THE CARBON BOOM

National And State Trends In Global Warming Pollution Since 1960

MontPIRG Education Fund

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Table of Contents

Executive Summary 4

Temperatures Rising: The Consequences of Global Warming 6

Early Signs of Global Warming 6
Consequences of Increased Warming 6

Sources of Global Warming Pollution 8

U.S. Failure to Limit Global Warming Pollution 9

Report Findings: Global Warming Pollution Continues to Rise Unabated 11

Trends from 1960 to 2001 11
Growth in Oil Emissions from Transportation Sources 13
Growth in Coal Emissions from Electricity Generation 16
Increased Natural Gas Emissions from Multiple Sectors 19

Conclusion and Recommendations 21

Methodology 22

Appendices
Appendix A. Carbon Dioxide Emissions from Fossil Fuel Combustion, 2001 23
Appendix B. Trends in Carbon Dioxide Emissions from Fossil Fuel Combustion, 1960-2001 25
Appendix C. Contribution of Each Fossil Fuel to the Overall Increase in Carbon Dioxide Emissions, 1960-2001 27
Appendix D. Carbon Dioxide Emissions from Oil and Vehicle Miles Traveled (VMT), 1960-2001 29
Appendix E. Carbon Dioxide Emissions from Coal and Coal-Fired Power Plant Capacity, 1960-2001 31
Appendix F. Carbon Dioxide Emissions from Natural Gas, 1960-2001 33

End Notes 35

Executive Summary

The early effects of global warming are already evident across the United States and worldwide. The year 2005 was the warmest on record. Left unchecked, temperatures will continue to rise, and the effects of global warming will become more severe. This report examines trends in U.S. global warming pollution nationally and by state and concludes that the failure to limit emissions from burning oil, coal, and natural gas has allowed global warming pollution to grow out of control.

Human activities over the last century – primarily burning fossil fuels – have changed the composition of the atmosphere in ways that threaten to dramatically alter the climate in the years to come. In a December 2005 speech, James Hansen, director of NASA's Goddard Institute for Space Studies, stated, "The Earth's climate is nearing, but has not passed, a tipping point, beyond which it will be impossible to avoid climate change with far ranging undesirable consequences." These consequences, he said, would "constitute practically a different planet" and include sea level rise, heat waves, drought, more intense hurricanes, decreased crop yields, water scarcity, and the spread of infectious diseases.

The United States is by far the largest worldwide contributor to global warming, releasing a quarter of the world's carbon dioxide, the primary global warming pollutant. Power plants, cars, and light trucks are the largest U.S. sources of carbon dioxide.

Existing technology could substantially reduce global warming pollution by making power plants and factories more efficient, making cars go farther on a gallon of gasoline, and shifting the country to clean, renewable energy sources, such as wind, solar, geothermal, and biomass. These solutions also would reduce our dependence on oil, reduce air pollution, protect pristine places from oil drilling and mining, and save consumers money.

Unfortunately, the United States has rejected mandatory limits on global warming pollution, opting instead to allow global warming pollution to increase unabated. As a result, carbon dioxide emissions have skyrocketed nationally and in most states.

Using data compiled by the Oak Ridge National Laboratory, this report examines trends in carbon dioxide emissions and fossil fuel combustion nationally and by state for the four decades spanning 1960 to 2001. Our major findings include the following:

Carbon Dioxide Emissions Are Booming

• Between 1960 and 2001, U.S. emissions of carbon dioxide almost doubled, jumping from 2.9 billion metric tons of carbon dioxide in 1960 to almost 5.7 billion metric tons in 2001, an increase of 95 percent.

• In the 1990s, carbon dioxide emissions grew more quickly than in the 1970s and 1980s, increasing steadily at an average rate of 1.5 percent each year. The Energy Information Administration estimates that emissions grew by 1.7 percent in 2004, increasing to almost 6.0 billion metric tons.

• Regionally, carbon dioxide emissions rose most rapidly in the Southeast and Gulf South between 1960 and 2001, increasing by 163 percent and 175 percent, respectively.

• Among the states, Texas ranked first in the nation for the highest emissions of carbon dioxide in 2001, releasing 12 percent of the nation's total carbon dioxide emissions. In 1960, Texas emitted 240.7 million metric tons of carbon dioxide; by 2001, the state's

emissions had grown to 668.5 million metric tons, an increase of 178 percent.

• Twenty-eight (28) states more than doubled their carbon dioxide emissions between 1960 and 2001. The 10 states that experienced the largest overall increases in emissions in this period include Texas, Florida, California, Georgia, Louisiana, Indiana, Kentucky, North Carolina, Missouri, and Arizona.

Driving the Boom in Carbon Dioxide Emissions

A dramatic growth in oil emissions from the transportation sector and coal emissions from electricity generation fueled the rapid increase in U.S. carbon dioxide emissions between 1960 and 2001.

• Carbon dioxide emissions from oil combustion jumped 1.1 billion metric tons from 1960 to 2001, accounting for 40 percent of the total increase in U.S. carbon dioxide emissions. The transportation sector drove this rapid increase. Carbon dioxide emissions from oil burned in the transportation sector increased by more than 150 percent over the period, largely due to a substantial rise in vehicle travel and the stagnating fuel economy of vehicles. In every other sector, carbon dioxide emissions from oil combustion peaked in the 1970s (Figure ES-1).

• Carbon dioxide emissions from coal climbed 1.1 billion metric tons between 1960 and 2001, accounting for 40 percent of the total increase in U.S. carbon dioxide emissions. Increased electricity generation from coal-fired power plants fueled this rapid growth. Emissions from coal combustion in the electricity sector skyrocketed from 1960 to 2001, increasing by 370 percent, as demand for electricity boomed. At the same time, carbon dioxide emissions from the industrial sector declined steadily after 1966 (Figure ES-2).

The longer we wait to reduce global warming pollution, the harder the task will be in the future. Key components of an action plan to protect future generations from global warming include:

• Establish mandatory limits on global warming pollution that reduce emissions from today's levels within 10 years, by 20% by 2020 and 80% by 2050.

• Reduce our dependence on fossil fuels by making our homes and businesses more energy efficient, making our cars and SUVs go farther on a gallon of gasoline, and generating more electricity from renewable energy sources.

Figure ES-1. Trends in Carbon Dioxide (CO2) Emissions from Oil Combustion, 1960-2001

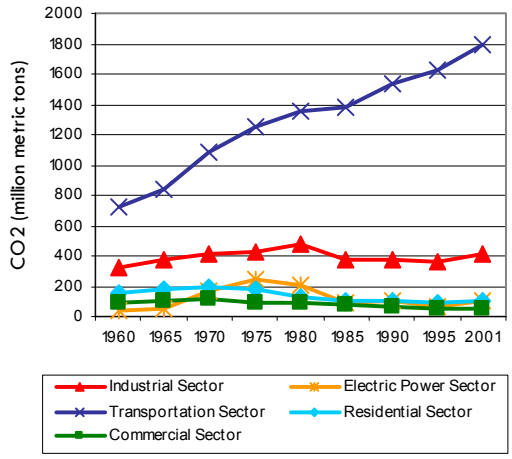
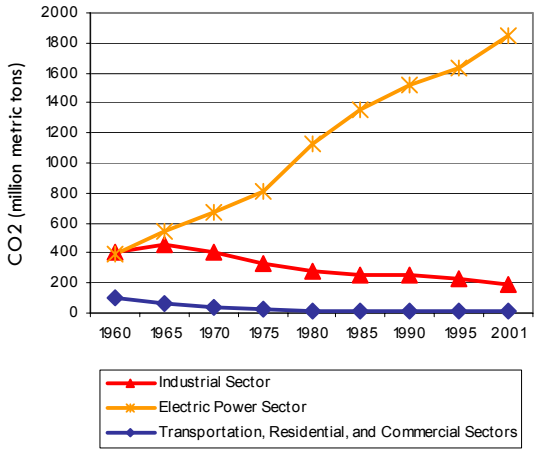


Figure ES-2. Trends in Carbon Dioxide (CO2) Emissions from Coal Combustion, 1960-2001



Temperatures Rising: The Consequences of Global Warming

There is strong scientific consensus that global warming is occurring, as evidenced by rising global surface temperatures, increases in sea levels, and the widespread retreat of glaciers, among many other indicators. Most of this warming has resulted from human activities.[1]

Water vapor, carbon dioxide, and other gases in the atmosphere trap some of the sun's heat close to the earth's surface, warming the planet enough for life to flourish. Without these gases, the earth would be too cold for life to survive. However, in the last 150 years, human activities – primarily burning fossil fuels – have substantially increased the concentration of these gases in the atmosphere. As a result, more of the sun's heat is being trapped close to the earth's surface, causing global average surface temperatures to rise. Since 1750, the concentration of carbon dioxide in the atmosphere has increased by 35 percent. Concentrations of other global warming gases have increased as well.[2]

Early Signs of Global Warming

According to the United Nations' Intergovernmental Panel on Climate Change (IPCC), global average surface temperatures increased by more than 1°F (0.6°C) over the 20th century.[3] Since 1975, temperatures have been increasing at a faster rate of about 0.36°F per decade.[4] The 10 warmest years on record have all occurred since 1994, except for 1996, with 2005 being the hottest year since official records began in 1861.[5]

The early effects of global warming are evident across the United States and worldwide. Among many other changes, warmer oceans may be contributing to more severe hurricanes,[6] such as those that struck Florida in 2004 and the entire Gulf Coast in 2005. In the western United States, snowpack has declined over the last 50 years, threatening the region's scarce water supplies.[7] The World Health Organization estimates that global warming already claims the lives of 150,000 people each year.[8]

Consequences of Increased Warming

As temperatures continue to rise, the effects of global warming will become more severe. According to the IPCC, if historic trends in emissions continue, temperatures could rise by an additional 1.4°C to 5.8°C from 1990 to 2100.[9] The consequences of this increase in global temperatures will vary from place to place since the Earth's climate is extraordinarily complex. These consequences will include sea level rise, heat waves, drought, more intense tropical storms, loss of plant and animal species, decreased crop yields, decreased water availability, and the spread of infectious diseases.[10]

Sea Level Rise and Coastal Flooding

As temperatures continue to increase, ocean levels will rise due to the melting of glaciers and ice sheets and the expansion of surface water as it warms. Sea level rise could flood low-lying coastal areas and devastate densely populated coastal areas in future years, displacing millions of people worldwide.

