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Transformation

Power check: Watt's going on with the grid?

22 July 2025

Key takeaways

- The US grid is facing an extended period of load growth. And while the drivers of this growth have changed over time, demand is largely due to 1) building electrification; 2) data centers; 3) industrial demand; and 4) electric vehicle (EV) adoption.
- If load growth forecasts continue to rise, utilities will need to invest to meet required reserve margins and increase spending on both power generation and transmission & distribution capacity.
- The good news? Deregulation and accelerated permitting may further help get more projects off the starting line, according to BofA Global Research.

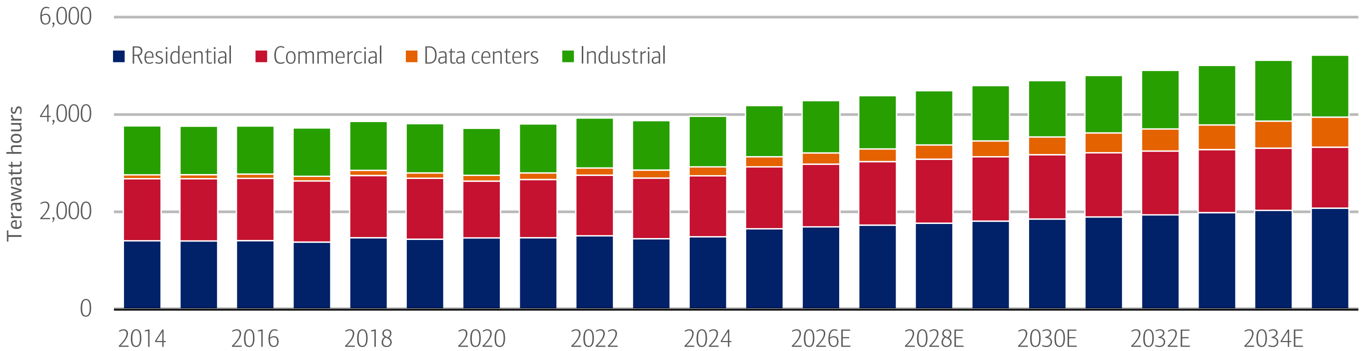
The grid is seeing gigawatt-scale growth

The US power grid is facing critical cross currents. Energy demand is surging – and will continue to do so for an extended period, which will require significant additions to power generation capacity and higher capex in order to grow the grid. In fact, BofA Global Research estimates that US electrical demand will increase at a 2.5% compound annual growth rate (CAGR) through 2035E (Exhibit 1). That compares to just a 0.5% CAGR from 2014-2024.

What's driving this super-charged growth? Our seemingly limitless array of gadgets and technology that require ever more watts in our homes and offices. We are substituting electricity for hydrocarbons for building heating and vehicles. Additionally, the vast development of data centers across the US is also a factor.

Exhibit 1: BofA Global Research expects US electrical demand to grow at a 2.5% CAGR over 2024-35E

US electrical demand (in terawatt hours per year) 2014–2035E



Source: BofA Global Research estimates, US Energy Information Administration

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Yet these energy needs pose a challenge: US energy infrastructure is aging quickly and in need of replacement. In fact, today, 31% of transmission and 46% of distribution infrastructure is near (<5 years) or beyond its useful life. Further, 67% of electric utilities' spending in 2024 was on replacements ($63 billion), while only $32 billion was spent on new lines and substations. Thus, US power outages are increasing.

Another aspect to this story is that new generation is necessary to power quality equipment. According to BofA Global Research, last year, 702 new, relatively small generators replaced 178 retired utility-scale generators with the net electricity generated remaining somewhat flat. Looking ahead, grid equipment vendors will continue to connect new sources of power generation, and the number of connections between generators and transmission systems needs to increase to deliver the same amount of power.

