



Sustainable Energy in America **2025 Factbook** **Executive Summary**



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BNEF - BCSE Sustainable Energy in America Factbook: Executive Summary

American Sustainable Energy Technologies Are Ready to Meet Increasing Energy Demand

Energy growth has returned to the US power system. Between 2009 and 2024, the compound annual growth rate for electricity sales in the country was 0.6%, or roughly flat. This changed in 2024, with rapidly rising expectations of power demand from new industrial sources and transportation, onshoring of US manufacturing, and a burst of new data centers planned by tech companies in the race for artificial intelligence mastery.

These expectations, coupled with an increasing number of electricity markets facing capacity constraints, have changed the focus of US energy system planning. Regulators, utilities and energy providers alike are looking to bring new sources of power online quickly, and are calling on an increasingly diverse mix of energy resources to meet these needs.

Investment and deployment continued to rise across the power sector last year, especially in the areas of renewable energy, energy storage, energy efficiency, natural gas and sustainable transportation. Strong federal and state policy signals from past years translated to steady investment: an estimated \$99 billion of federal funding was announced in 2024. The federal elections last November marked a shift in federal policy priorities, but leveraging the US's energy abundance and maintaining competitiveness in a changing energy landscape remain a focus.

Domestic supply chains are also ramping up, in response to a series of onshoring policies put in place over the past few years. However, not all policy efforts have borne fruit, and clean the hydrogen, carbon capture, and wind sectors are growing more slowly than expected as they await policy guidance and certainty.

1. Long-term trends locked in, supporting increased diversification

US energy productivity rose to record levels in 2024

The US economy expanded by 2.8% last year, while primary energy consumption increased by just 0.5%. In other words, the US's "energy productivity" (the ratio of US GDP to total US energy consumption) increased by 2.3% year-on-year to reach the highest economic output achieved per unit of energy consumed to date.

US natural gas demand reaches record, with LNG and power demand driving growth

Demand for US natural gas rose 1.3% year-on-year to reach a record 99.7 billion cubic feet per day (Bcf/d). Demand for natural gas exports – both on ships as liquefied natural gas (LNG), as well as pipeline gas to Mexico – also rose, along with power demand. Yet a warmer-than-normal winter over 2023-24 saw lower gas consumption for heating in residential and commercial buildings. This in turn led to higher levels of natural gas reserves in underground storage, which pushed prices down. The Henry Hub front month contract fell as low as \$1.38 per million BTU, marking the second price declines since the highs of 2022.

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Renewable energy broke records, with solar leading the pack

Renewable energy sources met a record volume of US energy demand in 2024. The combined contribution of wind, solar, biomass, waste-to-energy, geothermal and hydropower rose at the fastest pace among all sources of energy. In power, renewables were the second-largest source of power generation, contributing 1063 terawatt-hours, just behind natural gas at 1,885 terawatt-hours. Record levels of solar capacity additions helped push renewable sources to 24% of US power generation, and zero-carbon power (renewables plus nuclear power) to an all-time high of 42%.

The US added a record 49 gigawatts (GW) of new solar power-generating capacity to its grid in 2024, including distributed rooftop generation on homes and businesses. The market has absorbed the uncertainty around tariffs, supply chain scrutiny and higher interest rates to deliver record-setting volumes of new capacity. Buoyed by strong demand from utilities and corporate buyers, the technology is one of the cheapest sources of new bulk generation even without tax credits.

Energy storage deployment set new records

In 2024, the US commissioned an estimated 11.9GW of battery energy storage, including utility-scale capacity as well as distributed systems in homes and businesses. Battery storage additions jumped by 55% year on year, making it the fifth straight year of record-setting annual additions. Development incentives through the Inflation Reduction Act (IRA) and falling costs of batteries due to fierce competition among battery manufacturers drove this high buildout, making the US the world's second-largest battery storage market after China.

Globally, growing interest in long-duration storage led to record buildout in 2024. The first nine months of the year saw global installed capacity exceed 1GW (4.6 gigawatt-hours in energy capacity terms) for the first time. China has the largest installed base, with the US in fourth place globally.

Pumped hydropower energy storage remains the largest source of storage currently available on the power grid in terms of the total amount of energy that can be stored. However, in 2024, cumulative battery capacity in the US reached 31.5GW, compared with 23.2GW of pumped hydropower, meaning that for the first time batteries can provide more instantaneous power to the grid than any other source of storage.