Sea level increased by an average of 4 to 8 inches worldwide over the course of the 20th century, 10 times the average rate over the previous 3,000 years.[11] In 2001, the IPCC projected that sea level would rise by an additional 3.5 inches to 3 feet by the end of the century.[12] More recent research points to an accelerated rise in sea level due to the rapid melting of the Greenland and West Antarctic ice sheets.[13] A March 2006 article in *Science* analyzed records of past ice-sheet melting to predict future melting and sea level rise and concluded "a threshold triggering many meters of sea-level rise could be crossed well before the end of this century."[14]

Currently, ice loss from Greenland and West Antarctica contributes less than half of the yearly rise in sea level; the rest comes from melting mountain glaciers and the thermal expansion of seawater.[15] However, the collapse of the Greenland or West Antarctic ice sheets would raise sea levels substantially, and recent research indicates that both ice sheets are melting faster than projected.[16]

In February 2006, researchers documented that Greenland's glaciers are melting at twice the expected rate. The faster melting is the result of a warming trend that makes previous predictions of how quickly ocean levels will rise obsolete.[17] If the Greenland ice sheet were to melt completely, it would raise sea level by 23 feet worldwide.[18]

In addition, the West Antarctic ice sheet is losing mass at a significant rate, contrary to the IPCC's 2001 prediction that the ice sheet would gain mass this century.[19] Antarctica holds 90 percent of the world's ice, and the disappearance of its smaller West Antarctic ice sheet would raise the sea level by 13-20 feet.[20]

According to geoscientist Michael Oppenheimer of Princeton University, "The time scale for future loss of most of an ice sheet may not be millennia," as glacier models have suggested, "but centuries."[21]

Sources of Global Warming Pollution

Burning fossil fuels – coal, oil, and natural gas – produces the vast majority of U.S. global warming pollution. Carbon dioxide (CO2) emissions comprised 84 percent of U.S. global warming emissions in 2004; as shown in Figure A, the other five global warming pollutants are methane, nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).[22]

Power plants are the nation's largest source of carbon dioxide emissions, contributing 39 percent of emissions from energy sources in 2004 (Figure B). Passenger vehicles are the next largest source, contributing 20 percent of emissions. Other transportation sources contribute an additional 13 percent of emissions. The remaining 28 percent of U.S. carbon dioxide emissions from energy sources come from the direct consumption of fossil fuels in the commercial, industrial, and residential sectors.[23]

Figure A. U.S. Global Warming Emissions, 2004[24]

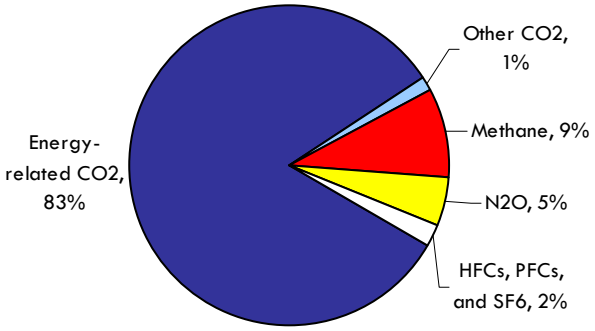
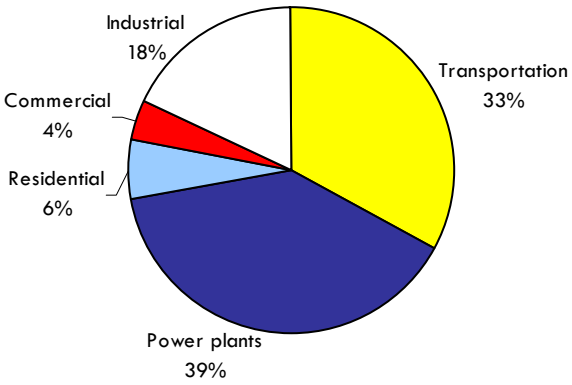


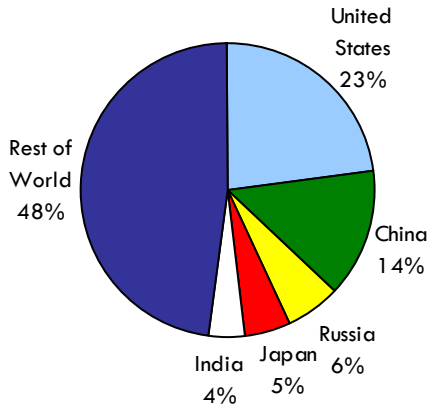
Figure B. Sources of U.S. Carbon Dioxide Emissions from Energy Consumption, 2004[25]



U.S. Failure to Limit Global Warming Pollution

The United States is by far the largest global contributor of carbon dioxide emissions, releasing 23 percent of the world's total carbon dioxide emissions in 2003 (Figure C).[26] Yet, the United States has done little to cut its emissions. In 2004, the most recent year for which data are available, the United States emitted the most global warming pollution ever produced by any country.[27]

Figure C. Carbon Dioxide Emissions by Country, 2003[28]



Carbon dioxide and other global warming gases can stay in the atmosphere for a century or longer after being emitted,[29] meaning the decisions we make today will have ramifications for generations. Leading scientists now indicate that we may only have a narrow window of time left – possibly a decade – to reduce emissions below today's levels and start the process of stabilizing global warming gases at a level that averts devastating and irreversible impacts.[30] In a December 2005 speech, James Hansen, director of NASA's Goddard Institute for Space Studies, stated, "The Earth's climate is nearing, but has not passed, a tipping point, beyond which it will be impossible to avoid climate change with far ranging undesirable consequences." These consequences, he said, would "constitute practically a different planet."[31]

Despite the urgency to act, the United States has so far rejected mandatory limits on global warming emissions and has pursued an energy policy that commits the U.S. to an even greater reliance on fossil fuels.[32]

In the absence of federal leadership, states across the country have taken action to reduce their global warming emissions. Ten states have adopted limits on emissions from cars and light trucks; these policies will reduce carbon dioxide emissions by a total of 64 million metric tons each year by 2020.[33] Eight Northeast states have agreed to reduce global warming emissions from the region's power plants by 10 percent by 2019.[34] Twenty states and Washington, DC have committed to obtain a growing portion of their electricity from wind, solar, and other clean, renewable sources; these state standards will reduce carbon dioxide emissions by nearly 75 million metric tons each year by 2017.[35] States also have adopted numerous energy efficiency measures, among other clean energy policies.[36]

In addition, several states and regions have adopted, or are considering adopting, long-term goals for reducing global warming emissions. For instance, in June 2005, California Governor Arnold Schwarzenegger signed Executive Order S-3-05, committing the state to reduce its emissions to 2000 levels by 2010, 1990 levels by 2020, and 80 percent below 1990 levels by 2050.[37]

In addition to reducing global warming pollution, these state policies will cut oil dependence, reduce air pollution, protect

pristine places from mining and oil drilling, and save consumers money. In a January 2006 study, researchers at Berkeley concluded that California likely can reach Governor Schwarzenegger's target of reducing the state's global warming pollution to 1990 levels by 2020, with a net gain for the state economy. The researchers analyzed eight policies and found that they can achieve almost half of the 2020 targets while increasing Gross State Product by about $60 billion and creating more than 20,000 new jobs.[38]

Despite these state actions, the lack of a national strategy has allowed U.S. carbon dioxide emissions to continue to rise, as examined in detail in the pages that follow.

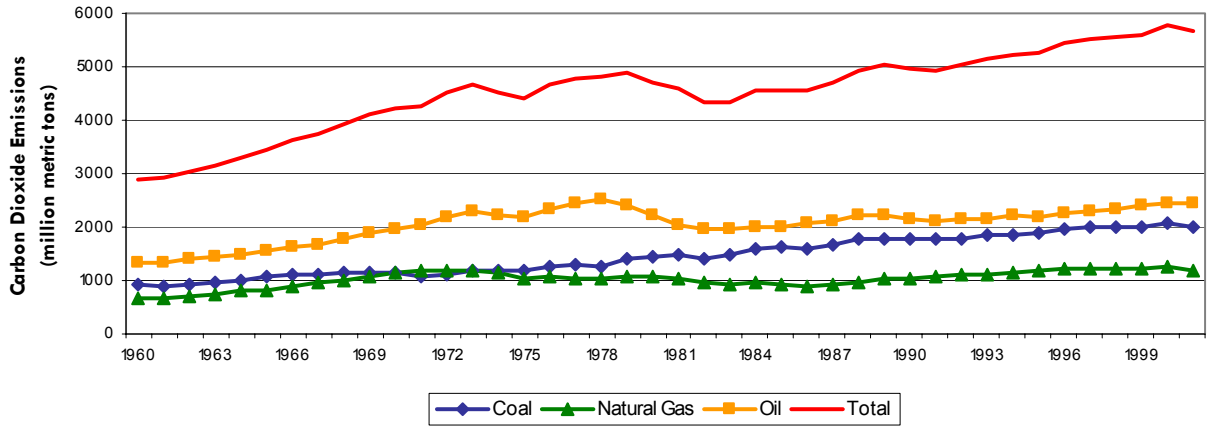
Report Findings: Global Warming Pollution Continues to Rise Unabated

Using data compiled by the Oak Ridge National Laboratory,[39] this report examines trends in carbon dioxide emissions and fossil fuel combustion nationally and by state for the four decades spanning 1960 to 2001. Emissions are attributed to the state where fossil fuels were burned; as such, the data do not take into account that some states generate little electricity within their borders and import much from neighboring states' power plants. Emissions from those power plants are attributed to the states in which they are located, rather than the states that consumed the power.

Trends from 1960 to 2001

Between 1960 and 2001, U.S. emissions of carbon dioxide almost doubled, jumping from 2.9 billion metric tons of carbon dioxide in 1960 to almost 5.7 billion metric tons of carbon dioxide in 2001, an increase of 95 percent (Figure D). In 2001, 43 percent of U.S. carbon dioxide emissions resulted from burning oil, 36 percent came from burning coal, and 21 percent came from burning natural gas. Oil is used primarily in the transportation sector; the vast majority of coal is used to generate electricity; and natural gas is used mainly for heating and powering our homes and businesses and in industry.

