Dispatchable power	557	530	-5%
Intermittent	103	144	39%
Total	**660**	**674**	**2%**

Source: Energy Information Administration

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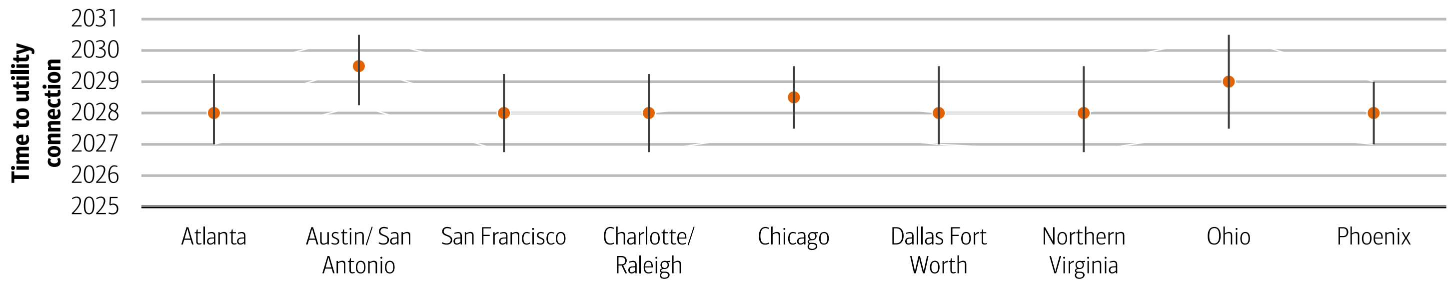
Resulting in lead time for electrical connections increased

A survey of utility executives shows the earliest time for a grid connection at 2028-2029 (depending on location). This suggests a 30+ month wait time. Bloomberg News reported on an extreme example: Digital Realty Trust's Santa Clara data center has been waiting for a grid connection for six years. The utility (Silicon Valley Power) needs at $0.5bn grid upgrade before making the connection; the project is expected to be complete in 2028. Dominion Energy (serving Virginia) now expects to be unable to fulfil some data center requests until 2032.

Exhibit 6: When is the earliest a utility could give you power? 2028 or 2029
Survey of 23 utility executives suggests a wait time of over 2.5 years at the earliest



Source: 2025 Data Center Power Report, Survey of 23 utility executives performed in April 2025
Note: orange dot is median answer

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Case studies of on-site power

Centersquare BOS1-A: peak shaving

The Centersquare BOS1-A is a 16 MW data center in Waltham, Massachusetts. The owner entered into a 20-year Energy Services Agreement with Unison Energy. Unison deployed two 997 kW reciprocating engines at the site to offset 75% of peak demand. Energy savings in the first year of operation totaled ~$0.4mn versus utility power.

Middletown Data Center: peak shaving

Commissioned in 2022, the Middletown Data Center is a 14 MW data center located in Middletown, Virginia. In addition to three utility connections, the site has six Caterpillar G3520 reciprocating natural gas engines (each capable of providing 2.5 MW). The engines are permitted to run up to 1,800 hours per year (or ~5 hours per day) to reduce peak demand and deliver electricity back to the grid.

Aligned Data Centers NEO 01-04: bridge-to-grid

In 2023, the Perkins Township approved an economic development agreement with Aligned Data Centers for up to four data centers (NEO 01, 02, 03, and 04). Located on the site of a former General Motors plant, the building came with its own electrical substation for 80 MW. However, to accelerate the build-out, Aligned contracted with Wärtsilä for fifteen 18V50SG engines (each with 19MW), for a total of 282MW of power. The project is still under construction.

Meta New Albany: behind-the-meter

Will-Power OH, a subsidiary of The Williams Companies, is building ~400MW of natural gas generation for a behind-the-meter deal with Meta. The plant will feature thirty Caterpillar 3520 reciprocating engines, twenty-two Titan 130 turbines, six Titan 250 turbines, and six Siemens SGT400 turbines. The varied assortment of generation types (engines and turbines) and manufacturers suggests the key criteria was speed-to-power, in our view. The total plant is expected to cost $1.6bn, according to press reports.

EdgeConneX New Albany: behind-the-meter

EdgeConneX, a data center developer with over 80 completed sites, has received construction for phase one (120WM) of behind the meter power for a new data center in New Albany, Ohio. Across phase one and two, the proposal includes twenty eight Jenbacher 624 engines (3 MW each), four Jenbacher J620 engines (5 MW each), and 15 Wartsila 18V50SG engines (19 MW each) for a total of 425MW of combined output.

Oracle/Crusoe Stargate Abilene: mega project

Data center developer Crusoe has placed an order with GE Vernova for twenty nine LM2500XPRESS aeroderivative gas turbines (35MW each), providing a total of 1.0 gigawatts (GW) of prime power. Currently, Crusoe operates five Caterpillar Titan 350 turbines and five GE Vernova LM2500XPRESS turbines (per Texas air permit filings), for a total of 360MW of power. Ultimately, Crusoe intends to run on grid (per its website).

However, the company's air permit filings allow them to run the onsite turbines year-round, suggesting this may be a bridge-to-grid solution in our view.