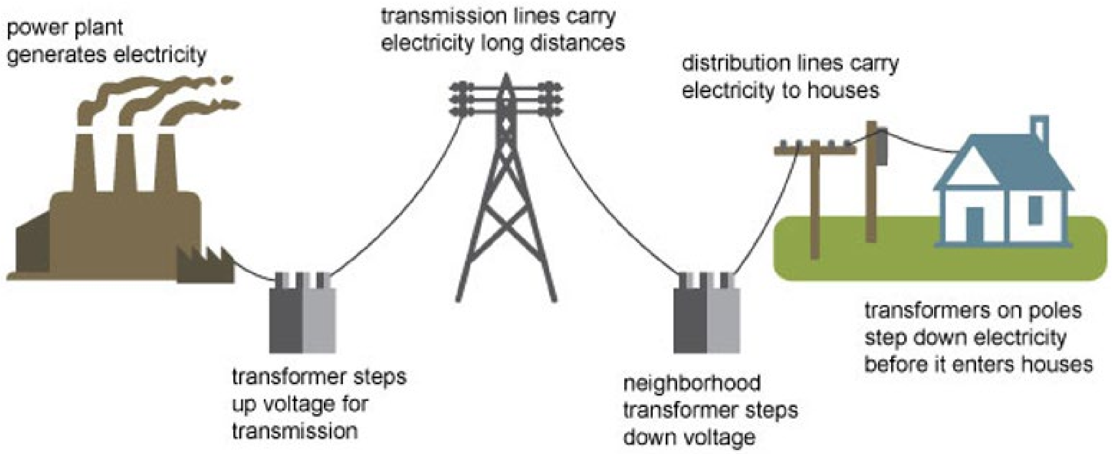
The grid in a snapshot

But before we get too far in, let's ground ourselves first (see what we did there?). Asked simply: What is the grid?

The US electrical grid (Exhibit 2) has ~7,000 power plants with capacity of at least one MW (megawatt). These are connected to step-up transformers to increase the voltage for transmission. Transmission takes place over 642,000 miles of high-voltage lines (i.e., over 34 kilovolts, or kV). Then, before electricity is distributed to consumers, these high-voltage transmission lines go through step-down transformers. The US grid has over 201,050 distribution circuits, which run from substations to end users through 6.3 million miles of distribution lines. There are also residential transformers with 120-240 voltage, which is typical for single-family homes.

The US grid delivers over 3,800 terawatt hours of electricity to 162 million customers annually. Residential customers use 37% of total generation, with commercial and industrial customers using 36% and 26% of generation, respectively.

Exhibit 2: The grid includes power generation, transmission, and distribution
Stylized diagram of an electrical grid



Source: National Energy Education Development Project (Need.org) Electricity (2023)

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What has changed in 2025?

- **National energy emergency.** As part of his "Day One" executive orders, President Donald Trump declared a national energy emergency on 1/20/2025. The order aims to create affordable, abundant energy, and streamline energy infrastructure permits and regulation. According to BofA Global Research, deregulation (e.g., fast-track approval for electrical equipment on federal lands) may help to accelerate the US grid build out.

- **Downshift in some renewable power plans…** The Trump Administration is pursuing an "all of the above" strategy for power generation, with a particular focus on cost efficiency and reliability. Given this focus, it is unsurprising that some higher cost renewable offerings, such as offshore wind, have come under more scrutiny.

- **…but traditional power generation gearing up.** Power sources that can be adjusted as needed (aka dispatchable power generation), particularly natural gas power, are enjoying increased demand. This is true both for traditional utilities and independent power producers aligned with data center development. BofA Global Research views broader deregulation efforts at the Environmental Protection Agency, Department of Energy, and Department of the Interior as helping to accelerate traditional power projects.

- **Biden era funding is still flowing.** The Grid Deployment Office, created under the Biden administration, is being maintained by the Trump administration. This agency awarded $14.5 billion in grants over 2023 and 2024 in conjunction with $36.9 billion in private sector investment for US grid projects. BofA Global Research believes that grid reliability has bipartisan support.