Figure D. U.S. Emissions of Carbon Dioxide, Total and by Fuel Source, 1960-2001



Carbon dioxide emissions grew most rapidly in the 1960s, at an average rate of 3.9 percent each year. Annual emissions growth slowed in the 1970s and 1980s to 1.1 percent and 0.6 percent on average, respectively. In the 1990s, emissions grew more quickly than in the 1970s and 1980s, increasing steadily at an average rate of 1.5 percent each year.

Between 1990 and 2001, carbon dioxide emissions increased by 14 percent from almost 5 billion metric tons to almost 5.7 billion metric tons. In 2001, carbon dioxide emissions fell by approximately

1.8 percent; this decline resulted from slow economic growth in 2001, a considerable reduction in industrial output, and warmer winter conditions.[40]

The Oak Ridge National Laboratory data forming the basis of this report are only available through 2001. The Energy Information Administration (EIA), however, estimates that total U.S. carbon dioxide emissions increased to almost 6.0 billion metric tons in 2004. Emissions rose by 1.7 percent in 2004, surpassing the average annual increase of 1.5 percent in the 1990s.[41]

Regionally, carbon dioxide emissions grew the most in the Southeast and Gulf South over the four decades, with emissions increasing by 812.4 million metric tons (163 percent) and 689.7 million metric tons (175 percent), respectively (Table 1). In the Southeast, 50 percent of the increase resulted from coal combustion; in the Gulf South, nearly 50 percent of the increase resulted from oil combustion. In the Northeast, carbon dioxide emissions rose by a more modest 12 percent; the upward trend was tempered by a regional decline in carbon dioxide emissions from carbon-intensive coal from 1960 to 2001.

Table 1. Regional Trends in Carbon Dioxide (CO2) Emissions, 1960-2001

in million metric tons (MMT)

Region[a]	Total 1960 CO2 Emissions (MMT)	Total 2001 CO2 Emissions (MMT)	Increase in CO2 Emissions, 1960-2001 (MMT)	% Increase, 1960-2001	% of Region's Increase from Coal Emissions	% of Region's Increase from Oil Emissions	% of Region's Increase from Natural Gas Emissions
Southeast	497.7	1310.1	812.4	163%	50%	40%	10%
Gulf South	395.1	1084.8	689.7	175%	34%	48%	18%
Mountain West	114.3	448.8	334.4	292%	60%	28%	12%
Great Lakes/Midwest	755.9	1087.5	331.6	44%	40%	31%	29%
Pacific West	256.3	552.9	296.6	116%	5%	58%	37%
Plains	170.7	385.6	214.9	126%	80%	20%	*
Northeast	703.0	784.1	81.1	12%	*	26%	74%

* Indicates that carbon dioxide emissions from this fossil fuel decreased between 1960 and 2001.

Among the states, Texas ranked first in the nation for the highest emissions of carbon dioxide in 2001, releasing 12 percent of the nation's total carbon dioxide emissions and nearly two times more than the next most polluting state. In 2001, 44 percent of the state's emissions resulted from burning oil, 35 percent came from burning natural gas, and 21 percent came from burning coal. See Appendix A for each state's 2001 carbon dioxide emissions and how burning coal, oil, and natural gas contributed to these emissions.

Twenty-eight (28) states more than doubled their carbon dioxide emissions from 1960 to 2001. In 1960, Texas emitted 240.7 million metric tons of carbon dioxide; by 2001, the state's emissions had grown to 668.5 million metric tons of carbon dioxide, an increase of 178 percent. In addition to

[a] The states are grouped regionally as follows: **Great Lakes/Midwest:** Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; **Gulf South:** Arkansas, Louisiana, Mississippi, Oklahoma, and Texas; **Mountain West:** Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming; **Northeast:** Connecticut, Delaware, Massachusetts, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; **Pacific West:** Alaska, California, Hawaii, Oregon, and Washington; **Plains:** Iowa, Kansas, Missouri, Nebraska, North Dakota, and South Dakota; and **Southeast:** Alabama, Florida, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.

Texas, the states that experienced the largest overall increases in carbon dioxide emissions between 1960 and 2001 are Florida, California, Georgia, Louisiana, Indiana, Kentucky, North Carolina, Missouri, and Arizona (Table 2). Appendix B shows trends in carbon dioxide emissions for each state from 1960 to 2001.

Table 2. Top 10 States for Overall Increase in Carbon Dioxide (CO2) Emissions, 1960-2001

in million metric tons (MMT)

Rank: Increase in CO2 Emissions	State	1960 CO2 Emissions (MMT)	2001 CO2 Emissions (MMT)	Increase in CO2 Emissions, 1960-2001 (MMT)	% Increase, 1960-2001
1	TX	240.7	668.5	427.8	178%
2	FL	52.8	235.6	182.9	347%
3	CA	198.8	368.7	169.9	85%
4	GA	38.2	158.2	120.1	315%
5	LA	80.2	183.0	102.8	128%
6	IN	125.1	223.8	98.6	79%
7	KY	47.1	145.4	98.2	209%
8	NC	52.4	142.0	89.7	171%
9	MO	56.2	128.3	72.1	128%
10	AZ	15.5	87.6	72.1	464%

Why did U.S. carbon dioxide emissions rise so quickly between 1960 and 2001? The major factors included a dramatic growth in (1) oil emissions from the transportation sector and (2) coal emissions from electricity generation. Refer to Appendix C for trends in carbon dioxide emissions by fuel source for each state.

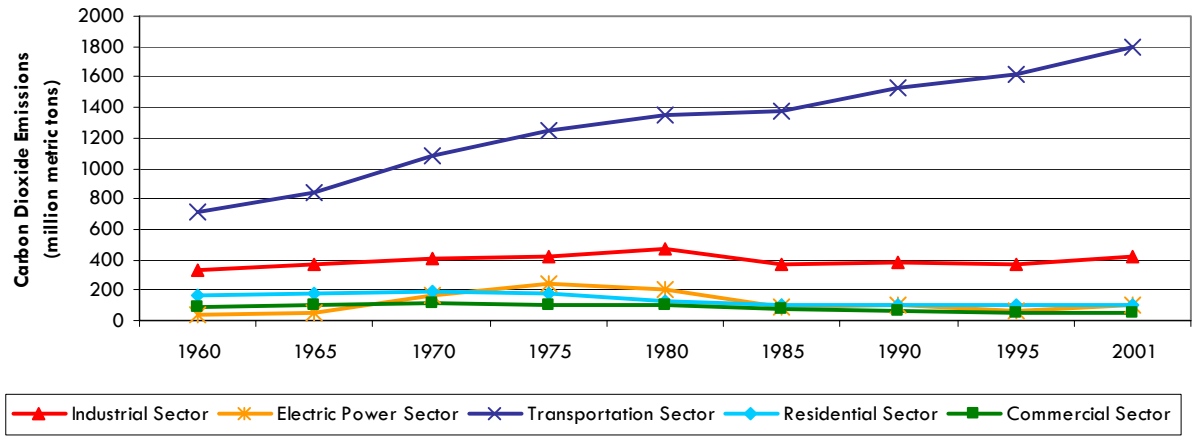
Growth in Oil Emissions from Transportation Sources

Between 1960 and 2001, U.S. carbon dioxide emissions from oil combustion jumped 1.1 billion metric tons, accounting for 40 percent of the total increase in U.S. carbon dioxide emissions. The transportation sector drove this rapid increase. According to EIA, carbon dioxide emissions from oil combustion in the transportation sector increased by 151 percent from 1960 to 2001 (Figure E). In every other sector, carbon dioxide emissions from oil combustion peaked in the 1970s, as the economy switched from oil to other fuels and as energy efficiency improved. Specifically, carbon dioxide emissions from oil peaked in 1972 in the residential sector; in 1973 in the commercial sector; in 1978 in the electric power sector; and in 1979 in the industrial sector.[42]

In 1960, the transportation sector accounted for a quarter of U.S. energy-related carbon dioxide emissions from all sources; by 2001, the sector contributed nearly one-third (32 percent) of the total.[43] In 2001, almost all (98 percent) of transportation sector emissions came from the combustion of petroleum products,[44] and about 60 percent of transportation sector emissions resulted from burning gasoline in motor vehicles.[45]

Two of the major factors contributing to the rapid rise in transportation sector carbon dioxide emissions were a dramatic increase in driving and the stagnating fuel economy of U.S. vehicles.

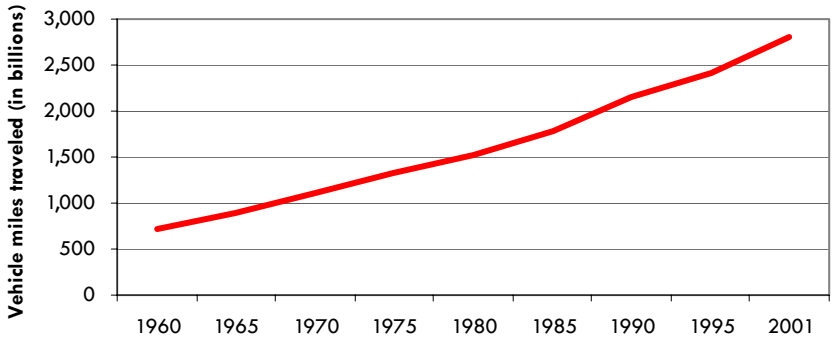
Figure E. Trends in Carbon Dioxide Emissions from Oil Combustion, 1960-2001[46]



Americans Are Driving More

Americans drove far more in 2001 than they did in 1960. Over the four decades, the number of miles driven on America's roads nearly tripled, reaching 2.8 trillion miles in 2001 (Figure F).[47]

Figure F. Trends in Vehicle Miles Traveled, 1960-2001[48]



Vehicle travel has accelerated at a far faster pace than population growth. In 1960, vehicle miles traveled (VMT) per capita was just over 4,000 per year. By 2001, per-capita VMT had more than doubled to 9,800 per year.[49]

The reasons for the increase in driving are complex and interrelated but include sprawling development patterns, demographic shifts, low fuel prices, and massive public investment in highways coupled with insufficient investment in public transit, rail travel, bicycling and pedestrian infrastructure, and other transportation alternatives.[50]

Carbon dioxide emissions from oil combustion rose most rapidly in the Gulf South and Southeast, increasing by 214 percent and 154 percent, respectively, over the four decades (Table 3). These regions also saw substantial increases in vehicle travel, including in such states as Florida, Georgia, North Carolina, Texas, and Virginia, due to population growth and sprawling development, among

other factors. For trends in VMT and carbon dioxide emissions from oil combustion by state, see Appendix D.

