



# Sustainable Energy in America **2024 Factbook** **Executive Summary**



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 **The Business Council  
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# BNEF-BCSE Sustainable Energy in America Factbook: Executive Summary

## Clean Energy Transition Thrives in 2023, Boosted by Strong Policy Support

Both the pace and scope of the clean energy transition grew in 2023, supported by a suite of federal policies. While many post-pandemic market challenges eased over the course of 2023, the headwinds of high interest rates and disrupted clean energy supply chains remained. However, the market signals created by new policies under the Infrastructure Investment and Jobs Act and the Inflation Reduction Act (IRA) bolstered adoption of renewables and electric vehicles, drove entirely new levels of activity in nascent low- and zero-carbon fuels and processes and spurred a wave of domestic manufacturing announcements.

### 1. Mature sectors grew, setting records

#### *The construction of new renewable power grew, and solar set records*

In 2023, the US added a record 42GW of new renewable power-generating capacity to its grid, including distributed rooftop generation on homes and businesses. However, the fortunes of solar and wind diverged – both large-scale and rooftop solar set records for new build, while wind additions were the lowest since 2015. New biomass, geothermal, waste-to-energy and small hydro capacity build remained comparatively small in 2023. In all, 35MW of new biomass and waste-to-energy capacity came online in 2023.

Despite higher costs and supply chain uncertainty, the solar market benefitted from a waiver on tariffs imposed on cells and modules imported from Southeast Asia, which supplied 78% of the country's photovoltaic module imports in 2023. This led to a near-doubling of imports, year-on-year, with 50GW of modules imported in 2023. However, legal challenges are not yet over, and it is possible that retroactive tariffs could be applied on imports going back to 2022. The industry absorbed this uncertainty, weighing other factors that led to strong growth, such as high demand and a beneficial tax credit regime.

Renewable energy sources met a record volume of US energy demand in 2023. Specifically, the contribution of wind, solar, biomass, waste-to-energy, geothermal and hydro rose at the fastest pace among major sectors of the economy. In power, renewables contributed 972TWh, or 23% of total US power generation in 2023 – their highest level ever. The growth was driven by an increase in solar generation, which offset declines in hydro and wind production. In 2023, zero-carbon power (renewables generation plus nuclear power) accounted for an all-time high of 41.1% of all output.

#### *Electric vehicle sales surged*

Electric vehicles (EVs) had another record year of sales in 2023. Sales of EVs and fuel-cell vehicles hit nearly 1.46 million, up 50% from 2022. EV sales surged in response to price cuts, IRA incentives and a slew of new models. Tesla, the biggest player in the market, saw its proportion of

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new sales fall to 46% in 2023 from 52% in 2022. Other carmakers leading sales are Stellantis, Hyundai-Kia, GM, BMW and VW. Battery-electric vehicles (BEVs) dominated: they made up 80% of 2023 sales, with plug-in hybrid electric vehicles (PHEVs) making up the remaining 20% and fuel-cell vehicles accounting for well under 1% of sales.

### *Energy storage deployment more than doubled*

The US commissioned an estimated 7.5 gigawatts (GW) of battery storage in 2023, a 62% rise year-on-year, to bring total installed capacity to 19.6GW. Despite record new additions for the fourth year in a row, the US was eclipsed by China as the largest energy storage market in the world and stood in second place in 2023. Tax credits and other incentives passed through the IRA spurred storage deployments and investment in the sector. Funding to increase the duration, and therefore the grid benefits, of storage also picked up in 2023, with the US Department of Energy (DOE) announcing \$13 million for advanced pumped hydro storage, and \$505 million towards long-duration energy storage, or projects that can deliver electricity for 10 hours or more.

## **2. Green shoots from climate package seeds: emerging low-carbon sectors**

### *Interest in “clean” hydrogen takes off with strong policy foundations*

As of 2023, developers in the US have announced hydrogen project pipelines totaling 10.4 million metric tons per year. A favorable policy environment was the main driver for these plans, which are a mix of conventional hydrogen production with carbon capture and storage, and electrolysis running on renewable energy. The Biden administration’s regional hydrogen hubs, established under the bipartisan Infrastructure Investment and Jobs Act of 2021, will contribute an additional three million metric tons of hydrogen per year once all four phases of the program are complete. The hubs are currently in award negotiations with the Department of Energy, which are expected to be completed by mid-2024. Pre-rulemaking draft guidance on the IRA’s 45V hydrogen production tax credits in 2023 proposed that qualifying facilities must meet requirements on incrementality, time matching, and deliverability of production to emissions. The strictness of these rules has split opinion among market participants in the near term. The draft rules are expected to be released and finalized over the year.