- **Skepticism about artificial intelligence buildout grows.** Just last year, investors were concerned that tech advancement would drive less spending on AI-related infrastructure and power generation. However, BofA Global Research's bottom-up demand model for US electrical power shows that data centers (both AI and non-AI) comprise only one-fifth of the total load growth over 2024-35E, and even if data center growth slows, US electricity load growth is still accelerating.

From AI to EVs: Where the load growth comes from

BofA Global Research's 2.5% CAGR forecast is based on the view that incremental US load growth will be driven by: 1) increased building electrification; 2) a wave of new data centers; 3) the industrial sector; and 4) electric vehicle (EV) adoption (Exhibit 3).

Exhibit 3: BofA Global Research expects US electrical demand to grow at a 2.5% CAGR over 2024-35E

Sources of incremental US electrical load growth, 2024-35E

Historical CAGR (2014-24)	**0.5%**
Building electrification	1.0%
Data centers	0.5%
Industrial growth	0.3%
EV adoption	0.2%
Forecast CAGR (2024-34E)	**2.5%**

Source: BofA Global Research estimates, US Energy Information Administration

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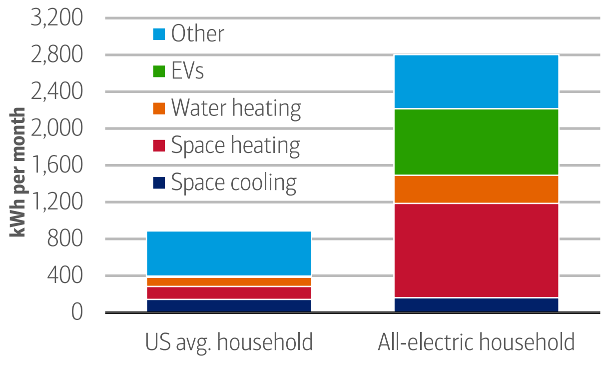
Exhibit 4: The average household would need 220% more electricity to go all electric

Current US household electricity usage versus hypothetical all-electric household



Source: BofA Global Research, Energy Information Administration, Federal Highway Administration

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1) Building electrification

Will electricity slowly replace fossil fuel use in US homes? Yes. According to BofA Global Research, electricity consumption will gradually overtake natural gas for space and water heating, either through new construction or retrofit. In fact, certain cities in California, Colorado, and Massachusetts among others, have already banned the use of fossil fuels to heat newly constructed buildings.

The all-electric home: 200+% more power needed

What would happen if homeowners quit natural gas and oil entirely? The average household would use 220% more electric per month, according to our analysis of Energy Information Administration (EIA) data (Exhibit 4). That amounts to 2,803 kilowatt hours (kWh) per month. By contrast, in 2024, the average US household used 875 kWh/month.

Currently fossil fuels power 54% of residential water heaters, 65% of space heating, and 98% of passenger vehicles. Replacing space heating would add 1,024 kWh/month and replacing water heaters would add 306 kWh/month. For EVs, BofA Global Research used average vehicle data from the Federal Highway Administration and assumed an average of 14,000 miles driven per vehicle per year, 1.79 vehicles per household, and 0.346 kW/mile efficiency. This yields 723 kWh/month for EV charging (assuming all charging is done at home).

2) Data centers

Already big users of electricity, data centers will guzzle even more energy going forward. Such centers consume approximately 1-2% of global electricity production and forecasts range from an 11% CAGR through 2030 globally,[1] to a ~20% CAGR (2023-30; range: 15-23%) for the US alone.[2]

Global estimates range from 240-340 terawatt hours (TWh) in 2022,[3] to 409-499 TWh in 2023.[4] [5] In the US, Berkeley Lab estimated data center electricity usage at 176 TWh in 2023.[6] And using a separate methodology, McKinsey estimated it at 147 TWh for the same year.[7]

[1] Mytton, D., & Ashtine, M. (2022). *Sources of data center energy estimates: A comprehensive review*. Joule.

[2] Shehabi, A., Smith, S.J., Hubbard, A., Newkirk, A., Lei, N., Siddik, M.A.B., Holecek, B., Koomey, J., Masanet, E., Sartor, D. 2024. *2024 United States Data Center Energy Usage Report.* Lawrence Berkeley National Laboratory, Berkeley, California.

