

Greenhouse Gases from Power Plants 2005–2020:

Rapid Decline Exceeded Goals
of EPA Clean Power Plan



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THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (<http://www.environmentalintegrity.org>) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws.

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Greenhouse Gases from Power Plants, 2005-2020

Rapid Decline Exceeded Goals of EPA Clean Power Plan

Global warming pollution from U.S. power plants declined more than 38 percent between 2005 and 2020, according to the latest emission reports available from the Environmental Protection Agency.¹ The rate of progress has already exceeded the goals of the Obama Administration’s Clean Power Plan. These were regulations imposed in 2015 that were expected to cut greenhouse gas emissions from power plants by 32 percent below 2005 levels, but not until 2030. By the end of 2019, electric generators had already cut carbon emissions almost 31 percent below that 2005 baseline. Despite the COVID-19 pandemic, electricity generated from wind, solar, and geothermal sources grew 12.5 percent in 2020 while power generated by natural gas grew more than 6 percent last year.² The data suggest that President Biden’s ambitious plan to obtain all U.S. electricity from carbon-free sources by 2035 may not be so unrealistic after all.

Greenhouse Gas Emissions from U.S. Power Plants, 2005 to 2020

Year	U.S. Power Plant CO ₂ Emissions Totals (Millions of Tons)	Years	Percent Decline in U.S. Power Plant CO ₂ Emissions Totals
2005	2,539	2005 to 2019	31%
2016	1,982	2005 to 2020	38%
2019	1,760	2016 to 2019	11%
2020	1,572	2016 to 2020	21%

Source: EPA Clean Air Markets data

Given that the U.S. has already surpassed the Clean Power Plan’s greenhouse gas targets – and done so ten years ahead of schedule – it can be hard to remember why the Obama Administration’s regulations provoked such fury. Power companies and their allies in Congress criticized the plan as overly aggressive, impractical, and even reckless.³ Twenty-eight states – led by Texas and West Virginia – sued in federal court to block what they claimed was federal overreach that threatened blackouts and higher prices for millions of Americans. The Supreme Court put the regulations on hold in 2016 until the arguments raised by states and industry groups could be heard. The Trump Administration then tried to repeal the Clean Power Plan and replace it with a much weaker alternative, the “Affordable Clean Energy” plan. But the United States Court of Appeals for the District of Columbia voided this alternative on January 19, 2021, saying the Trump Administration’s watered-down regulations violated the federal Clean Air Act.

Ironically, carbon dioxide emissions from power plants declined even more rapidly under the four years of the Trump Administration, despite Trump's relentless promotion of fossil fuels and repeated attempts to roll back Obama-era regulations for coal-fired power generators. Even under President Trump, greenhouse gas emissions from power plants dropped 11 percent between 2016 and 2019 (before the COVID-19 recession) and 21 percent between 2016 and 2020, EPA numbers show.⁴ This is because while Trump's EPA managed to delay or temporarily weaken some rules (and the Clean Power Plan was put on hold by the courts), most of the Obama-era regulations limiting emissions of sulfur dioxide, nitrogen oxide, and mercury air pollution from power plants took effect over the last four years, as did federal rules controlling wastewater from coal plants and the disposal of coal ash.



Burning coal has become gradually more expensive as laws and regulations have required more pollution control systems, such as scrubbers, wastewater treatment plants, and lined landfills.

When finally faced with the cost of cleaning up all the pollution caused by coal fired-power plants, many power companies chose to retire the oldest and dirtiest units and replace them with natural gas generators or renewable energy. At the same time, falling prices for zero-carbon sources like wind and solar energy, and lower-carbon sources like natural gas, made these alternatives much more affordable.

As explained further below, while a natural gas generator emits about 40 percent as much carbon dioxide as a coal-fired generator for each kilowatt hour produced, that advantage is undercut by the substantial amounts of methane and carbon dioxide released when drilling, processing, or transporting the natural gas that power plants burn.