xAI Colossus 2: renting for speed-to-power

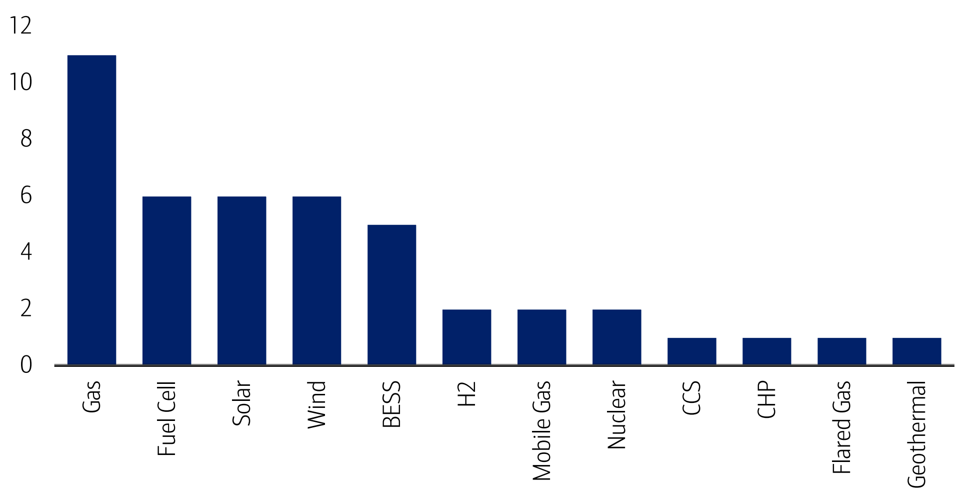
xAI is building Colossus 2 in Memphis, Tennessee. In 2025, xAI acquired the site of a former Duke Energy power plant in Southaven, Mississippi, which is located across the state line. xAI then contracted with Solaris Energy Infrastructure (SEI; not covered) to provide approximately 1,100MW of gas turbines at this site. While the exact mix of turbines was not disclosed, Solaris' fleet includes GE Vernova LM2500 (35MW), Caterpillar Titan 130 turbines (17MW), and Caterpillar Taurus 60 turbines (6MW).

Data centers (still) love grid power…

On-site power generation remains a minority solution. Data center developers continue to prefer grid interconnection for primary power. Out of 540 data center projects tracked by Wood Mackenzie, only 6% show evidence of co-located generation. This implies ~94% still rely on the default: grid supply, backed by uninterruptable power supply (UPS) and diesel back-up generators.

> "We're not in the power business," he said. "We're building these bridges to allow the cavalry to come up with the transmission or other pieces of the puzzle that they may need to provide power." – Andrew Power, CEO of Digital Realty (colocation firm with over 300 data centers)

Exhibit 7: 6% of the 540 data center projects tracked by Wood Mackenzie have on-site power
Number of deployments with on-site power generation by resource type



Source: BofA Global Research, Wood Mackenzie

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…but the grid may not love them back

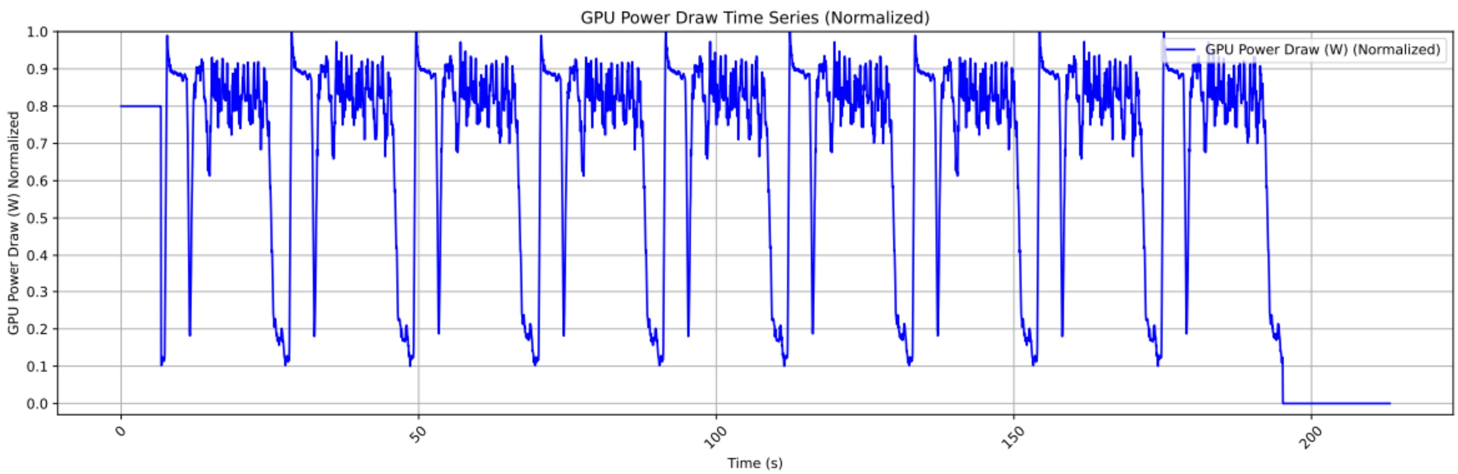
AI training: power swings every minute & every hour!

Infinite loop: Compute, communicate, repeat

During AI training, the alternation between a power-intensive computation phase and a less power-demanding communication phase leads to large power swings. Models iterate over a small batch of training data, with each GPU processing the batch separately (compute phase). Since results must converge to the same global model, individual results are shares across all GPUs (communication phase).

The chart below shows the rack-level power consumption of Nvidia H100 GPUs during an AI training run. Electricity consumption swings dramatically down during the communication phase.

Exhibit 8: Normalized power readings from Nvidia H100 racks during an AI training job
Computation phase at 80-90% of normalized power consumption, communication phase at 10-20% of normal power consumption



Source: Choukse, Esha, et al. "Power stabilization for AI training datacenters." arXiv:2508.14318 (2025)

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Just one more jump until the save point

While this is bad, it gets worse. Eventually the model needs to be saved to persistent storage. This process, called checkpointing, guards long-running training jobs against potential failures/errors.

Typically checkpointing is done every 4-8 hours during a training run. The greater the number of GPUs simultaneously running, the greater the probability of an individual chip failure. Many practitioners will decrease the time between checkpoints if increasing the number of GPUs running on the task.

During checkpointing, electricity consumption declines across all GPUs running the AI training. The actual down time could be just a few seconds, but because it occurs across all GPUs, the aggregate power declines are measured in megawatts.

Is there a solution? Maybe

A 2025 paper by researchers from Microsoft, OpenAI, and Nvidia (Choukse, Esha, et al.) details why training loads are inherently volatile. They propose a two-pronged solution.

> "Power stabilization is emerging as a critical bottleneck in the continued scaling of AI training workloads." – Esha Choukse, et. al. is *Power Stabilization for AI Training Datacenters*

First, to add a layer of GPU power smoothing software/hardware. By definition, power smoothing will require more electricity, particularly if you add a minimum power floor. Second, to add rack-level energy storage. However, they acknowledge that the capacitors would be "expensive from cost, rack-level space, and embodied carbon perspectives."