[3] International Energy Agency

[4] Mytton, D., & Ashtine, M. (2022). *Sources of data center energy estimates: A comprehensive review*. Joule.

[5] Avelar, V., Donovan, P., Lin, P., Torell, W., Torres Arango, M. (2023). *The AI Disruption: Challenges and Guidance for Data Center Design.* White Paper 110.

[6] Shehabi, A., Smith, S.J., Hubbard, A., Newkirk, A., Lei, N., Siddik, M.A.B., Holecek, B., Koomey, J., Masanet, E., Sartor, D. 2024. *2024 United States Data Center Energy Usage Report. Lawrence Berkeley National Laboratory*, Berkeley, California.

[7] Green, A. Tai, H., Noffsinger, J., Sachdeva, P., Bhan, A., and Sharma, A. *How data centers and the energy sector can sate AI's hunger for power.*

AI adoption could drive power consumption even higher

BofA Global Research expects AI-related GPU (graphics processing unit) shipments to grow from around 9 million in 2024 to around 25 million in 2030, or a 17% CAGR. The number of GPUs per AI server will vary, but power consumption is tied more to the number of active GPUs versus server count.

The International Energy Agency estimates that AI servers used ~63 TWh of electricity in 2024, or 15% of total data center electricity. The organization expects this to jump to more than 300 TWh by 2030. AI servers would then comprise around one-third of total data center electricity consumption.

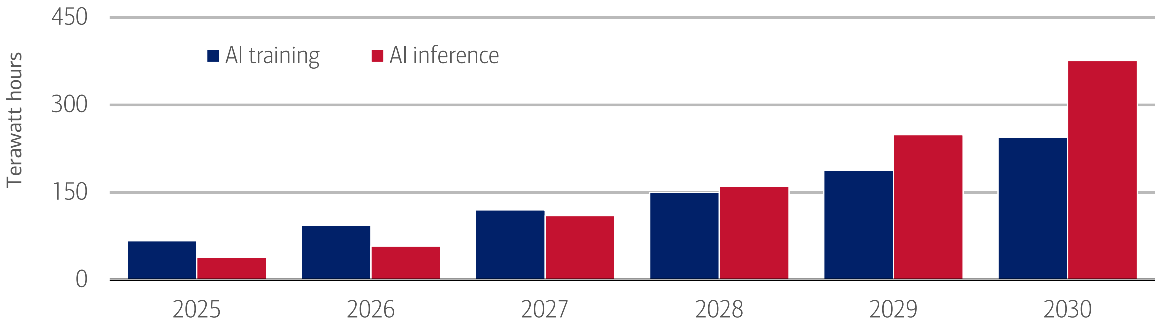
AI inference is proving to be energy intensive

That AI chatbot query that you make isn't as free as it looks. According to analysis by the University of California, ChatGPT uses about 0.14 kWh to generate a 100-word response. And the number of ChatGPT queries now exceeds one billion per day, according to press reports.

As AI models become more widely used, the energy required to churn out answers and tips (aka inference) will likely exceed that needed to train AI chatbots (see our three-part AI dictionary for definitions of AI terminology). Exhibit 5 shows that AI training uses around 70% more electricity compared to AI inference. However, by 2028, Schneider Electric Sustainability Research Institute expects inference applications will exceed the electricity used in training.

Yet, despite rising demand from cloud service providers, BofA Global Research notes that AI emissions net impact is likely to be positive, particularly as data centers increasingly source power from low-carbon energy, including renewables and more nuclear in the near future.