Table 3. Carbon Dioxide (CO2) Emissions from Oil and Vehicle Miles Traveled (VMT), by Region, 1960-2001

in million metric tons (MMT)

Region[b]	1960 CO2 Emissions from Oil (MMT)	2001 CO2 Emissions from Oil (MMT)	Increase in CO2 Emissions from Oil, 1960-2001 (MMT)	% Increase, 1960-2001	1960 VMT (in millions)	2001 VMT (in millions)	Increase in VMT, 1960-2001 (in millions)	% Increase in VMT, 1960-2001
Gulf South	153.2	481.8	328.5	214%	78,198	368,461	292,708	374%
Southeast	211.7	537.5	325.8	154%	135,577	732,779	597,202	440%
Pacific West	176.2	347.0	170.8	97%	92,016	412,053	320,037	348%
Great Lakes/Midwest	267.3	371.3	104.0	39%	159,790	491,026	331,236	207%
Mountain West	55.2	149.2	94.0	170%	33,364	190,317	156,953	470%
Plains	83.0	126.8	43.8	53%	51,936	159,682	107,746	207%
Northeast	387.6	425.3	37.6	10%	165,658	439,271	273,613	165%

The Efficiency of America's Vehicles Stalled in the late 1980s

The efficiency of America's vehicle fleet was poor in the 1960s and 1970s, until the 1973 oil crisis led Congress to establish the first minimum fuel economy standards for cars and light trucks in order to protect consumers from high gasoline prices and supply vulnerability resulting from U.S. dependence on foreign oil. In 1973, members of the Organization of Arab Petroleum Exporting Countries (consisting of the Arab members of OPEC, plus Egypt and Syria) announced that they would no longer ship petroleum to the United States and other countries that had supported Israel in its conflict with Syria and Egypt, causing oil prices to skyrocket. A second oil shock struck the United States in 1979 in the wake of the Iranian Revolution, causing prices to rise substantially once again.

In 1975, in the wake of the first oil shock, Congress established miles-per-gallon (MPG) standards for cars and light trucks. Those standards have proven to be among the most effective steps ever taken to reduce oil consumption. Cars today use 2.8 million fewer barrels of oil per day than they would have without the fuel economy increase.[51] Between 1975 and 1987, the average, real-world fuel economy of new cars and light trucks increased by nearly 70 percent – from 13.1 MPG to 22.1 MPG.[52] By 1978, thanks in part to the new standards, gasoline consumption began to fall. It was not until 1993 that the U.S. again used as much gasoline as it did in the late 1970s.[53]

Since the late 1980s, however, the fuel economy of America's vehicle fleet has not only stalled but has actually declined. America's vehicle fleet has changed dramatically, with increasing sales of less-efficient vehicles, such as SUVs. By 2004, SUVs and other light trucks accounted for more than half of all light-duty vehicle sales, while the share held by cars had shrunk to less than half.[54] At the same time, Congress and several administrations have not increased fuel economy standards for passenger cars since first implementing the standards in 1975 and have raised light truck fuel economy standards only modestly. As a result, the average fuel economy of new vehicles *declined* by 5 percent between 1987 and 2005 even though we have witnessed significant improvements in other aspects of vehicle

[b] See footnote 'a' for a list of states in each region.

technology, including acceleration and power.[55] In 2005, new cars and light trucks achieved only 21 MPG on average, a lower fuel economy average than the new vehicle fleet achieved in 1982.[56]

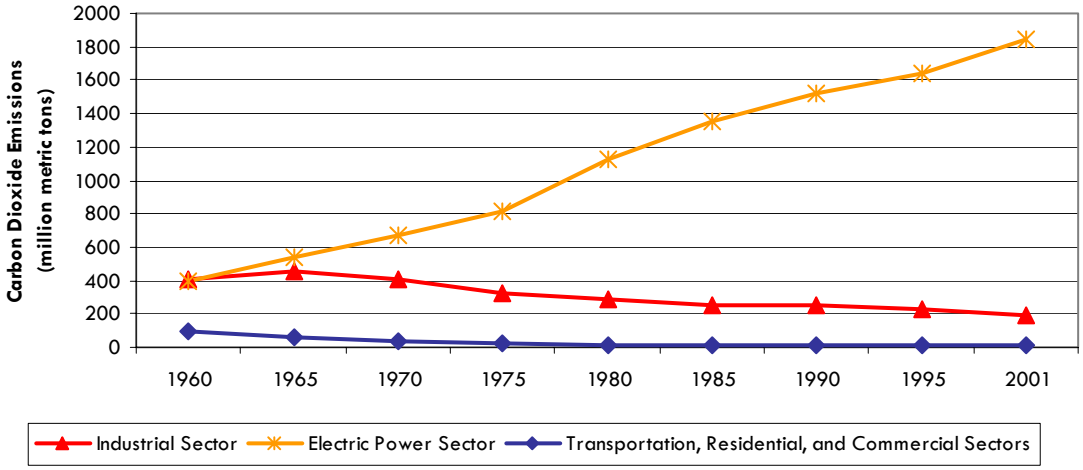
In sum, transportation sector emissions drove the rapid increase in carbon dioxide emissions from oil combustion from 1960 to 2001, largely due to the dramatic rise in vehicle travel and stagnating fuel economy of vehicles.

Growth in Coal Emissions from Electricity Generation

Between 1960 and 2001, U.S. carbon dioxide emissions from coal jumped 1.1 billion metric tons, accounting for 40 percent of the total increase in U.S. carbon dioxide emissions. Increased electricity generation from coal drove this growth.

In 1960, the industrial sector was the largest contributor to carbon dioxide emissions from coal combustion, responsible for 45 percent of coal emissions. Industrial sector coal emissions, however, declined steadily after 1966, as the U.S. economy moved away from traditional "smokestack" industries toward a more service-based economy and as industries switched fuels and pursued efficiency improvements.[57] By 2001, the industrial sector contributed just 10 percent of U.S. carbon dioxide emissions from coal combustion (Figure G). In contrast, carbon dioxide emissions from coal combustion in the electricity sector skyrocketed from 1960 to 2001, increasing by 370 percent, as demand for electricity boomed. In 2001, the electricity sector was responsible for 90 percent of total U.S. carbon dioxide emissions from coal combustion.[58]

Figure G. Trends in Carbon Dioxide Emissions from Coal Combustion, 1960-2001[59]



Between 1960 and 2001, U.S. electricity generation nearly quintupled, and electricity generation from coal also increased nearly five fold (Figure H).[60] Coal has the highest carbon content of any fossil fuel, meaning that burning coal for electricity produces more carbon per unit of energy than does burning oil or natural gas, which contain about 25 percent and 45 percent less carbon than coal, respectively.[61] While coal-fired power plants produced 53 percent of U.S. electricity in 2001, they emitted 82 percent of carbon dioxide emissions from electricity generation. Oil and natural gas

produced 3 percent and 16 percent, respectively, of U.S. electricity in 2001 and emitted 5 percent and 13 percent, respectively, of carbon dioxide emissions from electricity generation (Figures H and I).[62]

Figure H. Trends in Electricity Net Generation from Fossil Fuel Combustion, 1960-2001[63]

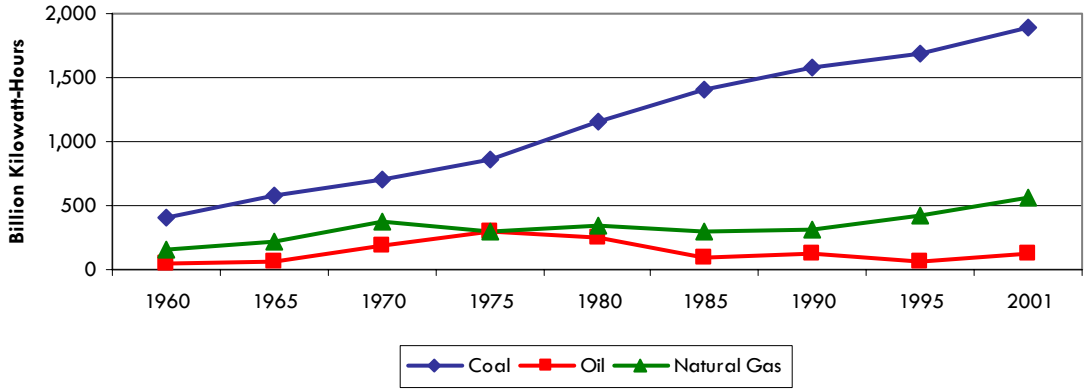
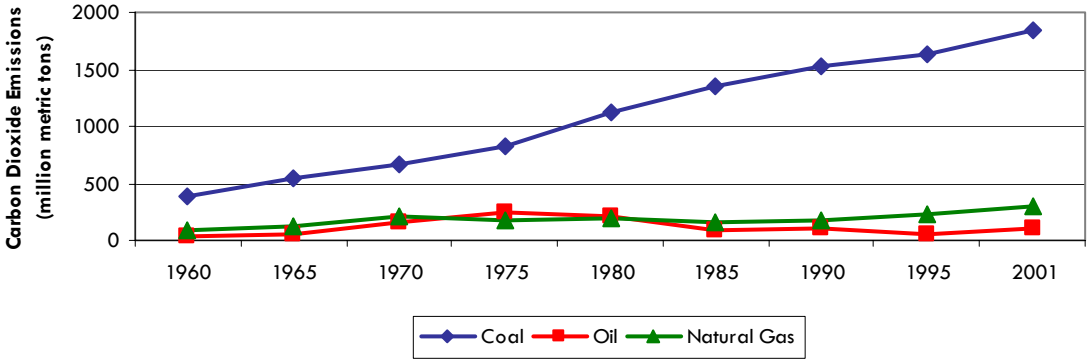


Figure I. Trends in Carbon Dioxide Emissions from Electricity Generation, 1960-2001[64]



Carbon dioxide emissions from coal increased most rapidly in the Southeast United States, which also saw the largest increase in new coal-fired power plant capacity over the four decades studied. Coal emissions in the Southeast rose by 408.9 million metric tons from 1960 to 2001, an increase of 185 percent; at the same time, coal-fired power plant capacity exploded, increasing by 84,000 megawatts (MW), or 350 percent (Table 4).[65] While the rush to expand new coal-burning power plants and/or add significant new capacity at existing plants occurred nationwide, the Southeast and Great Lakes/Midwest regions experienced the most dramatic increase in coal-fired power plant capacity. In contrast, coal-fired power plant capacity increased relatively modestly in the Northeast and Pacific West over the same period. For trends in coal-fired power plant capacity and carbon dioxide emissions from coal combustion by state, see Appendix E.