In 2023, BNEF tracked 437MW of hydrogen-producing electrolyzers shipped to the US, with the largest share from HydrogenPro’s 220MW delivery to the ACES Delta project in Utah, followed by Plug Power shipping 120MW.

### *Manufacturing facility plans rise, battery manufacturing grows*

The number of manufacturing facilities planned in response to the IRA rose to 104 as of December 2023, representing \$123 billion in announced investments across North America. Battery and solar facilities dominate, with 34 facilities planned in each sector. The majority of battery manufacturing announcements were for cell manufacturing, intended to support the automotive sector.

By the end of 2023, the US had 114GWh of lithium-ion battery manufacturing capacity. Cumulative capacity grew 28% year-on-year, with 25GWh of new capacity additions. Though capacity has grown significantly, this is short of the 178GWh that was anticipated to be commissioned by the end of 2023, based on original company announcements. Slower-than-expected EV market demand has decelerated expansions throughout the year.

### *New sectors develop interest in carbon capture and storage*

The US is the global leader on carbon capture and storage (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. The overwhelming majority of carbon capture currently installed in the US is in natural gas processing facilities, but a generous revival of the 45Q tax credit has led to a jump in sectors planning to add CCS. Sectors like ethanol, power generation, ammonia and hydrogen, and chemicals make up most of the demand from the 137Mtpa of new planned projects.

### *Renewable fuels and biofuels grow, seeing more supply and demand*

*Renewable natural gas:* The US continues to build out more renewable natural gas (RNG) production capacity, which grew 13% year-on-year in 2023. Investment tax credits included within the IRA can offset the cost of new-build RNG facilities by 6-30% of eligible costs. As of 2023, 17 natural gas utility companies now have regulatory approval to sell RNG to customers using a special tariff mechanism. RNG also saw more adoption in transport, reaching 55% of total natural gas consumed in vehicles in 2023, the first time it has surpassed conventional natural gas.

*Liquid biofuels:* IRA incentives drove increased production of sustainable aviation fuel, another name for renewable jet fuel. Demand for such fuel is increasing amongst some airlines' corporate customers, especially those looking to reduce their emissions associated with aircraft combustion (Scope 3 carbon emissions). Renewable jet fuel supply rose 81.2% year-on-year. Renewable diesel saw 53% year-on-year growth.

## **3. Growth was uneven, and work remains to be done in some sectors**

### *Both onshore and offshore wind struggled*

Interconnection delays and a lack of early-stage development projects were the year's primary complications weighing on US onshore wind build in 2023. While the IRA revived the tax credit mechanism for new wind farms, it will take time for the support offered by the new law to translate into new capacity additions. In addition, 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 also struggled in 2023, with the year marked by project cancellations and contract renegotiations as developers confronted high costs of capital, inflation, supply chain constraints and uncertainty over tax credit qualification. For 6.7GW, or half of US contracted capacity, these blows to project economics proved fatal. However, efforts to sustain expansion of the offshore wind sector continued last year through state procurements, lease auctions, regulatory decisions, and company investment decisions.

### *Energy efficiency spending stabilized after a Covid-related drop*

After a sharp drop in efficiency spending from 2019 to 2020 due to the pandemic, efficiency spending stabilized in 2021, the last year for which there is complete data. Spending rose 1% year-on-year from 2020 to 2021 to reach \$7.7 billion, according to data compiled by the American

Council for an Energy Efficient Economy (ACEEE). Spending on efficiency improvements related to electricity stayed essentially flat at \$6 billion in 2021, while spending on improving the efficiency of natural gas delivery grew from \$1.5 billion to \$1.7 billion. The total impact of all ratepayer-funded electric energy efficiency programs in place in 2021 was a savings of about 290 million MWh – equivalent to approximately 7.63% of 2021 electricity consumption, according to ACEEE.