Electric vehicle sales grew, with legacy automakers taking on a bigger role

Sales of electric vehicles (EVs) set a new record in 2024, seeing 6.5% growth year-on-year. With over 1.5 million EVs sold in the US, one in 10 new cars registered last year came with a plug. Tesla remained the largest player, despite seeing its market share slide to 38% from 42% the prior year, largely due to their aging lineup of models. The slowdown in performance by the market leader dragged on the country's overall sales, obscuring double-digit growth rates by legacy automakers such as GM and Ford. The US EV market is steadily diversifying from outright dominance by a single firm; Stellantis NV, Ford and GM all saw their electric vehicle sales rise year-on-year.

Renewable fuels and biofuels grow, seeing more supply and demand

Renewable natural gas: US renewable natural gas supply and demand are both increasing, bolstered by the federal Renewable Fuel Standard and California's Low Carbon Fuel Standard (LCFS). In addition, investment tax credits included in the IRA can offset the cost of new-build

RNG facilities by 6-30% of eligible costs. Transportation remains the largest end-use market for RNG by volume, and the renewable fuel accounted for 70% of the sector's natural gas consumption last year. While some utilities offer renewable natural gas for homes and businesses at a cost premium, growth in this use case remains slower than in transport.

Liquid biofuels: Production of renewable jet fuel, also called sustainable aviation fuel (SAF), soared 325% in 2024, thanks to investment tax credits under the IRA. While production has taken off dramatically, future demand ultimately depends on the appetite of airline customers. While some corporates, looking to reduce their scope 3 emissions, are pushing for greener flights, these fuels come at a cost premium; as airlines cannot absorb the higher cost, they must pass it on to customers. Globally, 34 new agreements were signed to procure SAFs in 2024, marking the second year of decline.

2. Manufacturing and investment respond to supply needs

Manufacturing facility plans rise, battery manufacturing grows

The number of manufacturing facilities planned in response to the IRA rose to 264 as of December 2024. Clean vehicle factories – representing both vehicle and battery assembly – saw the largest number of announcements, followed by solar and stationary storage facilities. Together these announcements represent over \$100 billion in investments.

Lithium-ion battery manufacturing capacity was of particular focus to produce cells for both stationary storage as well as automotive applications. By the end of 2024, the US had factories capable of producing 159GWh of storage cells, a 39% year-on-year rise. Ultium's 35GWh plant in Tennessee was one of the major facilities that opened in 2024, intending to produce batteries for the auto industry.

Energy transition investment remains steady

Investment into the technologies that are accelerating decarbonization increased slightly year-on-year, with the US spending \$338 billion on the energy transition, up from \$303 billion in 2023. These investments were dominated by clean power and grid-related spending. Globally, China was the country that spent the most on the energy transition, at an estimated 4.4% of 2024 GDP. The US spent an estimated 1.3% of 2024 GDP.

3. Consumers see competitive costs and energy savings

Energy sector jobs grow steadily

Some 8.36 million people were employed in the energy sector in 2023, the last year for which data is available, according to the US Department of Energy (DOE). This was a 3% rise compared with the prior year. The motor vehicles segment employing the most workers, with the DOE estimating that 2.7 million people were employed in manufacturing, trade of, and maintenance of vehicles, a 16.4% rise compared to 2020.

Energy efficiency spending rebounded after a post-pandemic drop

Utility spending on energy efficiency reached its highest level in eight years, rebounding after the pandemic. In 2023, the last year for which there is complete data, spending rose 14% year-on-year to reach \$8.8 billion, according to data compiled by the American Council for an Energy-Efficient Economy (ACEEE). Spending on efficiency improvements related to both electricity and natural gas rose to all-time highs of \$6.9 billion and \$1.9 billion, respectively. The ACEEE

estimated that electric utilities in 2023 saved 23.2TWh of energy, equivalent to 0.52% of retail sales.

Falling prices for natural gas, power keep costs low for consumers

The two-year trend of falling natural gas prices translated into a decline in retail natural gas prices across residential, commercial and industrial consumers. Residential price adjustments tend to lag index prices by six to 12 months, depending on utility practices. Industrial prices tend to be most correlated to wholesale markets.

Wholesale power prices remained stable year-on-year in 2024, benefitting in part from falling natural gas prices, while average retail prices saw a modest 0.68% drop in 2024. While regional differences in retail prices remain large, energy accounted for just 3.8% of personal expenditures on average in 2024, down from 4.1% in 2023.