Table 4. Carbon Dioxide (CO2) Emissions from Coal and Coal-Fired Power Plant Capacity, by Region, 1960-2001

in million metric tons (MMT) | in megawatts (MW)

Region[c]	1960 CO2 Emissions from Coal (MMT)	2001 CO2 Emissions from Coal (MMT)	Change in CO2 Emissions from Coal, 1960-2001 (MMT)	% Change, 1960-2001	% of Region's CO2 Increase from Coal Emissions	Coal-Fired Power Plant Capacity, 1960 (MW)	Coal-Fired Power Plant Capacity, 2001 (MW)	Increase in Coal-Fired Power Plant Capacity, 1960-2001 (MW)
Southeast	221.2	630.1	408.9	185%	50%	23,939	108,020	84,081
Gulf South	2.7	240.5	237.9	8928%	34%	378	37,294	36,916
Mountain West	19.2	221.0	201.9	1054%	60%	1,101	31,914	30,812
Plains	33.5	205.7	172.1	513%	80%	2,648	31,704	29,056
Great Lakes/Midwest	375.9	508.2	132.3	35%	40%	20,699	88,749	68,050
Pacific West	6.3	22.5	16.2	256%	5%	63	2,837	2,774
Northeast	249.5	187.5	-62.0	-25%	*	8,206	28,221	20,015

* The Northeast region did not experience an increase in carbon dioxide emissions from coal in the period studied.

The long-term effect of adding a large coal-fired power plant often is stark. Spikes in carbon dioxide emissions from coal coincide with adding a new coal-fired power plant; carbon dioxide emissions go up rapidly and then plateau until another power plant goes online. For example, as shown in Figure J:

• Arizona experienced low carbon dioxide emissions from coal in the 1960s and early 1970s. In 1974, the first unit of the 2,400 MW coal-fired Navajo generating station went online in Coconino County; the third unit went online in 1976. Between 1974 and 1977, carbon dioxide emissions from coal almost quadrupled in Arizona. Over the next four years, Arizona added more than 2,200 MW of new coal-fired generating capacity in the state; as a result, between 1977 and 1982, carbon dioxide emissions from coal almost doubled again.

• Arkansas also experienced low carbon dioxide emissions from coal in the 1960s and 1970s. The state's first coal-fired power plant went online in 1978; by the end of 1984, the state had more than 3,900 MW of coal-fired generating capacity. The state went from releasing less than one million metric tons of carbon dioxide from coal combustion in 1977 to more than 25 million metric tons in 2001.

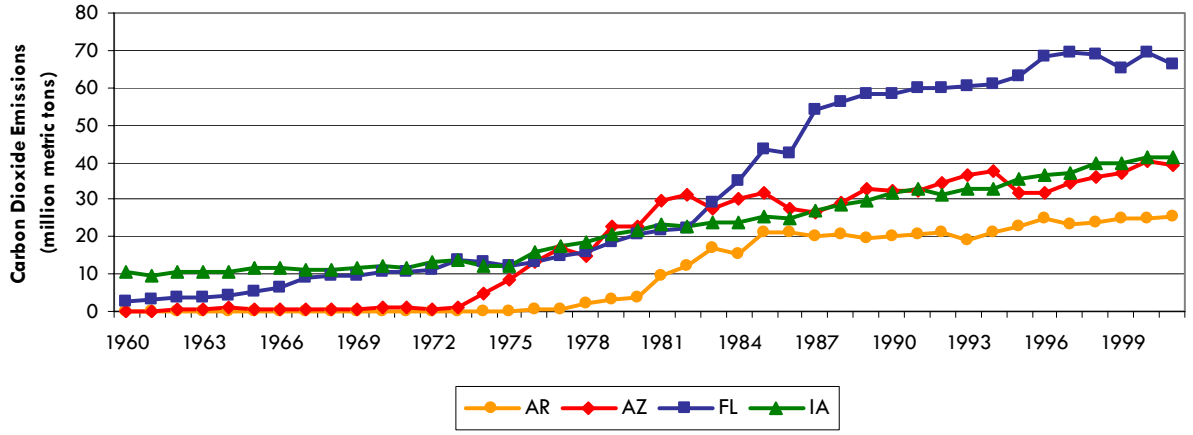
• Between 1981 and 1985, Florida added more than 4,000 MW of coal-fired generating capacity, including two new 700 MW units at the existing Crystal River power plant in Citrus County and the 1,400 MW Seminole plant in Putnam County. Carbon dioxide emissions from coal doubled between 1980 and 1986 and spiked again after 1987 and 1988, when Florida added 1,300 MW of coal-fired capacity at the St. Johns River Power Park and opened the first 460 MW unit at the Stanton Energy Center.

• Iowa's carbon dioxide emissions climbed steadily between 1975 and 1991, during which time Iowa added more than 4,000 MW of coal-fired generating capacity, including an additional 700 MW unit at the Council Bluffs power plant in Pottawattamie County, the new 700 MW Ottumwa facility in

[c] See footnote 'a' for a list of states in each region.

Wapello County, and 1,200 MW of new capacity at the George Neal facility in Woodbury County. Between 1960 and 2001, Iowa's carbon dioxide emissions from coal almost quadrupled.

Figure J. Growth in Carbon Dioxide Emissions from Coal in Arizona, Arkansas, Florida, and Iowa, 1960-2001



Increased Natural Gas Emissions from Multiple Sectors

Between 1960 and 2001, natural gas emissions increased by 550 million metric tons (compared with an increase of 1.1 billion metric tons for both oil and coal), accounting for 20 percent of the total increase in U.S. carbon dioxide emissions. The industrial sector released 37 percent of the carbon dioxide emissions from natural gas in 2001, more than any other sector. Natural gas emissions from the electricity sector are climbing, however, comprising 24 percent of emissions in 2001 compared with 14 percent in 1960 (Figure K).

While the United States consumed more natural gas in 2001 than in 1960, natural gas emissions from each sector fluctuated over the four decades as consumption patterns changed. Natural gas consumption rose and fell due to ups and downs in natural gas prices, improvements in energy efficiency, and federal policies that for a time prohibited the construction of new natural gas-fired power plants (Figure L).[66] The 1990s saw a dramatic increase in natural gas-fired electric power generation, fueled in part by the low cost of gas for much of the decade. Between 2001 and 2005 alone, the United States added more than 250,000 MW of new gas-fired generation capacity.[67]

The Northeast is the only region in which an increase in natural gas emissions drove the overall regional increase in carbon dioxide emissions between 1960 and 2001. Emissions from natural gas climbed 105.4 million metric tons (160 percent) over the period, accounting for 74 percent of the increase in the region's overall carbon dioxide emissions (Table 5). In the Plains region, carbon dioxide emissions from natural gas declined slightly over the four decades studied. Refer to Appendix F for a breakdown of carbon dioxide emissions from natural gas by state.

Figure K. Trends in Carbon Dioxide Emissions from Natural Gas Combustion, 1960-2001[68]

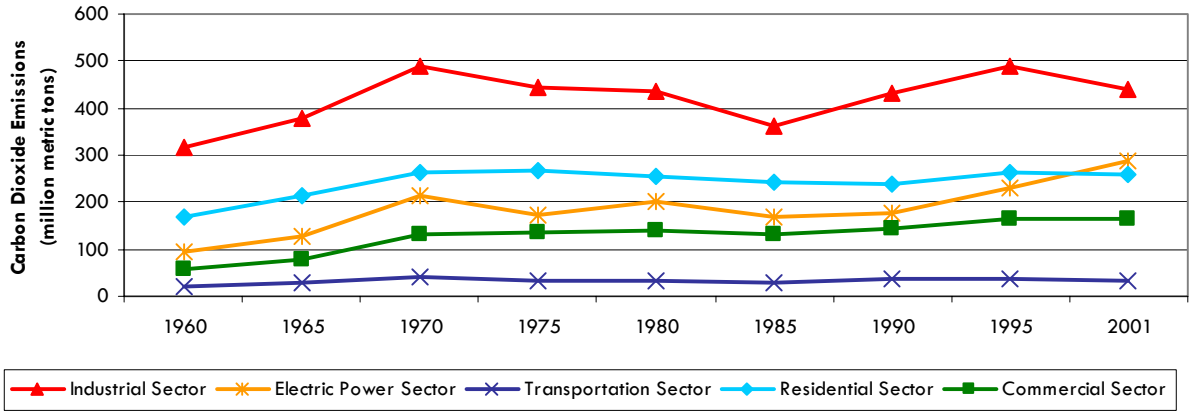


Figure L. Natural Gas Consumption by Sector, 1960-2001[69]