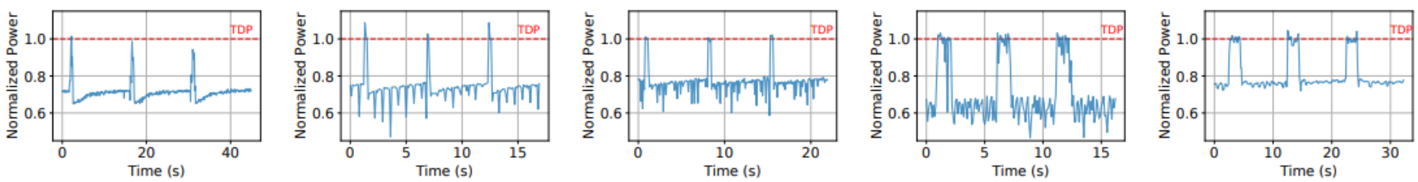
AI inference: spikes, spikes, and more spikes

What happens when I ask ChatGPT for the best NYC pizza?

As a large language model (LLM) analyzes the initial prompt phase ("Best NYC pizza?"), the power consumption of the GPU spikes upwards. Thermal design power (TDP) is the maximum amount of power a CPU/GPU can use (or conversely, heat it can generate) without failure. During this prompt interpretation phase, peak power usage can even exceed the chips' TDP.

As the LLM starts to work out its response (e.g., "Joe's Pizza, L'Industrie, Lucali…"), the power consumption is lower, more stable, and runs for a longer period. The charts below show this similar pattern across five different LLMs: Google's Flan-T5, EleutherAI's GPT-NeoX-20B, Kobold's OPT-30B, Meta's Llama2-70B, and the open source BLOOM-176B. In each case, the spikes are prompts and the lower (but still volatile) periods are inference.

Exhibit 9: Individual GPU's power consumption spikes as it initially analyzes the prompt before steadily working on the answer
Comparing GPU-level power consumption across five large language models (LLMs) normalized to the thermal design power (TDP) of the GPU



(a) Flan-T5. **(b)** GPT-NeoX-20B. **(c)** OPT-30B. **(d)** Llama2-70B. **(e)** BLOOM-176B.

Source: Wilkins, Grant, Srinivasan Keshav, and Richard Mortier. "Offline energy-optimal LLM serving: Workload-based energy models for LLM inference on heterogeneous systems." ACM SIGENERGY Energy Informatics Review 4.5 (2024): 113-119.

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But we can smooth these spikes out, right? In reality, not so much

In the real world, these spikes are showing up in the grid. Thousands of server racks can create power harmonics that then spread into the local distribution grid. A 2024 Bloomberg analysis of sensor data from more than 700,000 homes found that proximity to data centers was correlated with declining power quality. Other issues include voltage flicker, unbalanced loads, and binary power circuits.

Rising regulations for data center power

Regulations pushing on-site power generation

We think state regulatory and legislative action is driving more data center developers to continue on-site power generation as well. The proposed Federal rules would favor data centers that have collocated power generation. State rules are likely to increase the electricity costs through either higher rates, contract terms, or renewable requirements. Both trends make on-site generation more attractive, in our view.

Faster reviews for "large loads" that add on-site power

There is a potentially beneficial regulatory proposal for on-site data center power generation. The Federal Energy Regulatory Commission (FERC) regulates interstate transmission and wholesale electricity. On October 23, Secretary of Energy Chris Wright initiated rulemaking to accelerate connection of large loads, historically defined as over 20 megawatts (MW).

Sec. Wright aims "ensure efficient, timely, and non-discriminatory load interconnections." Data centers that add on-site power generation or agree to voluntarily reduce demand during peak times could get expedited reviews (e.g., 60 days versus current years-long processes).

State legislation focuses on cost shifting

So far, regulatory and legislative action on the state level has focused on "cost shifting" versus limiting access to power. Regulated US electric utilities must connect all customers in their service area (i.e., "duty to serve"). However, connecting large customers may require specific grid or generation costs. If the customer's electricity rate does not fully cover those costs, they are shifted to other customers.

In contrast, European regulation action has been more draconian. Several key European cities have full moratoriums on new data center connections (e.g., Dublin, Amsterdam).

Examples of recent regulatory actions

According to the Database of Emerging Large-Load Tariffs, there are 29 pending regulatory actions. We highlight actions that have already occurred below:

- In November 2024, Indiana Michigan Power reached a settlement to require customers with more than 70 MW of power to sign a contract term at least 12 years.

- In January 2025, Georgia's Public Service Commission approved a new rule for customers using >100 MW allowing for higher (and longer) billing terms to reflect increased grid/generation costs-to-serve.

- In January 2025, the Alabama Public Service Commission approved the Alabama Power's ability to negotiate separate terms and conditions for customer loads over 30,000 kilovolt amperes.

- On March 18, 2025, the Kentucky Public Service Commission approved new rules for customers adding 150 MW or more of incremental load. Terms include a 20-year contract, minimum monthly billing requirements, and other contractual protections.

- In April, South Carolina's state-owned utility began charging a higher rate to customers >50 MW.

- In June, Texas passed legislation (SB 6) that requires the Public Utility Commission of Texas (PUCT) to create rules that large load customers (>75 MW) contribute to interconnection costs and agree "only after all available market services have been deployed" to use backup generating facilities during emergencies. PUCT has started the rulemaking process, so the exact details remain uncertain.

- In July, the Public Utilities Commission of Ohio ordered AEP Ohio to file new tariffs applying to data centers.

- In August, the Arkansas Public Service Commission approved Arkansas Electric Cooperative Corporation new Transmission Extension of Facilities Tariff, which puts higher costs to customers exceeding 50 MW.

Demand response & data centers

Demand response: an emerging regulatory path

The passage of Texas' Senate Bill 6, requiring the electricity regulator to create demand response rules for large load customers, has sparked more interest in similar proposals elsewhere. Demand response balances on-grid loads by having customers shift demand to off-peak times.