The dramatic decline in greenhouse gases from power plants from 2005 to 2020 is significant because power plants still make up the second largest source of greenhouse gas pollution from the U.S. economy, contributing 27 percent of the total, behind only transportation (which accounts for 28 percent of emissions). Manufacturing contributes 22 percent of greenhouse gas pollution, commercial and residential buildings 12 percent, and agriculture 10 percent, according to EPA figures.⁵

The drop in carbon dioxide from power plants was all the more impressive because it came during a period of economic expansion over the last decade and a half, when the U.S. Gross Domestic Product grew by about 40 percent.⁶ Some of the emissions decline from 2019 to 2020 was related to the COVID-19 recession and slightly reduced electricity generation last year (about 3 percent less).⁷ However, if the greenhouse gas pollution totals before the

pandemic – in 2019 – are compared to the 2005 baseline, the decline in emissions over this period was still 31 percent, which was close to Obama’s goal of a 32 percent decline, but achieved 11 years early.⁸

Advances in technology are contributing to a steady drop in greenhouse gas pollution from the power sector, providing reason for optimism that even steeper reductions are achievable. President Biden has announced a goal of a “carbon pollution free power sector by 2035,”⁹ which is even more ambitious than the Obama-era Clean Power Plan. However, if the last 15 years are any indication, what might seem like a pipe dream today could quickly change as cleaner energy sources become continually cheaper and more economically competitive.

Factors Driving Decline in Emissions

The cause of the decline in greenhouse gases from the power industry was twofold. Technological advances in the solar, wind, and natural gas industries drove down prices for these cleaner sources of electricity, while energy efficiency improved across the overall U.S. economy. Meanwhile, the costs associated with burning coal gradually increased because of environmental laws and regulations dating back decades, which the Trump Administration was not able to repeal.

The result was that the use of renewable sources of energy tripled from 2010 to 2020, according to data from the Energy Information Administration.¹⁰ Renewables (including wind and solar power) contributed only about 4 percent of the nation’s electricity a decade ago, but 12 percent last year. Meanwhile, the use of coal as a source of electricity tumbled by more than half, falling from 45 percent of the total in 2010 to 19 percent in 2020, and the use of gas surged by almost two thirds.

U.S. Power Plant Electricity Generation by Source

	Thousand Megawatt Hours			Percent Change 2010 to 2020
	2010	2019*	2020*	
Total Generation	4,125,060	4,130,768	4,001,064	- 3%
Coal	1,847,290	992,695	767,358	- 58%
Natural Gas	987,697	1,563,688	1,621,591	+64%
Renewables: wind, solar, hydropower, geothermal, biomass	167,173	437,768	493,044	+195%
Nuclear	806,968	809,409	720,048	- 11%

Source: Energy Information Administration (EIA) data

*Represents 12 months ending 11/30 for each year

During this decade, natural gas became cheaper because of the expansion of newer extraction techniques, hydraulic fracturing and horizontal drilling. Falling prices made natural gas the new leading source of electricity generation in the U.S., fueling 41 percent of

electricity generation in 2020, up from 24 percent in 2010, according to federal data. Overall, total electricity generation in the U.S. remained essentially unchanged from 2010 to 2019, despite the overall growth in the economy – which is a reflection of the improving efficiency of industries, buildings, and appliances.

Natural gas-powered plants release less than half as much carbon dioxide as coal-fired electric generators per kilowatt hour. Because burning natural gas emits so much less of this greenhouse gas than burning coal, on the surface, this shift in the industry would seem to be a step forward, from a climate perspective. However, these particular EPA estimates of climate impacts reflect only carbon dioxide released from the burning of gas in power plants – and do not include the large amount of methane (an even more potent greenhouse gas) that escapes during the hydraulic fracturing process and leaks from pipelines, tanks, and processing equipment. The under-reporting of methane leaks from pipelines, compressor stations and equipment has come into spotlight in recent years, as satellite data continues to reveal methane’s often underestimated contribution to climate change. A 2018 study in the journal *Science*¹¹ concluded that methane emission rates from the natural gas industry were approximately 60 percent higher than estimates provided in the EPA’s annual Greenhouse Gas Inventory --- throwing into question whether natural gas, overall, is much better than coal, when the whole supply chain is taken into account.