## Post-Covid disruptions and rebound effects end

### *US emissions started to fall again, ending post-Covid rebound*

In 2023, the US emitted 6,229 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e) of greenhouse gases, according to BNEF estimates. This represents a 1.8% drop from the year prior, with emissions falling in every sector except transport. As a result, 2023 was the first year since 2020 (an anomalous year due to the impact of lockdowns) that US emissions have fallen – if there was a post-Covid rebound, it appears to be over. Ignoring 2020, the last time US emissions were this low was 1987. Progress remains concentrated in the power sector, where the annual change in emissions was -95MMtCO<sub>2</sub>e, or 83% of the net drop. Power is now the US economy's third-highest emitting sector, having been first as recently as 2016. The majority of emissions reductions in the power sector to date can be attributed to coal being displaced by natural gas. In the long-term natural gas will also need to decarbonize or be replaced by zero- or low-carbon generation sources. This could happen through uptake of renewable energy and renewable fuels, as well as investments in energy efficiency and carbon capture and storage. US emissions are 15.8% lower than 2005 levels, while power emissions are 40% lower than 2005 levels.

### *Key clean energy cost inputs (mostly) find new equilibrium*

Prices for key commodities that underpin the clean power sector finally eased in 2023, with some nearly returning to pre-pandemic levels. The global price of polysilicon – used to manufacture photovoltaic solar – fell steadily over 1H 2023, as new factories ramped up production and tipped the market back toward oversupply. Lithium carbonate and lithium hydroxide, key minerals for batteries, saw their prices fall sharply in 2023, reversing the surge seen in 2022, when supply chain disruptions, including the Russian invasion of Ukraine, significantly disrupted metal supply and pushed prices as high as 10-14 times their pre-pandemic levels. By the end of 2023, lithium commodity indices were trading at just twice their pre-pandemic levels. International freight costs also dropped to pre-pandemic levels. However, this cost easing is not uniform. The price of steel has fluctuated over 2023, ticking back up to twice pre-pandemic costs. This impacts the wind industry, where steel is a substantial part of the material costs. In addition, interest rates are 3.3 times higher than in January 2020, which raises the cost of finance for all clean power plants.

### *Falling natural gas costs*

US natural gas prices fell from highs in 2022, with milder winter weather and higher production from Alaska. The average benchmark Henry Hub wholesale natural gas price for 2023 was 27% below 2022 levels. Retail natural gas prices were down for all segments – 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.

## Persistent trends remain at play

### *US energy productivity rose to record levels in 2023*

In 2023, the US economy expanded by 2.4% while primary energy consumption slowed down by 1.4% year-on-year. Taken together, the US “energy productivity” (the ratio of US GDP to total US energy consumption) increased by 3.8% year-on-year. This resulted in the highest economic output achieved per unit of energy consumed: on average, \$240 billion of GDP was generated per quadrillion British thermal units (Btu) of energy consumed. With Covid-19 firmly past, US primary energy consumption dipped, returning to the declining energy consumption trajectory seen since the peak of 2007. Energy consumption in 2023 was 5.8% lower than the 2007 peak.

### *The highest number of extreme weather events*

The impacts of climate change continue to be felt throughout the US, and 2023 saw the highest number of extreme weather events recorded. The country experienced 28 climate-related disasters each causing at least \$1 billion in damage over the 12 months. Although the number of events has increased, the costs associated with them have decreased, as there were fewer expensive tropical cyclones and a higher incidence of severe storms. About 19 severe storms made up 58% of the \$92.9 billion dollars in damage in 2023. In response, citizens and communities are installing a growing number of microgrids powered by solar, storage, natural gas and diesel generation sets.

### *US natural gas demand reaches a record, as the country becomes the world's largest supplier of LNG*

Demand for US natural gas rose 4.3% in 2023 from the year prior to reach another record of 99.9 billion cubic feet per day (Bcf/d). Higher demand was due to more consumption by the power sector, as well as exports – both via pipeline (to Mexico) and liquefied natural gas (LNG) shipments. A warmer-than-normal winter in early 2023 saw lower consumption for heating. This in turn led to higher levels of gas reserves in underground storage, which pushed prices down over the course of the year. The Henry Hub front month contract fell as low as \$2.00 per million BTU. These prices improved gas power plant economics when compared to coal, which also retreated from the market as plants retired, resulting in more gas being burnt to produce power in 2023. About 20% of US gas demand is for exports, whether through pipelines to neighboring countries or shipped as LNG. Following the return of the Freeport terminal to service, LNG feedgas demand from exports was 31% higher than in 2022. In addition, hotter-than-normal temperatures over the summer, particularly in the south, saw demand from Mexico rise.