Google's demand response experience

Google services (e.g., Search, YouTube, Google Cloud) run across dozens of owned data centers and additional servers in colocation facilities. Because Google operates system-wide planning, it can shift loads across data centers and delay non-immediate tasks. As a result, Google has been able to sign demand response agreements for several years in countries around the world. In 2025, Google signed two demand response agreements (with Indiana Michigan Power and Tennessee Valley Authority) for its owned AI data centers in those regions.

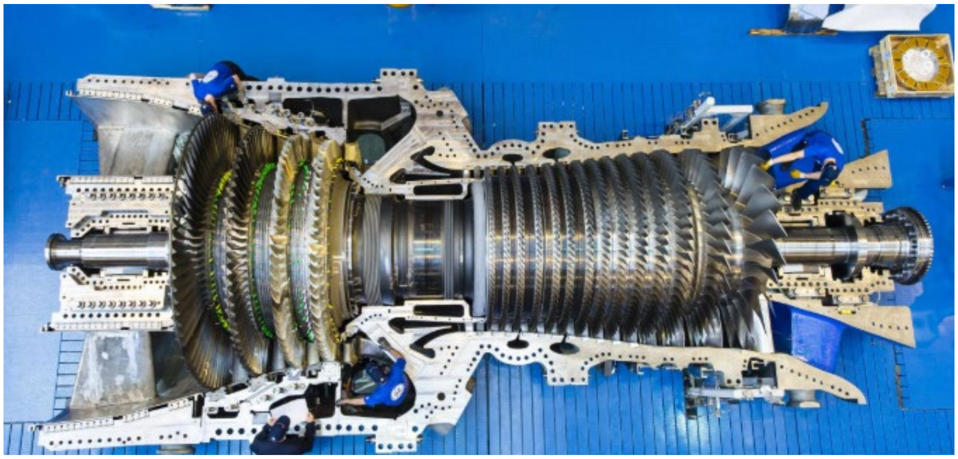
Adding batteries for faster interconnection

In October, Aligned Data Centers (owner of 50 data centers total 5 GW of capacity) announced it would buy and install a 62 MWh battery storage system on its own land. In turn, the local electric utility would accelerate the sites interconnection to the grid. The utility's study estimated the incremental constraints the new load would have on the grid. Batteries offer the ability for Aligned's site to go "off-grid" during peak periods without running backup diesel generators.

Types of solutions

Heavy-duty natural gas turbines

Exhibit 10: GE Vernova 9HA turbine being built (note three employees in frame for scale)
9HA turbines are typically used in combined cycle applications



Source: Company website

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Heavy-duty combined cycle turbines turn 64% of the energy from burning natural gas into electricity. The initial ignition powers the combustion turbine. Then the exhaust gas is used to heat water creating steam which in turn drives a steam turbine. This fuel efficiency makes them preferred by utilities. They are large-scale plants. For example, operating two GE Vernova 9HA.02 turbines and one steam turbine (i.e., 2x1 configuration) would have a 1,680 MW output.

For on-site power applications, the key drawbacks are their current long lead times, large format sizes (making them less modular), high initial capex costs, long start-up times (i.e., 30 minutes or more), and the need for a natural gas connection.

Aeroderivative natural gas turbines

Exhibit 11: GE Vernova TM2500 DLE installed in Veresegyház, Hungary
Installation in less than three weeks at manufacturing plant

Source: Company website

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Aeroderivative natural gas turbines are based on the designs of jet engines. They are typically used in simple cycle configurations for peaking applications, given their lower efficiency. For the current generation of aeroderivative turbines, 43% of energy from burning natural gas is converted into electricity. They are smaller plants, generating 30-120 MW of electricity per turbine. Trailer-mounted versions (e.g., GE Vernova's TM2500 DLE) can be quickly installed after natural disasters.

For on-site power applications, the key drawback are medium start-up times (i.e., 5-10 minutes), medium format sizes, ongoing operating costs, and the need for a natural gas connection.

Industrial natural gas turbines

Exhibit 12: Caterpillar's subsidiary Solar Turbines' Titan 130 installed in Tarkwa, Ghana
Providing 16.5 MW of electricity to a mining location

Source: Company website

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Industrial natural gas turbines are typically used in robust settings and have longer operating times between required overhauls. However, they have lower efficiency versus combined cycles. For the current generation of industrial turbines, 39-40% of energy from burning natural gas is converted into electricity. They are larger plants, generating 50-300 MW of electricity per turbine.

For on-site power applications, the key drawback are longer start-up times (e.g., 20 minutes), larger format sizes, and need for a natural gas connection.

Reciprocating natural gas engines

Exhibit 13: Caterpillar CG170B-20 offers 2.3 MW of power generation in 120 sq. ft.
Up to 45% electrical efficiency

Source: Company website

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Reciprocating natural gas engines are used in industrial, commercial, and institutional facilities for both power generation and combined heat and power applications. The US has over 6 GW of installed capacity with an 18% capacity factor, suggesting a mix of prime and backup power applications. Best-in-class reciprocating engines can turn 50% of the energy from burning natural gas into electricity. They are typically smaller plants, generating 1-30 MW of electricity per engine. They ramp quickly and are efficient even with partial loads (e.g., 25% of nameplate capacity).

For on-site power applications, the key drawbacks are the initial capex costs, the need for a natural gas connection, and higher lifetime maintenance costs with scheduled downtime.

Fuel cells

Exhibit 14: Bloom Energy solid oxide fuel cells in Ulsan, South Korea
These fuel cells produce 0.1 MW and are part of a 1 MW project

Source: Company website

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Fuel cells convert chemical energy into electricity through a reaction, without combustion. There are a wide variety of fuel cells, but the most common are solid oxide fuel cells (which typically use natural gas) and proton exchange membrane fuel cells (which typically use hydrogen). CoreWeave deployed 14 MW of solid oxide fuel cells at a site in Volo, Illinois. Microsoft, Ballard Power Systems, and Caterpillar demonstrated a pilot to use hydrogen fuel cells in backup power applications.