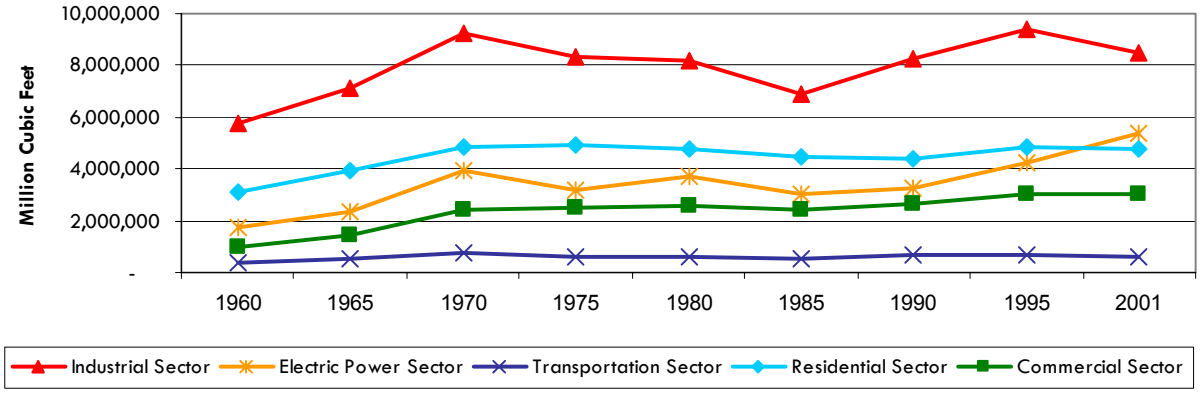


Table 5. Carbon Dioxide (CO2) Emissions from Natural Gas by Region, 1960-2001

in million metric tons (MMT)

Region[d]	1960 CO2 Emissions from Natural Gas (MMT)	2001 CO2 Emissions from Natural Gas (MMT)	Change in CO2 Emissions from Natural Gas, 1960-2001 (MMT)	% Change, 1960-2001	% of Region's CO2 Increase from Natural Gas Emissions
Gulf South	239.1	362.5	123.4	52%	18%
Pacific West	73.8	183.4	109.6	149%	37%
Northeast	65.9	171.3	105.4	160%	74%
Great Lakes/Midwest	112.7	208.0	95.3	85%	29%
Southeast	64.8	142.5	77.7	120%	10%
Mountain West	40.0	78.5	38.5	96%	12%
Plains	54.2	53.2	-1.0	-2%	*

* Carbon dioxide emissions from natural gas decreased in the Plains states in the period studied.

[d] See footnote 'a' for a list of states in each region.

Conclusion and Recommendations

The longer we wait to reduce global warming pollution, the harder the task will be in the future. Leading scientists say that we have a limited time to act to avoid a climate "tipping point." Key components of an action plan to protect future generations from global warming should include the following priorities:

Require Steep Cuts in Carbon Dioxide Emissions

• Establish mandatory limits on carbon dioxide and other global warming gases that reduce emissions from today's levels within 10 years, by 20% by 2020 and 80% by 2050. These reductions are needed to stabilize global warming gases in the atmosphere at a level that averts devastating and irreversible impacts, such as a 20-foot rise in sea level due to the collapse of the Greenland ice sheet.

Reduce Our Dependence on Fossil Fuels

• **Make our homes and businesses more energy efficient.** Energy efficiency measures can reduce electricity demand, thereby reducing fossil fuel consumption and global warming pollution. In the past two decades, energy efficiency standards for household appliances alone have reduced global warming emissions by 53 million tons per year. By 2020, new or updated standards for major appliances such as air conditioners will reduce the need for up to 150 new medium-sized (300 MW) power plants.[70] Conservative estimates suggest that the United States has the potential to reduce electricity use by 28 percent by 2020 through energy efficiency.[71]

• **Make our cars and SUVs go farther on a gallon of gasoline.** In 2002, the National Academy of Sciences concluded that automakers could use a combination of existing and emerging technologies to achieve 37 MPG within 10-15 years while improving safety and maintaining performance.[72] The Union of Concerned Scientists has shown that with more aggressive use of high-strength, lighter-weight materials, we could hit the 40 MPG mark in 10 years.[73]

When fully implemented, a 40 MPG standard would cut our national oil use by 2.3 million barrels per day – nearly as much as we currently import from the Persian Gulf – and reduce carbon dioxide emissions from cars and light trucks by nearly 400 million metric tons each year.[74]

• **Generate more electricity from renewable energy sources.** Increasing the capacity of proven renewable energy sources such as solar, wind, geothermal, and biomass can significantly reduce global warming pollution. Currently, only 2.3 percent of the country's electricity comes from non-hydropower renewable energy sources. The technical potential of wind, biomass, and geothermal resources in the United States, however, is four times greater than our current total electricity consumption.[75] A renewable energy standard requiring that we generate 20 percent of our electricity from non-hydropower renewables by 2020 would reduce carbon dioxide emissions by 434 million metric tons per year by 2020.[76]

In addition to addressing global warming, these solutions will reduce U.S. oil use, reduce air pollution, save consumers money, and protect pristine places from mining and oil drilling.

Methodology

The data included in the report on national trends in fossil fuel combustion by sector,[77] electricity generation,[78] and natural gas consumption[79] are from the Energy Information Administration.

We obtained the state-by-state carbon dioxide emissions data from a report issued by the Oak Ridge National Laboratory (ORNL), a laboratory of the Department of Energy.[80] The ORNL report estimates carbon emissions by multiplying consumption data for coal, oil, and natural gas by their respective thermal conversion factors, thus yielding the amount of heat energy generated from fossil fuel combustion. ORNL multiplied the heat energy data by each source's carbon content coefficient – the amount of carbon per unit of energy released during combustion of each fuel – thus yielding the total amount of carbon emitted in each state by fuel type. To convert the carbon data to carbon dioxide emissions, we multiplied the carbon emissions by 3.67.

The energy data were categorized by end use; for coal and natural gas, end uses largely include fuel for energy production, with only a small or negligible percentage going to non-fuel uses. End uses for petroleum are vastly more complicated and include petrochemicals used in the manufacture of plastic products (e.g., bags, toys, prosthetic limbs) and fabrics (e.g., nylon and polyester) as well as waxes, asphalt, graphite, lubricants, solvents waxes, etc.[81]

It is important to note that the consumption data are based on where fossil fuels were burned. As such, the data do not take into account that some states generate little electricity within their borders and import much from neighboring states' power plants. Emissions from those power plants are attributed to the states in which they are located, rather than the states that consumed the power.

We calculated coal-fired power plant capacity by state and nationally using data obtained from the Energy Information Administration.[82] We summed the nameplate capacity for all units online up to and including the reference year (1960 or 2001) that listed anthracite coal, bituminous coal, lignite coal, subbituminous coal, or waste/other coal as the primary energy source. We included all units listed in 2004 as operating (in service and producing some electricity); backup (used for test purposes or emergency such as shortage to power to meet load requirements); standby (available for service but not normally used); and out of service (units that could not be used in 2004 but are expected to be returned to service in the future). We did not include retired units in our calculations.

Appendix A. Carbon Dioxide Emissions from Fossil Fuel Combustion, 2001

in million metric tons (MMT)

Rank: 2001 Total CO2 Emissions	State	2001 CO2 Emissions (MMT)	Coal Rank: 2001 CO2 Emissions from Coal	% of 2001 Emissions from Coal	Natural Gas Rank: 2001 CO2 Emissions from Natural Gas	% of 2001 Emissions from Natural Gas	Oil Rank: 2001 CO2 Emissions from Oil	% of 2001 Emissions from Oil
1	TX	668.5	**2**	21%	**1**	35%	**1**	44%
2	CA	368.7	**39**	2%	**2**	36%	**2**	62%
3	PA	258.0	**3**	49%	**8**	14%	**5**	37%
4	OH	249.5	**4**	49%	**7**	18%	**7**	33%
5	FL	235.6	**12**	28%	**10**	13%	**3**	59%
6	IL	224.7	**6**	40%	**5**	23%	**8**	37%
7	IN	223.8	**1**	64%	**12**	12%	**15**	24%
8	NY	207.6	**28**	14%	**4**	31%	**4**	55%
9	MI	189.1	**9**	39%	**6**	26%	**11**	36%
10	LA	183.0	**31**	12%	**3**	38%	**6**	49%
11	GA	158.2	**10**	45%	**17**	12%	**10**	43%
12	KY	145.4	**5**	63%	**31**	8%	**20**	29%
13	NC	142.0	**11**	49%	**32**	8%	**13**	43%
14	AL	130.6	**8**	59%	**19**	14%	**25**	27%
15	MO	128.3	**13**	51%	**22**	12%	**17**	37%
16	TN	122.7	**14**	51%	**24**	11%	**18**	38%
17	NJ	120.7	**36**	9%	**9**	26%	**9**	66%
18	VA	118.9	**17**	37%	**26**	11%	**12**	52%
19	WI	105.9	**16**	43%	**16**	18%	**21**	39%
20	WV	102.7	**7**	78%	**36**	8%	**41**	14%
21	OK	102.2	**24**	34%	**11**	28%	**22**	38%
22	MN	94.5	**25**	35%	**18**	19%	**19**	46%
23	CO	87.8	**22**	42%	**14**	23%	**28**	35%
24	AZ	87.6	**20**	45%	**27**	15%	**24**	40%
25	MA	81.9	**37**	12%	**15**	23%	**16**	64%
26	WA	81.3	**38**	11%	**21**	21%	**14**	68%
27	IA	78.2	**18**	53%	**30**	15%	**30**	32%
28	SC	77.0	**21**	49%	**38**	10%	**27**	41%
29	MD	76.9	**27**	38%	**33**	13%	**23**	49%
30	KS	70.5	**26**	46%	**23**	20%	**33**	33%
31	MS	68.8	**33**	26%	**20**	26%	**26**	48%
32	AR	62.3	**30**	41%	**29**	20%	**32**	40%
33	WY	62.3	**15**	74%	**40**	9%	**44**	17%
34	UT	61.8	**23**	57%	**35**	14%	**35**	28%
35	NM	57.8	**29**	48%	**25**	24%	**38**	29%
36	ND	52.8	**19**	77%	**45**	6%	**47**	16%
37	NV	44.1	**34**	39%	**34**	22%	**37**	39%
38	AK	42.8	**46**	4%	**13**	51%	**34**	46%
39	NE	42.4	**32**	50%	**39**	15%	**40**	35%
40	CT	42.1	**41**	10%	**37**	19%	**29**	72%
41	OR	41.1	**42**	10%	**28**	30%	**31**	60%
42	MT	31.8	**35**	54%	**44**	11%	**43**	35%