The amount of electricity generation in the U.S. from natural gas increased by 64 percent between 2010 and 2020 as generation from coal dropped by 58 percent.

Federal Regulations as Drivers of Emissions Declines

Although both the Obama-era Clean Power Plan and the Trump-era Affordable Clean Energy Rule were blocked by the courts, older laws and regulations have been, over the decades, slowly increasing the costs of burning coal and managing coal ash waste for power companies. For years, coal plants benefitted from lax regulations and externalized the costs of their waste disposal. For example, their smokestacks released large volumes of sulfur dioxide air pollution and soot that contributed to the medical bills and deaths of people living downwind. Power companies also dumped coal ash into unlined pits that leaked toxic metals into the drinking water supplies of nearby homes. Over time, however, laws passed by Congress – including 1990 amendments to the Clean Air Act – and regulations imposed by EPA and states forced companies to start installing pollution control devices, such as scrubbers, to reduce their emissions, and compelled them to invest in lined landfills if they

want to keep dumping ash waste. These additional costs (scrubbers on smoke stacks, for example, often cost hundreds of millions of dollars) have convinced many power companies to make economic decisions to close their coal-fired power units and switch to natural gas or other cleaner sources of energy. The decisions to move to alternative energy sources such as wind and solar have, in some cases, also been boosted by federal and state government subsidies of green energy.

Among the laws and regulations contributing to the rising cost of burning coal are:

- In 2015, the Obama Administration's EPA finalized the Coal Ash Rule, which requires the closure of unlined coal waste ponds that are leaking contaminants, the cleanup of some sites, the installation of liners for new dumps, among other investments.
- In 2015, EPA imposed water pollution limits for coal-fired power plants that require many to install wastewater treatment plants or take other steps to reduce discharges of toxic metals and other pollutants into rivers and streams.
- In 2011, EPA announced the Mercury and Air Toxics Standards rule, which requires investments to reduce the release of mercury, acid gases, and other toxic pollution from power plants.
- The Clean Air Act Amendments of 1990 have been gradually requiring many older coal-fired power plants to install more advanced pollution control systems and take other steps to reduce sulfur dioxide, nitrogen oxide, and particulate air pollution.
- EPA's enforcement (mostly prior to the Trump Administration) of Clean Air Act New Source Review rules that require power plants that propose to expand capacity or modify old boilers to invest in up-to-date emission controls also helped to close loopholes that allowed some of the oldest and dirtiest plants to avoid emission limits their newer competitors had to meet many years ago.

Although the Trump Administration attempted to roll back or delay certain elements of these laws and regulations, they often failed when challenged in court. And the cumulative impact of the growing number of rules – many of which went into effect during and before the Trump years -- has been to help convince a growing number of power companies to decide to shift away from coal to alternative sources of energy. Overall, utilities have announced the retirement of about 100 coal-fired power units over the last four years. Over the last decade, companies have announced the retirements of least 546 coal power units, totaling about 102 gigawatts of generating capacity, according to the Energy Information Administration (EIA).¹² Plant owners plan to retire another 17 GW of coal-fired capacity by 2025, according to EIA.