For on-site power applications, the key drawbacks are the initial capex costs, the need for a natural gas connection, and limited large-scale operational history of the technology.

Battery Energy Storage Systems

Large-scale Battery Energy Storage Systems (BESS) can be used to complement renewable power generation sources to provide off-grid power. These are typically sized for two- or four-hours (e.g., 200 MWh = four hours of coverage for 50 MW data center). Microsoft has used BESS and renewable sources to eliminate the need for diesel backup in data centers in Sweden, although these are still connected to the grid. xAI has deployed ~655 MWh of Tesla Megapacks at its Colossus 1 site in Memphis, Tennessee. These are used to buffer on-grid electricity loads, according to press reports. Of course, BESS would still need to be complemented by on-site power generation. We view BESS as complementary to on-site power generation.

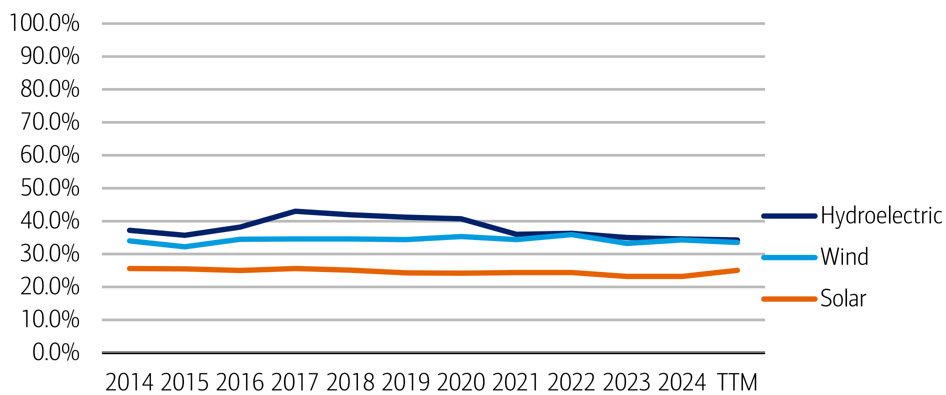
Appendix 1: Capacity factors

Not all gigawatts are created equal

In the trailing twelve months to September 2025, US solar panels produced electricity 25% of available hours, wind turbines 34%, and hydroelectric dams 34%. Other minor renewable sources are wood, biogas, and geothermal.

Exhibit 15: Renewable power sources are highly intermittent

Even hydroelectric dams generate electricity 34% of the time, solar panels only 25% of the time



Source: Energy Information Administration

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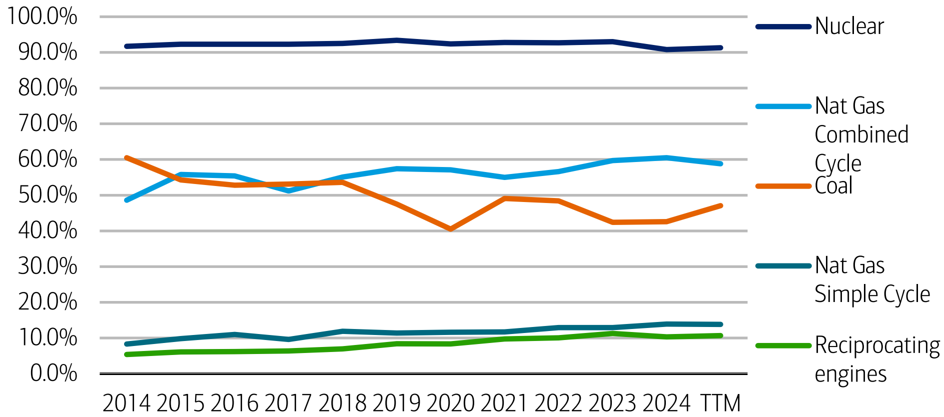
In the trailing twelve months to September 2025, US nuclear plants produced electricity 91% of available hours, natural gas combined cycle turbines 59%, and coal plants 47%. Natural gas simple cycle and diesel/gas reciprocating engines produced electricity 14% and 11% of available hours, respectively. Other minor dispatchable power sources include oil-fired plants and natural gas steam turbines.

Exhibit 16: Dispatchable power sources – coal capacity factor moving up, nuclear structurally high
Capacity factors are low for simple cycle and reciprocating engines used for peaking applications



Source: Energy Information Administration

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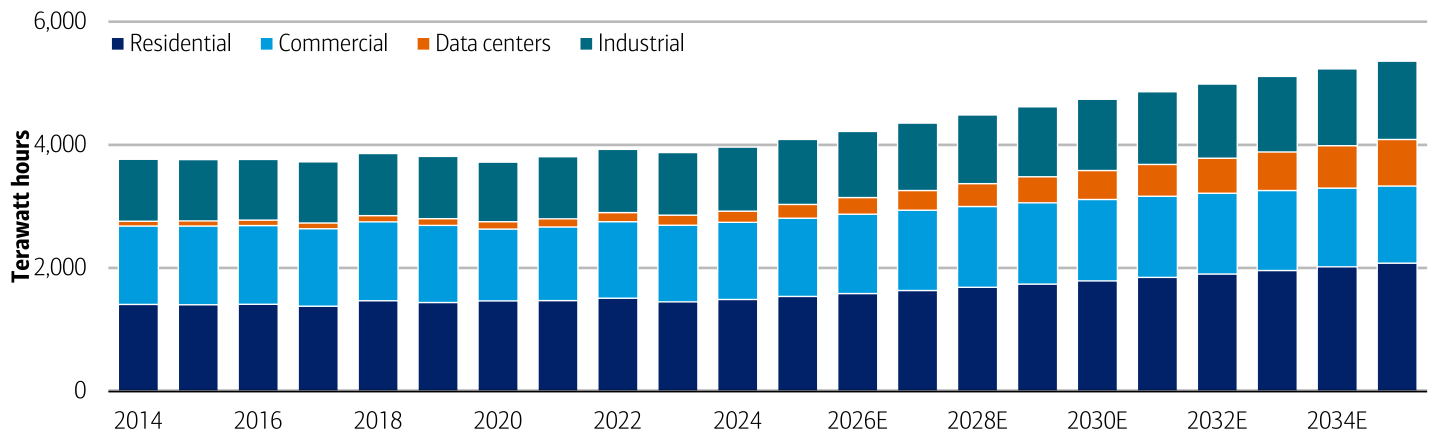
Appendix 2: US Electrical Demand model

For more details see our November 10th report: Building electrification key undervalued driver for US electrical demand.