Rank: 2001 Total CO2 Emissions	State	2001 CO2 Emissions (MMT)	Coal Rank: 2001 CO2 Emissions from Coal	% of 2001 Emissions from Coal	Natural Gas Rank: 2001 CO2 Emissions from Natural Gas	% of 2001 Emissions from Natural Gas	Oil Rank: 2001 CO2 Emissions from Oil	% of 2001 Emissions from Oil
43	ME	22.4	**48**	3%	**41**	24%	**39**	73%
44	HI	19.0	**45**	8%	**51**	1%	**36**	91%
45	NH	16.9	**43**	22%	**49**	8%	**42**	71%
46	DE	15.8	**44**	23%	**46**	17%	**46**	60%
47	ID	15.4	**47**	7%	**43**	28%	**45**	65%
48	SD	13.4	**40**	31%	**47**	15%	**48**	55%
49	RI	12.2	**50**	0.05%	**42**	43%	**49**	57%
50	VT	6.5	**51**	0.08%	**50**	6%	**50**	93%
51	DC	4.1	**49**	2%	**48**	40%	**51**	59%
U.S. TOTAL		**5,657.8**		**36%**		**21%**		**43%**

Appendix B. Trends in Carbon Dioxide Emissions from Fossil Fuel Combustion, 1960-2001

in million metric tons (MMT)

State	1960 CO2 Emissions (MMT)	1970 CO2 Emissions (MMT)	1980 CO2 Emissions (MMT)	1990 CO2 Emissions (MMT)	2001 CO2 Emissions (MMT)	Change, 1960-2001 (MMT)	% Change, 1960-2001	Change, 1990-2001 (MMT)	% Change, 1990-2001
AK	4.0	11.3	17.5	34.2	42.8	38.8	963%	8.7	25%
AL	62.1	101.5	105.8	108.8	130.6	68.5	110%	21.8	20%
AR	21.4	35.9	37.7	51.0	62.3	40.9	191%	11.4	22%
AZ	15.5	24.8	52.4	62.3	87.6	72.1	464%	25.3	41%
CA	198.8	299.0	336.3	348.7	368.7	169.9	85%	19.9	6%
CO	27.3	43.0	58.8	66.2	87.8	60.5	221%	21.7	33%
CT	37.7	49.2	40.7	40.5	42.1	4.4	12%	1.6	4%
DC	7.6	13.7	5.2	4.4	4.1	-3.6	-47%	-0.4	-8%
DE	10.9	15.4	17.3	17.3	15.8	4.9	45%	-1.5	-9%
FL	52.8	104.7	156.3	186.3	235.6	182.9	347%	49.3	26%
GA	38.2	72.9	111.7	137.3	158.2	120.1	315%	20.9	15%
HI	6.8	14.0	18.1	21.5	19.0	12.2	179%	-2.5	-12%
IA	39.7	53.1	59.3	63.6	78.2	38.4	97%	14.6	23%
ID	7.8	10.2	11.2	11.3	15.4	7.7	98%	4.1	36%
IL	186.4	244.8	230.7	192.0	224.7	38.3	21%	32.8	17%
IN	125.1	169.4	181.2	202.7	223.8	98.6	79%	21.1	10%
KS	37.5	50.7	66.9	68.4	70.5	33.0	88%	2.1	3%
KY	47.1	84.3	101.8	116.9	145.4	98.2	209%	28.4	24%
LA	80.2	141.4	188.8	183.9	183.0	102.8	128%	-0.9	-0.5%
MA	73.2	100.5	78.3	83.1	81.9	8.7	12%	-1.2	-1%
MD	49.6	74.2	67.2	69.7	76.9	27.4	55%	7.2	10%
ME	12.6	16.9	14.6	18.9	22.4	9.8	77%	3.5	18%
MI	129.4	185.9	179.4	180.1	189.1	59.7	46%	9.0	5%
MN	48.0	69.1	71.0	78.7	94.5	46.6	97%	15.8	20%
MO	56.2	85.7	103.3	101.8	128.3	72.1	128%	26.5	26%
MS	19.4	38.3	47.0	47.8	68.8	49.4	255%	21.0	44%
MT	10.6	13.9	19.9	27.5	31.8	21.3	202%	4.3	16%
NC	52.4	95.6	110.8	109.9	142.0	89.7	171%	32.2	29%
ND	11.1	14.8	25.8	46.0	52.8	41.8	378%	6.9	15%
NE	18.5	27.5	30.0	33.0	42.4	23.9	129%	9.4	28%
NH	6.4	12.8	12.8	14.5	16.9	10.5	163%	2.4	17%
NJ	88.7	131.0	113.3	111.2	120.7	32.0	36%	9.5	9%
NM	18.2	34.7	44.1	52.0	57.8	39.7	218%	5.8	11%
NV	4.7	10.7	22.1	30.3	44.1	39.4	835%	13.8	45%
NY	208.1	285.7	223.0	207.3	207.6	-0.5	-0.2%	0.3	0.2%
OH	207.3	271.4	271.5	243.2	249.5	42.2	20%	6.3	3%
OK	33.3	54.9	76.2	87.7	102.2	68.9	207%	14.5	17%
OR	16.9	25.5	28.1	30.4	41.1	24.3	144%	10.7	35%
PA	248.6	306.4	293.2	261.4	258.0	9.4	4%	-3.4	-1%
RI	13.3	13.2	8.4	8.8	12.2	-1.1	-8%	3.3	38%
SC	26.9	41.8	54.7	60.3	77.0	50.1	186%	16.7	28%
SD	7.7	9.3	11.6	11.8	13.4	5.7	73%	1.6	14%
TN	57.2	76.5	99.2	103.9	122.7	65.6	115%	18.8	18%

State	1960 CO2 Emissions (MMT)	1970 CO2 Emissions (MMT)	1980 CO2 Emissions (MMT)	1990 CO2 Emissions (MMT)	2001 CO2 Emissions (MMT)	Change, 1960-2001 (MMT)	% Change, 1960-2001	Change, 1990-2001 (MMT)	% Change, 1990-2001
TX	240.7	357.0	511.5	564.8	668.5	427.8	178%	103.7	18%
UT	21.0	24.3	35.5	53.2	61.8	40.8	194%	8.6	16%
VA	63.9	86.1	82.4	94.3	118.9	55.0	86%	24.5	26%
VT	3.5	5.5	4.6	5.4	6.5	3.0	84%	1.1	21%
WA	29.8	43.1	56.5	68.6	81.3	51.5	173%	12.7	19%
WI	59.6	87.3	80.9	85.3	105.9	46.2	78%	20.5	24%
WV	47.8	77.8	103.5	103.8	102.7	54.9	115%	-1.1	-1%
WY	9.2	18.5	41.0	57.1	62.3	53.1	575%	5.2	9%
U.S. TOTAL	**2,900.7**	**4,235.5**	**4,719.2**	**4,969.2**	**5,657.8**	**2,757.1**	**95%**	**688.6**	**14%**

Appendix C. Contribution of Each Fossil Fuel to the Overall Increase in Carbon Dioxide Emissions, 1960-2001

in million metric tons (MMT)

State	Increase in CO2 Emissions, 1960-2001 (MMT)	% of Increase from Coal Emissions	% of Increase from Natural Gas Emissions	% of Increase from Oil Emissions
AK	38.8	2%	56%	42%
AL	68.5	60%	12%	29%
AR	40.9	62%	1%	37%
AZ	72.1	54%	8%	38%
CA	169.9	2%	38%	61%
CO	60.5	50%	17%	33%
CT	4.4	*	59%	41%
DC	-3.6	n/a	n/a	n/a
DE	4.9	34%	46%	21%
FL	182.9	35%	12%	53%
GA	120.1	52%	8%	40%
HI	12.2	13%	1%	86%
IA	38.4	79%	4%	17%
ID	7.7	*	38%	62%
IL	38.3	16%	60%	25%
IN	98.6	71%	16%	13%
KS	33.0	81%	*	19%
KY	98.2	67%	3%	29%
LA	102.8	22%	17%	61%
MA	8.7	*	100%	*
MD	27.4	30%	23%	47%
ME	9.8	*	49%	51%
MI	59.7	21%	48%	31%
MN	46.6	43%	18%	39%
MO	72.1	70%	1%	29%
MS	49.4	36%	16%	47%
MT	21.3	79%	2%	19%
NC	89.7	53%	10%	37%
ND	41.8	91%	4%	5%
NE	23.9	77%	*	23%
NH	10.5	30%	11%	59%
NJ	32.0	*	62%	38%
NM	39.7	68%	7%	24%
NV	39.4	43%	22%	34%
NY	-0.5	n/a	n/a	n/a
OH	42.2	14%	14%	72%
OK	68.9	50%	17%	32%
OR	24.3	13%	44%	43%
PA	9.4	*	27%	73%
RI	-1.1	n/a	n/a	n/a
SC	50.1	58%	9%	33%
SD	5.7	61%	11%	28%
TN	65.6	43%	9%	48%

State	Increase in CO2 Emissions, 1960-2001 (MMT)	% of Increase from Coal Emissions	% of Increase from Natural Gas Emissions	% of Increase from Oil Emissions
TX	427.8	32%	20%	48%
UT	40.8	66%	12%	21%
VA	55.0	27%	17%	56%
VT	3.0	*	13%	87%
WA	51.5	15%	26%	59%
WI	46.2	38%	31%	32%
WV	54.9	86%	*	14%
WY	53.1	85%	5%	10%
U.S. TOTAL	**2,757.1**	**40%**	**20%**	**40%**

Washington DC, New York, and Rhode Island experienced overall decreases in carbon dioxide emissions between 1960 and 2001.

* Indicates that carbon dioxide emissions from this fossil fuel decreased between 1960 and 2001.