In 2023, the last year of complete data across countries, US industrial retail prices for power were the lower than four other countries in the Group of 7, while residential prices were lower than Germany and Japan.

4. Waiting for clouds to clear

Both onshore and offshore wind struggled

Both onshore and offshore wind struggled in 2024. Despite tax credits and support for new renewable energy deployment, onshore wind saw its fourth straight year of declining capacity additions. While tax credits through the IRA have revived interest in the sector, the regions where the tax credits have the most value are those where wind already has a high share of generation, meaning transmission congestion can hold back new build.

Offshore wind spent 2024 course-correcting after a harsh 2023, where inflation led to contract renegotiations and ultimately some project cancellations. Several projects made progress on new agreements to replace previously cancelled ones, final investment decisions were made on 1.7GW of projects, and approvals to begin construction for 10.8GW of capacity were received. While the nascent industry appears to have turned a corner, further growth will depend on sustained support from federal and state policymakers.

Generators wait on interconnection reform

Reforms are underway to expedite the process of connecting new power projects to the grid, but progress remains slow in comparison to how quickly queues fill up, especially when longer permitting processes are taken into account. Following an explosion in 2021-22 of new capacity seeking to connect to various US power grids, system operators are revising how projects are evaluated, costs are distributed, and new transmission infrastructure is planned and built. In 2024 alone, 317GW of new capacity applied to interconnect in the US, equivalent to nearly a third of the current installed US power system. Over two-thirds of this capacity is solar and storage.

Clean hydrogen spends the year in limbo

Developers announced plans to bring 16.4 million tons of hydrogen-producing capacity online in 2024. Yet this 27% year-on-year rise was driven by anticipation of federal support, and a shift in the new federal administration's energy priorities might affect what materializes. Of this announced capacity, 77% was 'blue', referring to thermochemical hydrogen produced from natural gas, and fitted with carbon capture to mitigate emissions. The low cost of US natural gas

makes hydrogen with natural gas and carbon capture and storage (CCS) in the US cheaper than hydrogen produced electrolytically by zero-emission sources, like renewables and nuclear.

While developers announced plans to bring online 34.7GW of electrolyzer capacity to produce low carbon hydrogen in the US, a 7% increase on the prior year, the wait for final guidance on the tax credit meant that the US only had 0.079GW of electrolyzer capacity operating by the end of 2024. Given that hydrogen produced electrolytically by renewables and nuclear is the more expensive of the low-carbon hydrogen options, the generous 45V tax credit is important to bringing down costs for end-customers.

New sectors develop interest in carbon capture and storage

The US is the global leader on CCS, with 23 million metric tons per annum (Mtpa) of operational capacity, and the IRA has provided the most generous incentives in the world to capture carbon dioxide that is currently emitted into the atmosphere. However, this status quo has remained unchanged since 2020, with no meaningful new capacity brought online, especially when compared with the 146Mtpa of announced new capacity.

5. Climate impacts persist as emissions grow slightly

The highest number of extreme weather events

The impacts of climate change continue to be felt throughout the US, and 2024 saw the second-highest number of extreme weather events since 2010. The country experienced 27 climate-related disasters that together caused \$182.7 billion in damages in 2024. Five destructive tropical cyclones accounted for 68% of the total disaster costs. Citizens and communities are installing a growing number of microgrids powered by solar, storage, natural gas and diesel generation sets to help mitigate the impact of these storms.

US emissions rose, driven by industry

In 2024, the US emitted 6,250 million metric tons of carbon dioxide equivalent (MtCO₂e) of greenhouse gases, according to BNEF estimates, representing a 0.5% increase year-on-year. Increased use of fossil fuels drove up emissions in industry, transport and agriculture, obscuring the slight decline in emissions from buildings. Industry is the second-largest and fastest-growing source of emissions due to rising natural gas use. With limited adoption of low carbon technology or fuels, industrial emissions accounted for 89% of the growth in national emissions in 2024. On the other hand, emissions in the sector with the most emissions – transport – remained below pre-pandemic levels. Lower gasoline consumption from drivers played a role, partially in response to higher prices at the pump post-pandemic. In addition, structural changes like persistent remote work flexibility reduced the need for commuting, and the associated gasoline-related emissions.

Power, which as recently as 2016 was the highest-emitting sector in the US, has now fallen to third place. Year-on-year, emissions remained unchanged even as power consumption rose, thanks to higher renewable energy and natural gas consumption and the steady decline of coal.