US electrical demand grew at a 0.5% CAGR over 2014-24. We project a 2.8% CAGR over 2024-35 to reflect incremental demand from 1) building electrification, 2) data centers, 4) "mega project" industrial demand, and 4) EV adoption.

Exhibit 17: US electrical demand (in terawatt hours per year) 2014–2035E
We forecast US electrical demand to grow at a 2.8% CAGR over 2024-35E



Source: BofA Global Research, US Energy Information Administration

BofA GLOBAL RESEARCH

Where the load growth comes from

Exhibit 18: Sources of incremental US electrical load growth, 2024-35E
We forecast US electrical demand to grow at a 2.8% CAGR over 2024-35E

Historical CAGR (2014-24)	**0.5%**
Building electrification	1.0%
Data centers	0.8%
Industrial growth	0.3%
EV adoption	0.2%
Forecast CAGR (2024-35E)	**2.8%**

Source: BofA Global Research, US Energy Information Administration

BofA GLOBAL RESEARCH

1. **Building electrification:** We assume electricity consumption gradually replaces natural gas for space and water heating, either through new construction or retrofit.

Several states and cities have banned fossil fuel heating from new construction. This drives an incremental 100bp to the 2024-35E CAGR.

2. **Data centers:** We forecast an 14% CAGR for data center electrical loads, which adds 80bp to the 2024-35E CAGR.

3. **Industrial growth:** We assume US industrial demand for electricity grows at a 1.9% CAGR. US manufacturing plant closures was a meaningful drag in 2014-24. Aided by greater reshoring and Federal policy support, US industrial firms are building new plants at a rapid pace. We view semiconductors, EV battery plants, and pharmaceutical as the largest areas of reshoring. Faster growth adds an incremental 30bp to the 2024-35E CAGR.

4. **EV adoption:** We assume EV adoption reaches 19% of the US passenger vehicle fleet in 2035, up from 2% in 2024. This adds an incremental 20bp to the 2024-35E CAGR.

Exhibit 19: Companies mentioned
Companies mentioned in this report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
CAT	CAT US	Caterpillar Inc	US$ 568.06	B-1-7
ETN	ETN US	Eaton Corp PLC	US$ 339.71	B-1-7
GEV	GEV US	GE Vernova	US$ 576.9	C-1-7

Source: BofA Global Research

BofA GLOBAL RESEARCH

Price objective basis & risk

Caterpillar Inc (CAT)

Our $650 PO on CAT is on based on 27x 2026e EPS which is above the 15y long term historical range of 15-18x and in the recovery multiple range (20-28x) as we believe EPS is nearing a bottom given easing rates, portfolio resiliency and structural growth drivers (power generation, midstream). While we see some headwinds that are likely to slow growth (higher inventories, capex plateauing, tariffs, pricing moderating), there are unique macro and business cycle factors that are underpinning stronger cycle over cycle earnings: infrastructure, construction spending mix shifts towards heavy vs light, higher miner free cash flow generation, aging fleets, and data centers.

Downside risks to our PO: 1) worse than expected tariff policy that tilts global economy into recession, 2) a greater-than-expected reduction or delay in capital spending among large mining, and oil and gas customers, 3) intensifying pricing pressure in the construction and mining equipment industries, 4) greater than expected dealer destocking, 5) ongoing deterioration in dealer sales growth.

Upside risks: 1) a faster recovery in the global economy, 2) firming earthmoving construction equipment market, 3) stronger-than-expected fleet replacement, 4) continuing recovery in commodity prices, 5) stronger-than-expected demand trends in gas compression.

Eaton Corp PLC (ETN)

We base our $432 price objective on a 25x EV/EBITDA multiple of our 2026 estimates. Our target multiple is at a premium to the 21x peer average on 2025 estimates. We argue a premium valuation is warranted due to expected upside from cyclical operating leverage, strong margin performance, and Eaton's less cyclical portfolio mix.

Downside risks to our PO are 1) a slower-than-expected manufacturing capex growth, 2) a more active M&A is inherently risky as it relies on the availability of accretive synergistic targets and the company's ability to integrate, and 3) the trajectory of the recovery in automotive and aerospace end markets.

GE Vernova (GEV)

We base our $725 price objective on a 26x EV/EBITDA multiple of our 2027E adjusted EBITDA estimate. Our target multiple is a premium to the 13x peer average on 2026 estimates. We argue a premium multiple is warranted given above-peer earnings growth and margin trajectory.

Risks to our price objective are 1) changes to government incentives for wind turbines, 2) execution risks on targeted $500mn cost-out by 2028, 3) secular decline in natural gas turbine demand, and 4) cost overruns on services & equipment contracts.

Analyst Certification

We, Andrew Obin and Michael Feniger, hereby certify that the views each of us has expressed in this research report accurately reflect each of our respective personal views about the subject securities and issuers. We also certify that no part of our respective compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