Exhibit 5: AI inference electricity demand to surpass AI training by 2028
Terawatt hours by AI electricity demand type (annual)



Source: Schneider Electric Sustainability Research Institute, CC-BY- 4.0. Reformatted; BofA Global Research

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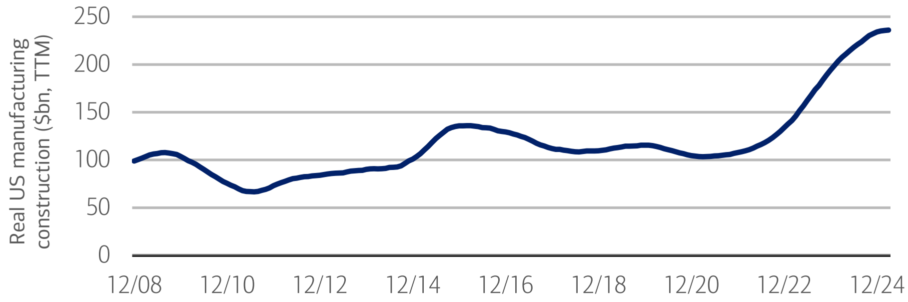
3) Industrial demand:

Between 2014 and 2024, US manufacturing plant closures helped slow the growth of their electricity demand. US electricity consumption by the industrial sector rose at a 0.3% CAGR over 2014-24, which reflects a ~9% decline in the number of manufacturing plants.[8]

Aided by greater reshoring and federal policy support, US industrial firms are building new plants at a rapid pace (read our recent piece, Manufacturing: Is it time to come home?, for more on this topic). Construction of manufacturing plants has risen every year since 2020 and advanced 21% in 2024 to $234 billion (Exhibit 6). This is roughly double average real spending of $117 billion (2016-20). According to BofA Global Research, semiconductors, EV battery plants, and pharmaceutical are the largest areas of reshoring, and US industrial electricity demand should grow as these plants are connected to the grid and begin production.

[8] *1998* and *2018 Manufacturing Energy Consumption Survey*. US Energy Information Administration.

Exhibit 6: Real (inflation-adjusted) spending on US manufacturing plants up 21% year-over-year (YoY) in 2024
Spending on US manufacturing facilities ($bn, trailing 12 months)



Source: US Census, BofA Global Research, Note: All spending at 2024 dollars

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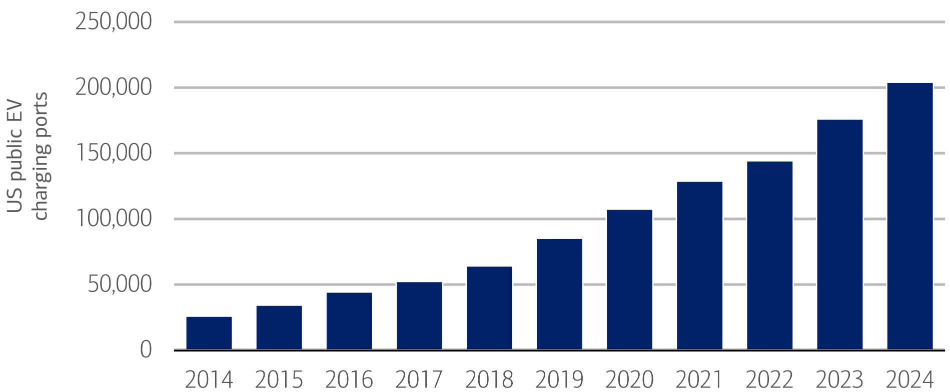
4) EV adoption:

Has the end of the EV wave been greatly exaggerated? Perhaps. While the pace of passenger EV adoption in the US has been below more optimistic forecasts – and the expiration of the federal consumer EV tax credits will further pressure adoption rates – there are still plenty of EVs on the road, and they're going to need plenty of power.

There are currently around 5 million EVs on US roadways, representing 2% of the total passenger vehicle fleet. EVs represented 9.7% of new vehicle sales in 2024. Even if the EV mix of new vehicle sales remained flat (e.g., at 9.7%), the number of EVs in use would still rise at a ~15% CAGR over 2024-30 to 22 million.

These vehicles are likely to be charged in residential areas, which have little spare capacity on substations. At the same time, more public EV charging stations will be needed and that will require significant grid investments. After all, the current electrical content per direct current charger is approximately $15,000. Exhibit 7 shows the growth in US public charging ports and notes that growth occurred before federal incentives provided by the US Infrastructure & Jobs Act.