Differences in Power Plant Emissions by State:

The 50 states vary widely in their greenhouse gas emissions. The state with the biggest carbon footprint – Texas, whose power plants released 200 million tons of greenhouse gases in 2020 – releases 500 times the pollution as the state with the smallest impact, Vermont, which emitted 0.4 million tons last year.¹³ Overall, the 10 biggest U.S. states (listed below)

contributed more than half of the U.S. total of carbon dioxide released from power plants: 779 million tons out of the 1.5 billion in 2020, according to EPA figures.¹⁴

States With Highest Power Plant CO₂ Emissions

Rank	State	CO ₂ Emissions in 2020 (Millions of Tons)	CO ₂ Emissions in 2005 (Millions of Tons)	Percent Drop, 2005-2020
1	Texas	200	255	22%
2	Florida	101	136	26%
3	Pennsylvania	78	122	36%
4	Ohio	75	139	46%
5	Indiana	65	134	52%
6	Missouri	57	781	30%
7	Kentucky	54	100	46%
8	West Virginia	53	885	40%
9	Alabama	50	915	46%
10	Illinois	46	106	57%

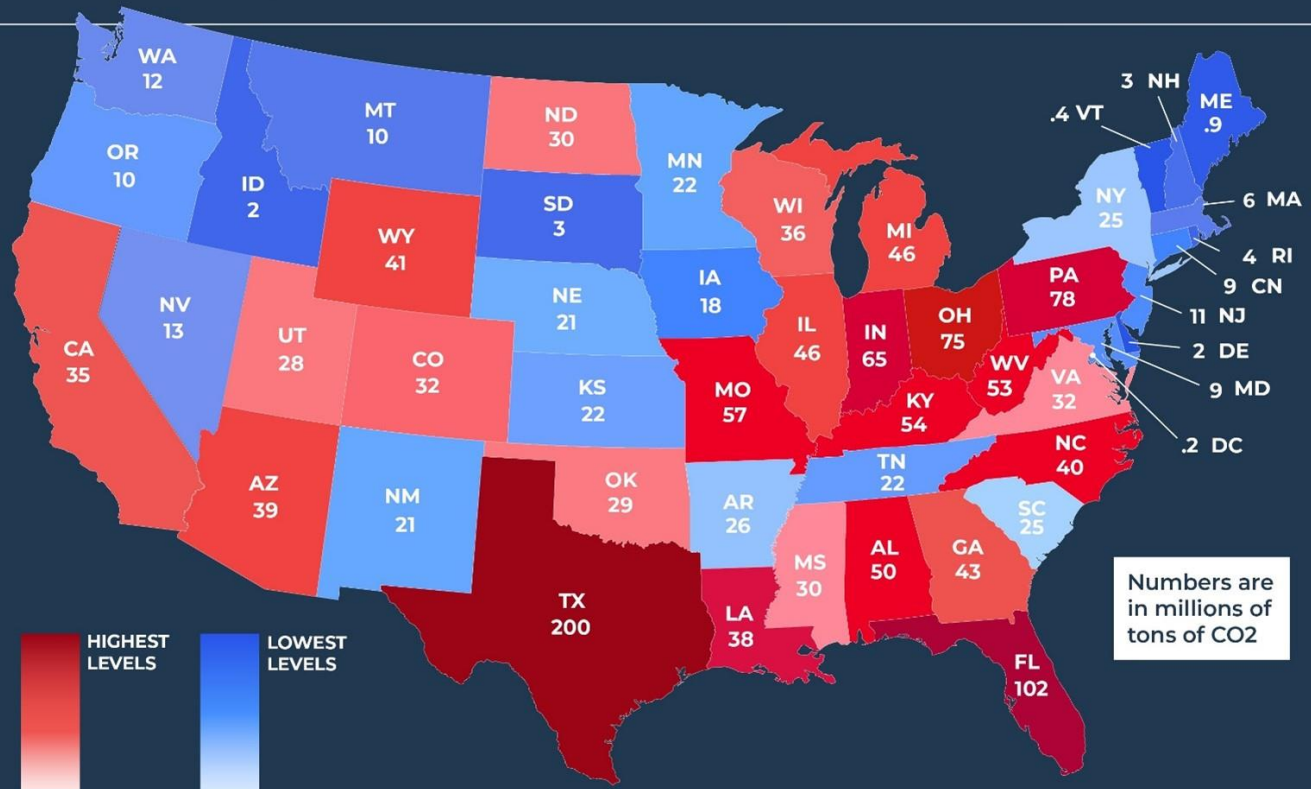
Source: EPA Clean Air Markets data

California has largest population in the U.S., but comes in 20th place in terms of the climate impact of its electricity generation sector, because it has no coal-fired power plants generating electricity for residential use.