US - Machinery Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	AECOM	ACM	ACM US	Michael Feniger
	Blue Bird Corp	BLBD	BLBD US	Sherif El-Sabbahy
	Bowman Consulting Group Ltd	BWMN	BWMN US	Sherif El-Sabbahy
	Caterpillar Inc	CAT	CAT US	Michael Feniger
	Construction Partners Inc.	ROAD	ROAD US	Michael Feniger
	CRH	CRHCF	CRH LN	Michael Feniger
	CRH	CRH	CRH US	Michael Feniger
	ESAB Corp	ESAB	ESAB US	Sherif El-Sabbahy
	Finning International Inc.	YFTT	FTT CN	Sherif El-Sabbahy
	Knife River Corp	KNF	KNF US	Sherif El-Sabbahy
	Legence Corp	LGN	LGN US	Sherif El-Sabbahy
	PACCAR Inc	PCAR	PCAR US	Michael Feniger
	Quanta Services Inc	PWR	PWR US	Sherif El-Sabbahy
	RB Global, Inc	RBA	RBA US	Michael Feniger
	Republic Services	RSG	RSG US	Michael Feniger
	Techtronic Industries Co Ltd	TTNDF	669 HK	Michael Feniger
	Techtronic Industries Co Ltd	TTNDY	TTNDY US	Michael Feniger
	United Rentals Inc	URI	URI US	Michael Feniger
	Vulcan Materials	VMC	VMC US	Michael Feniger
	Waste Connections Inc	WCN	WCN US	Michael Feniger
	WillScot Mobile Mini	WSC	WSC US	Sherif El-Sabbahy
NEUTRAL				
	AGCO Corp	AGCO	AGCO US	Michael Feniger
	CNH Industrial NV	CNH	CNH US	Michael Feniger
	Cummins Inc	CMI	CMI US	Michael Feniger
	Deere & Co	DE	DE US	Michael Feniger
	Fluor	FLR	FLR US	Michael Feniger
	GFL Environmental Inc	GFL	GFL US	Michael Feniger
	GFL Environmental Inc	YGFL	GFL CN	Michael Feniger
	Jacobs Eng.	J	J US	Michael Feniger
	Martin Marietta Materials	MLM	MLM US	Michael Feniger
	Timken Company	TKR	TKR US	Michael Feniger
	Waste Management	WM	WM US	Michael Feniger
UNDERPERFORM				
	Allison Transmission Holdings Inc.	ALSN	ALSN US	Sherif El-Sabbahy
	Casella	CWST	CWST US	Michael Feniger
	Centuri Holdings Inc	CTRI	CTRI US	Sherif El-Sabbahy
	Herc Holdings Inc	HRI	HRI US	Sherif El-Sabbahy
	IPG Photonics	IPGP	IPGP US	Michael Feniger
	Kennametal Inc.	KMT	KMT US	Michael Feniger
	Oshkosh Corp.	OSK	OSK US	Michael Feniger
	Snap-on	SNA	SNA US	Sherif El-Sabbahy
	Terex Corp.	TEX	TEX US	Michael Feniger
	Titan America	TTAM	TTAM US	Sherif El-Sabbahy

US - Multi-Industrials/Engineering and Construction Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	3M Company	MMM	MMM US	Andrew Obin
	Alliance Laundry	ALH	ALH US	Andrew Obin
	AMETEK Inc	AME	AME US	Andrew Obin
	Applied Industrial Technologies	AIT	AIT US	Sabrina Abrams
	Atmus Filtration	ATMU	ATMU US	Andrew Obin
	Dover Corp	DOV	DOV US	Andrew Obin
	Eaton Corp PLC	ETN	ETN US	Andrew Obin
	Emerson Electric Co	EMR	EMR US	Andrew Obin
	Fastenal Company	FAST	FAST US	Sabrina Abrams
	GE Vernova	GEV	GEV US	Andrew Obin
	ITT Inc.	ITT	ITT US	Andrew Obin

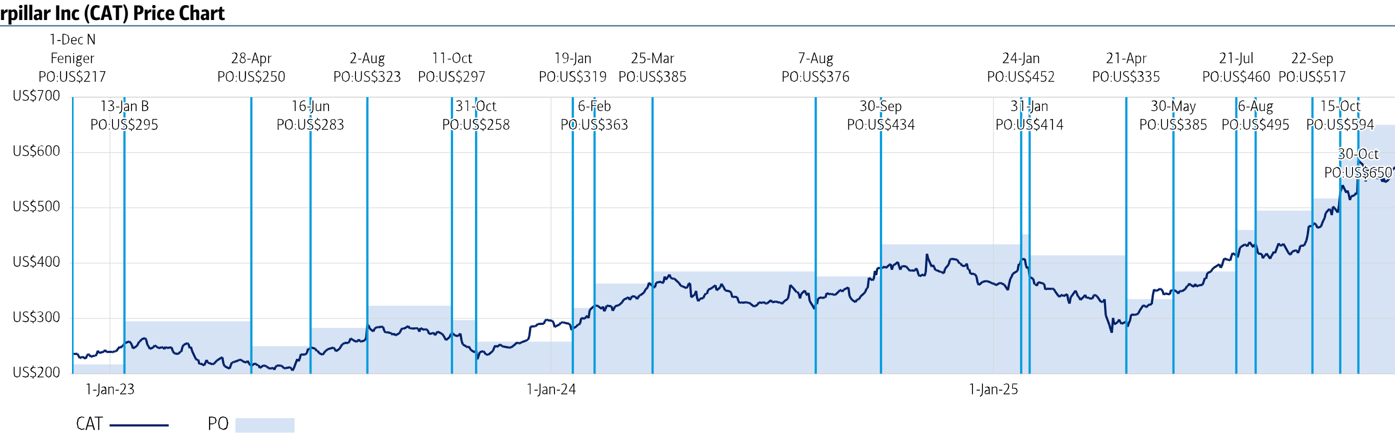
US - Multi-Industrials/Engineering and Construction Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
	Johnson Controls International PLC	JCI	JCI US	Andrew Obin
	Parker Hannifin Corporation	PH	PH US	Andrew Obin
	Rockwell	ROK	ROK US	Andrew Obin
	Rush	RUSHA	RUSHA US	Andrew Obin
	Trane Technologies PLC	TT	TT US	Andrew Obin
	Vertiv	VRT	VRT US	Andrew Obin
NEUTRAL				
	Allegion	ALLE	ALLE US	Andrew Obin
	Carrier Global Corp.	CARR	CARR US	Andrew Obin
	Flowserve	FLS	FLS US	Andrew Obin
	Illinois Tool Works	ITW	ITW US	Andrew Obin
	Keysight	KEYS	KEYS US	David Ridley-Lane, CFA
	Montrose Environmental Group, Inc.	MEG	MEG US	Andrew Obin
	PTC Inc.	PTC	PTC US	Andrew Obin
	SPX Technologies	SPXC	SPXC US	Andrew Obin
UNDERPERFORM				
	Core & Main	CNM	CNM US	Andrew Obin
	Honeywell International Inc.	HON	HON US	Andrew Obin
	JBT Marel Corp	JBTM	JBTM US	Andrew Obin
	Pentair plc	PNR	PNR US	Andrew Obin
	Ralliant	RAL	RAL US	David Ridley-Lane, CFA
	Vontier	VNT	VNT US	Andrew Obin
	W.W. Grainger, Inc.	GWW	GWW US	Sabrina Abrams