Exhibit 7: US public charging ports have grown to over 200,000
US public electric vehicle (EV) charging ports



Source: Department of Energy, Alternative Fuels Data Center; BofA Global Research

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Energy efficiency gains embedded in historical growth

Of course, energy efficiency has helped offset gross electrical load growth. To take just one example, the electricity usage per dishwasher cycle has fallen at a 3% CAGR over the last 20 years. According to the Lawrence Berkeley National Lab data, savings from efficiency regulations and building codes have driven a 0.6% annual reduction in electricity usage (2007-2017). However, these savings are already figured into historical US electrical growth and energy efficiency savings would need to accelerate to offset new sources of load growth from electrification.

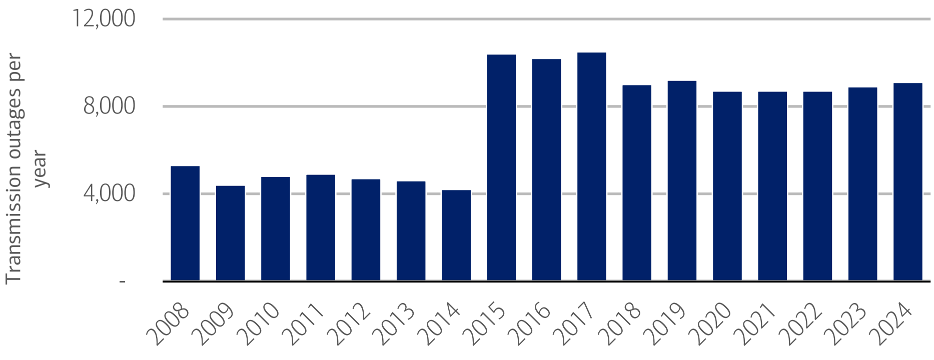
What's next? More grid investment needed

As electricity demand ramps, utility companies will need to invest more in capacity expansion for the grid. In 2024, US utilities invested $35 billion on transmission capex and $60 billion on distribution capex. However, expansion capex represented only 33% of total transmission and distribution capex, with replacements and upgrades the remaining 67%. While US electrical demand grew at a 0.5% CAGR over 2014-24, transmission and distribution spending has grown at an 8.9% CAGR, largely due to the aging nature of the US grid.

If load growth forecasts continue to rise, utilities will need to meet required reserve margins and increase spending on both power generation and transmission and distribution capacity. But despite the higher investment, power outages have become more frequent. Exhibit 8 shows the number of transmission outages (versus end-point customer outages) in the US.

The US Department of Energy's National Transmission Needs Study (2023) outlines the magnitude of the additions required. Cumulatively, US transmission carry capacity needs to expand by 64% through 2040 in the moderate load growth baseline forecast. This scenario assumes clean energy generation reaches 80% by 2040.

Exhibit 8: US transmission power outages have become more frequent and grid reliability is worse today than in the early 2000s
Transmission outages per year



Source: North American Electric Reliability Corporation (NERC); BofA Global Research

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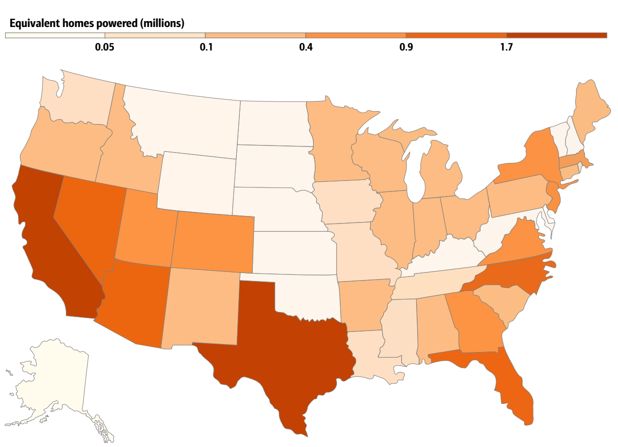
Geographical mismatch: production vs consumption

The transition to a clean energy economy is accelerating. And in turn, new, high efficiency transformers and modernized grid infrastructure is required to deliver electricity to a more regionally focused grid powered by intermittent and variable energy sources, such as wind and solar.