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

### Market responses to the IRA

- **A record-shattering \$303.3 billion in energy transition financing was deployed** in the US for clean energy technologies, including renewables, electric vehicles, power grid investment and others.

- **By the end of 2023, the number of manufacturing facilities planned in response to the IRA rose to 104**, representing \$123 billion in announced investments across North America. Battery and solar facilities dominate, with 34 facilities planned each.
- **Some 42GW 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: 8.8% of total US energy demand and 23% of electricity demand.
- **The US is the second-largest energy storage market in the world** and commissioned an estimated 7.5GW of battery storage capacity in 2023, a new US record. China overtook the US to become the largest storage market in 2023.
- **Electric vehicle sales surged 50% to nearly 1.46 million vehicles**. The rise in sales was driven by new EV incentives, price cuts and more EV models being released.
- **Interest in “clean” US hydrogen is growing**. About 437MW of new electrolyzers were shipped in 2023, and plans to add nearly three million metric tons of low carbon hydrogen capacity through the regional hydrogen hubs were announced in 2023. The DOE’s hydrogen hubs program announced the winners selected for funding and are currently in negotiations. This infrastructure is key to enabling hydrogen adoption and use.
- **Carbon capture plans are surging**: 137Mtpa of new projects are being planned, against an installed base of 23Mtpa in the US in 2023. Most of the new demand for carbon capture and storage (CCS) comes from diverse sectors like ethanol, power generation, ammonia and hydrogen, and chemicals, while current installations are primarily at natural gas processing facilities.
- **Renewable diesel and renewable jet fuel supply rose 52.8% and 81.2% year-on-year**, respectively. Globally, airlines signed a total of 36 agreements to procure sustainable aviation fuel (SAF) from January to early December 2023. To date, US-based airlines lead SAF procurement, which likely stems from government incentives such as investment tax credits under the IRA for SAF producers.

### Energy trends and updates

- **US CO2 emissions were 1.8% lower in 2023 than in 2022, BloombergNEF estimates**: Transport remained the top-emitting sector with industry second and power third.
- **US “energy productivity” set a new record in 2023** as economic growth outpaced energy consumption, and grew 3.8% year-on-year. The trend is even starker over the past 10 years, where GDP has grown by 25.5% while primary energy consumption has decreased 4%. The result: a 30.6% increase in productivity.
- **Total US energy consumption fell 1.4% year-on-year**, ending the rebounding after the Covid-19 pandemic and returning to trends of lower energy consumption. A warmer-than-normal winter also resulted in less fuel consumed for building heat.
- **Energy spending accounted for 4.2% of total US personal consumption expenditures in 2023**, down 0.6 percentage points from 2022 as the cost of motor fuel fell, along with slight drops in the price of natural gas and electricity.
- **Inflation and higher interest rates boosted levelized costs of electricity (LCOEs) for renewable energy technologies** in 2023, but natural gas plants saw costs fall as the underlying price of the fuel fell year-on-year.
- **Demand for US natural gas rose 4.3% to reach 99.9 billion cubic feet per day**. The jump was led by stronger power sector demand and rising LNG exports, which offset modest declines across industrial, commercial and residential sectors.

- **Corporations buying clean power slowed their activity in 2023**, signing up to buy 17.1GW zero-carbon power compared with a record 20GW in 2022. The number of deals signed fell to less than 100 as the prices of power purchase agreements jumped in response to inflationary pressures.
- **Only one new US company joined the RE100**, pledging to offset its power consumption with clean power at a future date, reflecting the growth of broader net-zero targets and the fact that the largest players in the market have already committed to the alliance.
- **A record number of extreme weather events hit the US in 2023**, with 28 events recorded. This cost the US \$92.9 billion in damages – although this was less than seen in 2022, when a smaller number of events caused more monetary damage.
- **Coal's contribution to power generation slid to 15.8% in 2023, its lowest level ever**. It was largely replaced by natural gas, which met 43% of US power demand with a record estimated output of 1,809 terawatt-hours (TWh), up 6.5% from the year prior.
- **Energy efficiency spending stabilized in 2021** (the last year with complete data). Utility spending on power and natural gas improvements rose 1% year-on-year to reach \$7.7 billion.

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



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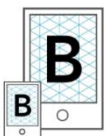
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