Disclosures

Important Disclosures

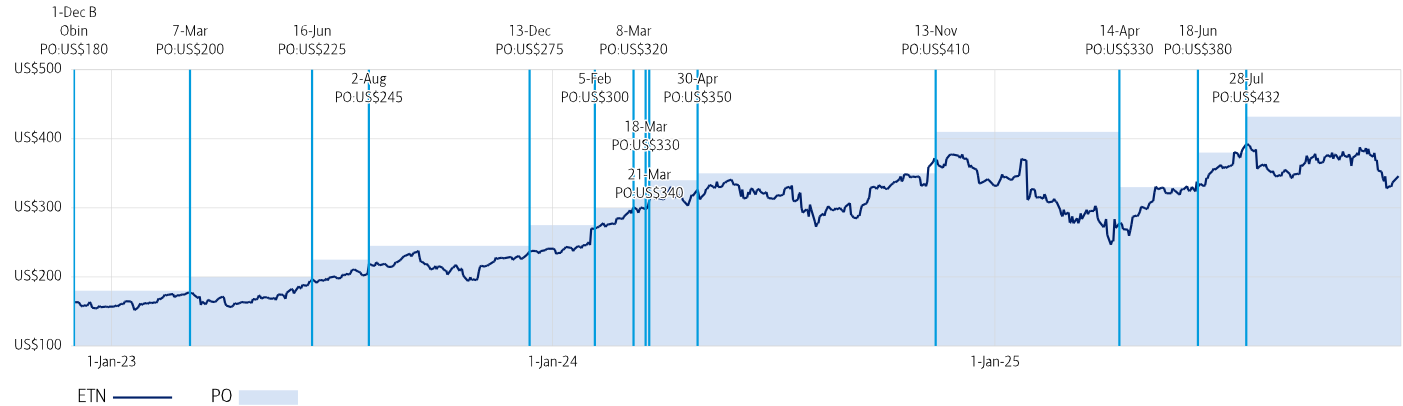
Caterpillar Inc (CAT) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

The Investment Opinion System is contained at the end of the report under the heading "Fundamental Equity Opinion Key". Dark grey shading indicates the security is restricted with the opinion suspended. Medium grey shading indicates the security is under review with the opinion withdrawn. Light grey shading indicates the security is not covered. Chart is current as of a date no more than one trading day prior to the date of the report.

Eaton Corp PLC (ETN) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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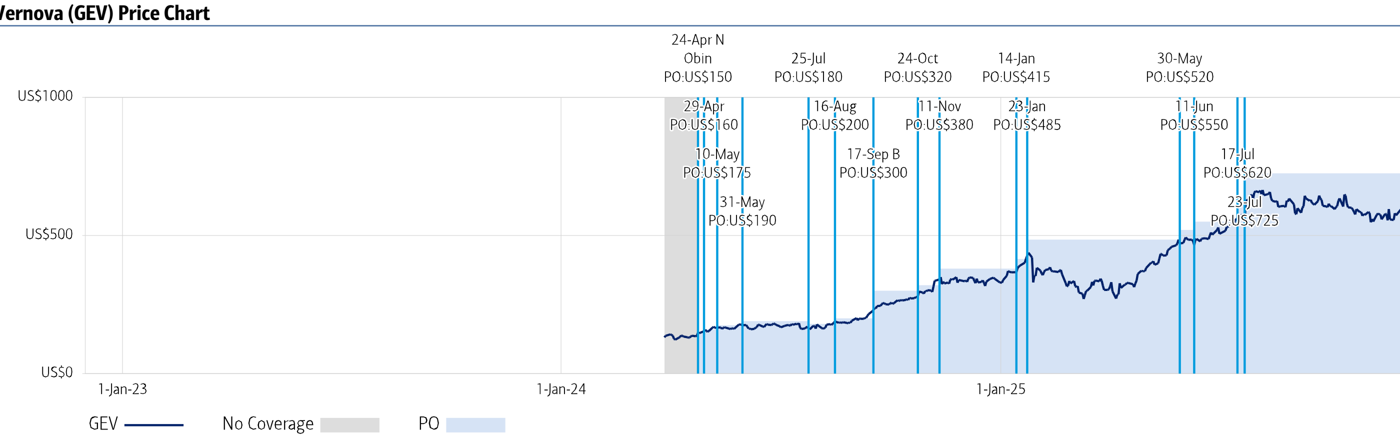
GE Vernova (GEV) Price Chart



B: Buy, N: Neutral, U: Underperform, PO: Price Objective, NA: No longer valid, NR: No Rating

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Equity Investment Rating Distribution: Electrical Equipment Group (as of 30 Sep 2025)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	18	66.67%	Buy	8	44.44%
Hold	5	18.52%	Hold	3	60.00%
Sell	4	14.81%	Sell	0	0.00%

Equity Investment Rating Distribution: Industrials/Multi-Industry Group (as of 30 Sep 2025)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	48	54.55%	Buy	24	50.00%
Hold	18	20.45%	Hold	9	50.00%
Sell	22	25.00%	Sell	12	54.55%

Equity Investment Rating Distribution: Machinery/Diversified Manufacturing Group (as of 30 Sep 2025)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	37	56.92%	Buy	14	37.84%
Hold	10	15.38%	Hold	8	80.00%
Sell	18	27.69%	Sell	8	44.44%

Equity Investment Rating Distribution: Global Group (as of 30 Sep 2025)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	1816	53.11%	Buy	1062	58.48%
Hold	825	24.13%	Hold	480	58.18%
Sell	778	22.76%	Sell	385	49.49%

[R1] Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster[R2]
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

[R2]Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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