US emissions are 15.8% lower than 2005, while power emissions are 41% lower than 2005 levels.

Here are some of the high-level findings from this year's Sustainable Energy in America Factbook:

Quick facts: Investment and deployment

A record-breaking \$338 billion in energy transition financing was deployed in the US for clean energy technologies, including renewables, electric vehicles and power grids.

54 gigawatts of new renewable power-generating capacity was added to the US grid, primarily driven by robust solar additions. Renewable energy use also set new highs: 9.2% of total US energy demand and 24% of electricity demand.

The US is the second-largest energy storage market in the world and commissioned an estimated 11.9GW of battery storage capacity in 2024 including large- and small-scale batteries a new US record. China remained the world's largest storage market.

Electric vehicle sales crossed the 1.5 million line, growing by 6.5%. Despite declining annual sales by market leader Tesla, strong growth by other automakers more than offset that drop.

The US led digitalization activities in the power sector. Over 2023 and 2024, the US accounted for 43% of global projects and partnerships announced in power sector digitalization, in part driven by Department of Energy funding

Interest in "clean" US hydrogen is growing, but developers spent the year waiting for guidance. The US had 79 megawatts of operational electrolyzer capacity at the end of 2024; developers have announced plans for another 34.7 gigawatts of 'clean' hydrogen capacity in the coming years. The Department of Energy's hydrogen program allocated \$170 million for planning and analysis. This infrastructure is key to enabling hydrogen adoption and use.

Carbon capture plans are surging, but activity stalled. Plans are in place for 146 million metric tons per annum (Mtpa) of new projects, compared with an installed base of 23Mtpa in the US. This base has remained largely unchanged since 2020. Most of the new demand for CCS comes from diverse sectors like power generation, ammonia and hydrogen, ethanol production and chemicals, while current installations are primarily at natural gas processing facilities.

Renewable diesel and jet fuel supply rose 25% and 325% year-on-year, respectively. Globally, airlines signed a total of 34 agreements to procure sustainable aviation fuel (SAF) from January to early December 2024. Incentives such as investment tax credits under the IRA support increased SAF production by lowering eligible costs by 6-30%.

Quick facts: Energy trends and updates

US CO2 emissions were 0.5% higher in 2024 than in 2023, BloombergNEF estimates. Transport remained the top-emitting sector, with industry second and power third.

US "energy productivity" set a new record in 2024 as economic growth outpaced energy consumption and grew 2.3% year-on-year. The trend is even starker over the past 10 years, where GDP has grown by 27.6% while primary energy consumption has decreased 1.3%. The result: a 29.3% increase in productivity.

Total US energy consumption grew 0.5% year-on-year, as the US consumed more electricity than it ever has before. More natural gas and renewables fueled this growth in power, even though petroleum remains the largest fuel consumed on an absolute basis across the economy.

Energy spending accounted for 3.8% of total US personal consumption expenditures in 2024, down 0.3 percentage points from 2023 as the cost of motor fuel fell, along with a slight decline in the price of natural gas.

Inflation and higher interest rates boosted levelized costs of electricity (LCOEs) for renewable energy technologies in 2023, the last year of complete data, but natural gas plants saw costs fall as the underlying price of the fuel fell year-on-year.

Demand for US natural gas rose 1.3% to reach 99.7 billion cubic feet per day. The jump was led by stronger power sector demand and rising LNG exports, which offset modest declines across the commercial and residential sectors.

Corporations buying clean power set a new record in 2024, signing up to buy 28 gigawatts of zero-carbon power. The year was marked by diversifying away from wind and solar, and a pivot toward partnerships and investment with nuclear plants.

Extreme weather events in the US were just below the prior year's record, with 27 events resulting in \$182.7 billion in damages. Tropical storms accounted for 69% of that total cost.

Coal's contribution to power generation slid to 14.7% in 2024, its lowest level ever. It was largely replaced by renewables, which produced an estimated 1,063 terawatt-hours of power in 2024, meeting 24.2% of 2024 power demand. The share of natural gas remained steady year on year, at 43% of the power generation mix.

Energy efficiency spending rose in 2023 (the last year with complete data). Utility spending on power and natural gas improvements rose 14.4% year-on-year to reach \$8.8 billion.

These trends are discussed in far greater depth, and with graphic illustrations, in the Factbook itself.

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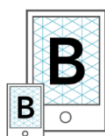
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