Although Texas Governor Greg Abbott on February 17, 2021, falsely blamed wind power¹⁵ for the widespread blackouts in the state following a snowstorm, in fact, natural gas and coal-fired generators lost more generation capacity during the storm than wind and solar, with the state’s fossil-fuel generators proving to be highly vulnerable because they were not prepared for freezing temperatures. During the storm, the Texas electric grid lost roughly five times as much power from natural gas generators – due to gas shortages, pipeline freezes, and equipment failures -- as it did from wind farms.¹⁶

It is also worth noting that not all states are shifting from coal to cleaner sources of electricity at the same rate. Even among the top 10 biggest polluting states, there are wide variances. Illinois and Indiana, for example, saw the greenhouse gas emissions from their power sectors plummet by more than half between 2005 and 2020. This was double the rate of decline than in Texas, whose power plants reduced their emissions by 22 percent over this period, and Florida, whose electricity generators experienced a 26 percent decline in carbon emissions, according to EPA data.

Greenhouse Gases from Power Plants by State, 2020



Bright red colors indicate higher amounts of CO2 from a state's power plants in 2020, with the numbers indicating millions of tons. Cooler/darker blue colors show lower amounts. Source: EPA.

Differences in Emissions Between Power Plants

EPA's Clean Air Markets online emissions database¹⁷ lists more than 1,000 power plants across the U.S. However, only 50 of the largest plants account for almost a third of the total carbon dioxide emissions from the whole sector (478 million tons out of 1.57 billion in 2020). The 10 biggest emitters among power plants on the list released as much greenhouse gases in 2020 (143 million tons) as the 684 smallest plants. That suggests that a few big power plants are having a disproportionate impact on the climate, according to EPA data. For example, the nearly 19 million tons of greenhouse gas emissions from a single power plant in 2020 -- James H. Miller Jr. plant in Alabama -- were equivalent to more than half of the electricity generated by all of the power plants in California

The largest are listed below:

Top Ten U.S. Power Plants CO₂ Emitters in 2020

Rank	State	Facility Name	Tons of CO ₂ Emissions
1	AL	James H Miller Jr	18,846,905
2	MO	Labadie	17,182,089
3	OH	Gen J M Gavin	15,074,332
4	TX	Martin Lake	14,788,925
5	TX	Oak Grove	14,334,643
6	MI	Monroe	14,276,708
7	IL	Prairie State Generating Station	12,988,380
8	IN	Gibson	12,455,766
9	WY	Jim Bridger	12,275,116
10	WV	John E Amos	11,181,737

Source: EPA Clean Air Markets data

Conclusion:

When the Obama Administration's Clean Power Plan was announced in 2014, it was widely attacked as being an overreach – even though it called for only a modest 32 percent reduction in greenhouse gases between 2005 and 2030. After Attorneys General representing 28 states – more than half the U.S. – sued to stop it, the courts halted the plan's implementation. The courts also threw out the Trump Administration's weaker replacement rule for controlling greenhouse gases from power plants. Despite these setbacks, advances in technology – including cheaper solar cells, and more efficient wind turbines and gas drilling techniques – made cleaner sources of energy cheaper than coal, which drove down greenhouse gas emissions. Regulations also played an important role in forcing coal-fired power plants to pay for the pollution burdens they impose on public health. The result was that greenhouse gas emissions between 2005 and 2020 fell far more rapidly than anticipated – 38 percent, exceeding the Obama-era goals of 32 percent, and meeting the target a decade early. The fact that the U.S. exceeded its greenhouse gas targets from the electricity generation sector so quickly, and even during a decade of economic growth, is an encouraging sign for the future of the Biden Administration's even more ambitious climate goals for the year 2035.