It is noteworthy that the top five electricity-producing states (largely Texas and the US West Coast) by solar (Exhibit 9) and wind power (Exhibit 10) represented about 56% and 67% of total electricity production in 2021, respectively, according to NREL (National Renewable Energy Laboratory). However, states mainly on the US East Coast account for most of the consumption. Thus, long distance transmission lines will continue to be required – and will further drive strong demand for power equipment (transmission and distribution) in the US.

Exhibit 9: US solar power is largely generated in California and Texas, followed by southern states like Arizona and Florida
US solar power generation by state



Source: EIA; BofA Global Research

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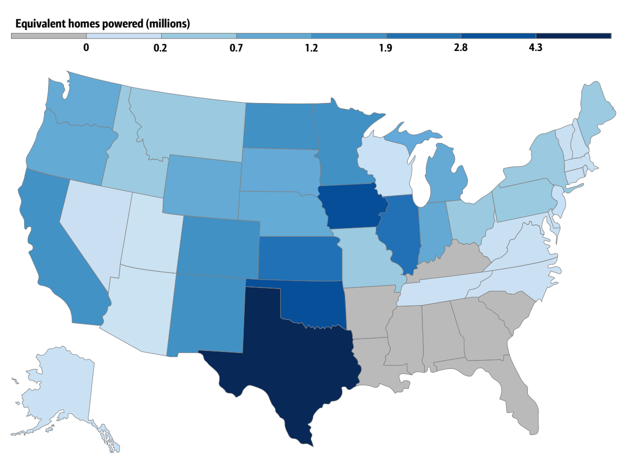
Exhibit 10: Texas generated the largest amount of US wind power, followed by midwestern states like Oklahoma and Kansas
US wind power generation by state



Source: EIA; BofA Global Research

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The elasticity of electricity demand

Higher electricity prices drive lower demand. This could be through energy efficiency investments, the decline of energy-intensive businesses, or consumer actions. Historically, US electricity costs have been largely stable over the last 20 years in real (i.e., inflation-adjusted) terms (Exhibit 11).

However, the opposite is true in California. Retail electricity prices in the state are ~2x the US average and up 68% over the last seven years (which includes the impact of multi-billion-dollar wildfire settlements) (Exhibit 12). Over this period, electrical demand in California has fallen 5%. BofA Global Research believes the elasticity of electrical demand on a state level is likely higher than at a national level, but the law of supply and demand works for electrical markets as well.

Exhibit 11: US retail electricity prices have been stable on an inflation-adjusted basis

Inflation-adjusted US retail electricity costs (cents per kW)

Source: US Energy Information Administration, Bureau of Labor Statistics; BofA Global Research

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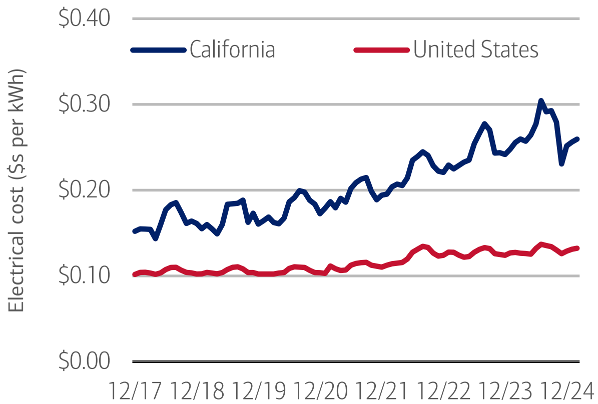
Exhibit 12: California prices are up 68% over last seven years

Monthly electrical retail price (cents per kWh)



Source: US Energy Information Administration; BofA Global Research

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Disclosures