Endnotes

¹ Environmental Protection Agency Clean Air Markets data, accessed February 13, 2021. Link: <https://www.epa.gov/airmarkets>. For this report, the Environmental Integrity Project (EIP) downloaded data for U.S. power plants for the years 2005, 2010, 2016, 2019, and 2020, and compared them. EIP also downloaded data from the U.S. Energy Information Administration on fuels used as sources of electricity in those years. See next note.

² U.S. Energy Information Administration data, accessed February 18, 2021. Link: <https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php>

³ Marianne Lavelle, “In Wake of Court Defeat, Opponents of Obama’s Climate Rule Tee Up Seven More Attacks,” *Science* magazine, Jun. 10, 2015. Link: <https://www.sciencemag.org/news/2015/06/wake-court-defeat-opponents-obama-s-climate-rule-tee-seven-more-attacks>

⁴ Ibid.

⁵ EPA “Sources of Greenhouse Gas Emissions,” 2018, viewed February 18, 2021, at: [https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=Electricity%20production%20\(26.9%20percent%20of,share%20of%20greenhouse%20gas%20emissions.](https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=Electricity%20production%20(26.9%20percent%20of,share%20of%20greenhouse%20gas%20emissions.)

⁶ Data from the World Bank compiled by Macro Trends, accessed on February 17, 2021. 21.6 trillion dollars GNP in 2019, and 19 trillion in 2020, compared to 13.6 trillion in 2005. Link:

<https://www.macrotrends.net/countries/USA/united-states/gnp-gross-national-product> 2020 GNP data from Trading Economics, <https://tradingeconomics.com/united-states/gross-national-product>

⁷ According to Energy Information Administration (EIA) data, power generation in the U.S. was 4.1 billion megawatts hours in 2019 and 4 billion megawatt hours in 2020.

⁸ Environmental Protection Agency Clean Air Markets data, accessed February 13, 2021. Link: <https://www.epa.gov/airmarkets>.

⁹ Joe Biden campaign website, “THE BIDEN PLAN TO BUILD A MODERN, SUSTAINABLE INFRASTRUCTURE AND AN EQUITABLE CLEAN ENERGY FUTURE,” accessed February 18, 2021. Link: <https://joebiden.com/clean-energy/>

¹⁰ Website of the U.S. Energy Information Administration, accessed February 18, 2021. Link: <https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php>

¹¹ Alvarez, et al. (July 13, 2018). Assessment of methane emissions from the U.S. oil and gas supply chain. *Science*. Vol. 361, Issue 6398, pp. 186-188. DOI: 10.1126/science.aar7204

¹² U.S. Energy Information Administration, “More U.S. coal-fired power plants are decommissioning as retirements continue,” July 26, 2019. Link: <https://www.eia.gov/todayinenergy/detail.php?id=40212>

¹³ Environmental Protection Agency Clean Air Markets data, accessed February 13, 2021. Link: <https://www.epa.gov/airmarkets>

¹⁴ Ibid.

¹⁵ Brian Mena, “Gov. Greg Abbott and other Republicans blamed green energy for Texas’ power woes. But the state runs on fossil fuels,” *Texas Tribune*. Link: <https://www.texastribune.org/2021/02/17/abbott-republicans-green-energy/>

¹⁶ Veronica Penney, “How Texas’ Power Generation Failed During the Storm,” *The New York Times*, February 19, 2021. Link: <https://www.nytimes.com/interactive/2021/02/19/climate/texas-storm-power-generation-charts.html>

¹⁷ EPA Clean Air Markets online database: <https://www.epa.gov/airmarkets/power-sector-emissions-data>