Appendix D. Carbon Dioxide Emissions from Oil and Vehicle Miles Traveled (VMT), 1960-2001

in million metric tons (MMT)

State	1960 CO2 Emissions from Oil (MMT)	2001 CO2 Emissions from Oil (MMT)	Change in CO2 Emissions from Oil, 1960-2001 (MMT)	% of State's CO2 Increase from Oil Emissions, 1960-2001	1960 VMT (in millions)	2001 VMT (in millions)	1960 Per-Capita VMT	2001 Per-Capita VMT	% Increase in Per-Capita VMT, 1960-2001
AK	3.2	19.6	16.4	42%	627	4,721	2,798	7,436	166%
AL	15.6	35.3	19.7	29%	11,637	56,769	3,585	12,716	255%
AR	9.7	24.8	15.1	37%	7,239	29,433	4,087	10,933	168%
AZ	8.1	35.5	27.3	38%	5,781	49,655	4,487	9,356	109%
CA	127.0	230.3	103.3	61%	69,152	310,575	4,459	9,002	102%
CO	10.6	30.7	20.1	33%	7,924	42,955	4,545	9,723	114%
CT	25.8	30.2	4.4	41%	10,246	30,844	4,071	9,005	121%
DC	4.4	2.4	-2.0	n/a	2,223	3,750	2,981	6,558	120%
DE	8.5	9.5	1.0	21%	2,170	8,615	4,900	10,821	121%
FL	42.8	139.4	96.7	53%	21,360	170,587	4,372	10,404	138%
GA	20.1	68.6	48.5	40%	17,167	107,897	4,390	12,870	193%
HI	6.8	17.3	10.4	86%	1,728	8,694	2,786	7,101	155%
IA	18.8	25.2	6.5	17%	10,870	30,016	3,963	10,268	159%
ID	5.0	10.1	5.1	62%	3,481	14,078	5,252	10,657	103%
IL	73.3	82.7	9.4	25%	37,421	103,038	3,740	8,255	121%
IN	40.6	53.7	13.1	13%	22,273	71,802	4,807	11,742	144%
KS	16.3	23.5	7.2	19%	11,016	28,155	5,058	10,449	107%
KY	12.7	41.7	29.0	29%	11,054	46,258	3,665	11,378	210%
LA	27.5	90.2	62.8	61%	10,485	43,244	3,242	9,684	199%
MA	57.8	52.7	-5.1	*	17,207	53,015	3,364	8,310	147%
MD	24.7	37.6	12.9	47%	11,947	51,996	3,885	9,673	149%
ME	10.7	16.3	5.6	51%	4,485	14,423	4,662	11,210	140%
MI	48.9	67.1	18.3	31%	32,608	98,987	4,192	9,908	136%
MN	25.6	43.7	18.0	39%	13,595	53,341	4,009	10,728	168%
MO	26.3	47.3	20.9	29%	17,263	67,632	4,021	12,013	199%
MS	9.4	32.8	23.3	47%	7,236	35,988	3,342	12,592	277%
MT	7.1	11.2	4.1	19%	2,964	10,011	4,427	11,069	150%
NC	28.5	61.4	32.9	37%	17,022	91,580	3,756	11,187	198%
ND	6.6	8.6	2.0	5%	2,757	7,235	4,396	11,404	159%
NE	9.2	14.8	5.6	23%	6,567	18,102	4,675	10,566	126%
NH	5.8	11.9	6.2	59%	2,987	12,315	4,972	9,780	97%
NJ	65.4	79.6	14.2	38%	29,603	68,725	4,901	8,100	65%
NM	6.9	16.5	9.6	24%	4,907	23,232	5,198	12,701	144%
NV	3.7	17.2	13.5	34%	1,840	18,309	6,522	8,693	33%
NY	121.1	115.2	-5.9	n/a	49,780	130,722	2,989	6,876	130%
OH	52.6	83.0	30.4	72%	38,419	106,589	3,982	9,372	135%
OK	16.3	38.5	22.2	32%	11,679	43,527	5,070	12,580	148%
OR	14.3	24.8	10.5	43%	7,907	34,398	4,499	9,905	120%
PA	78.2	96.7	18.5	73%	44,289	103,004	3,941	8,383	113%
RI	11.0	7.0	-4.0	n/a	3,308	7,991	3,929	7,546	92%
SC	14.8	31.5	16.6	33%	8,867	46,601	3,758	11,470	205%

State	1960 CO2 Emissions from Oil (MMT)	2001 CO2 Emissions from Oil (MMT)	Change in CO2 Emissions from Oil, 1960-2001 (MMT)	% of State's CO2 Increase from Oil Emissions, 1960-2001	1960 VMT (in millions)	2001 VMT (in millions)	1960 Per-Capita VMT	2001 Per-Capita VMT	% Increase in Per-Capita VMT, 1960-2001
SD	5.7	7.3	1.6	28%	3,463	8,542	5,117	11,290	121%
TN	14.8	46.0	31.2	48%	12,782	67,632	3,615	11,783	226%
TX	90.3	295.5	205.2	48%	41,559	216,269	4,380	10,142	132%
UT	8.8	17.5	8.7	21%	4,063	23,452	4,581	10,332	126%
VA	31.0	61.6	30.6	56%	17,702	73,745	4,535	10,260	126%
VT	3.2	6.1	2.9	87%	1,583	9,617	4,087	15,686	284%
WA	24.9	55.1	30.2	59%	12,602	53,665	4,453	8,962	101%
WI	26.4	41.1	14.7	32%	15,474	57,269	3,937	10,602	169%
WV	6.7	14.3	7.6	14%	6,039	19,714	3,268	10,941	235%
WY	4.9	10.4	5.5	10%	2,404	8,625	7,340	17,445	138%
U.S. TOTAL	**1,338.7**	**2,441.2**	**1,102.5**	**40%**	**718,762**	**2,797,339**	**4,041**	**9,822**	**143%**

Washington DC, New York, and Rhode Island experienced overall decreases in carbon dioxide emissions between 1960 and 2001.

* Indicates that carbon dioxide emissions from this fossil fuel decreased between 1960 and 2001.

Appendix E. Carbon Dioxide Emissions from Coal and Coal-Fired Power Plant Capacity, 1960-2001

in million metric tons (MMT) | in megawatts (MW)

State	1960 CO2 Emissions from Coal (MMT)	2001 CO2 Emissions from Coal (MMT)	Change in Coal Emissions, 1960-2001 (MMT)	% of State's CO2 Increase from Coal Emissions, 1960-2001	1960 Coal-Fired Power Plant Capacity (MW)	2001 Coal-Fired Power Plant Capacity (MW)	Increase in Coal-Fired Power Plant Capacity, 1960-2001 (MW)
AK	0.7	1.5	0.8	2%	37	118	81
AL	36.5	77.3	40.9	60%	3,552	12,458	8,906
AR	0.03	25.4	25.3	62%	0	3,958	3,958
AZ	0.02	39.2	39.2	54%	0	5,861	5,861
CA	3.3	6.2	2.9	2%	24	439	415
CO	6.5	36.9	30.4	50%	558	5,309	4,751
CT	10.3	4.1	-6.3	*	0	614	614
DC	2.6	0.1	-2.5	n/a	0	0	0
DE	1.9	3.6	1.7	34%	268	1,082	814
FL	2.5	66.2	63.8	35%	192	11,378	11,186
GA	8.2	70.5	62.4	52%	1,181	14,594	13,414
HI	0	1.6	1.6	13%	0	203	203
IA	10.8	41.1	30.3	79%	663	6,481	5,818
ID	1.6	1.0	-0.5	*	7	19	12
IL	85.0	91.0	6.0	16%	4,097	17,430	13,333
IN	73.0	143.1	70.1	71%	4,198	21,570	17,372
KS	1.5	32.6	31.1	81%	333	5,472	5,140
KY	26.3	92.3	66.0	67%	2,315	15,363	13,049
LA	0	22.3	22.3	22%	0	3,764	3,764
MA	11.1	10.0	-1.1	*	1,288	1,776	488
MD	21.0	29.2	8.2	30%	673	3,256	2,584
ME	1.9	0.7	-1.2	*	0	102	102
MI	60.4	73.1	12.7	21%	3,235	12,874	9,639
MN	12.5	32.7	20.2	43%	1,800	5,736	3,936
MO	15.7	65.9	50.1	70%	1,305	11,812	10,507
MS	0.1	18.1	18.0	36%	13	2,696	2,684
MT	0.4	17.1	16.7	79%	50	2,527	2,477
NC	21.4	69.3	47.9	53%	3,155	13,343	10,188
ND	3.0	40.9	37.9	91%	40	4,246	4,206
NE	1.9	21.1	19.2	77%	308	3,212	2,904
NH	0.5	3.7	3.2	30%	264	609	346
NJ	15.7	10.3	-5.4	*	400	2,237	1,837
NM	0.4	27.5	27.1	68%	0	4,382	4,382
NV	0.4	17.4	17.0	43%	0	2,769	2,769
NY	64.1	29.0	-35.1	n/a	2,603	4,230	1,627
OH	116.7	122.6	5.9	14%	6,023	24,028	18,005
OK	0.2	34.8	34.7	50%	0	5,720	5,720
OR	0.9	3.9	3.1	13%	2	615	613
PA	142.0	126.2	-15.8	*	3,384	17,571	14,188
RI	1.6	0.01	-1.6	n/a	0	0	0
SC	8.9	37.8	28.9	58%	651	5,658	5,007

State	1960 CO2 Emissions from Coal (MMT)	2001 CO2 Emissions from Coal (MMT)	Change in Coal Emissions, 1960-2001 (MMT)	% of State's CO2 Increase from Coal Emissions, 1960-2001	1960 Coal-Fired Power Plant Capacity (MW)	2001 Coal-Fired Power Plant Capacity (MW)	Increase in Coal-Fired Power Plant Capacity, 1960-2001 (MW)
SD	0.7	4.1	3.5	61%	0	481	481
TN	34.4	62.7	28.4	43%	6,572	10,310	3,739
TX	2.4	139.9	137.5	32%	365	21,155	20,790
UT	8.4	35.5	27.0	66%	339	4,973	4,635
VA	29.3	44.3	15.1	27%	2,705	6,288	3,583
VT	0.3	0.01	-0.3	*	0	0	0
WA	1.4	9.2	7.8	15%	0	1,462	1,462
WI	28.3	45.7	17.4	38%	1,347	7,112	5,765
WV	32.9	80.4	47.5	87%	2,945	15,372	12,426
WY	1.5	46.4	44.9	85%	148	6,074	5,926
U.S. TOTAL	**910.8**	**2015.6**	**1104.8**	**40%**	**57,033**	**328,738**	**271,704**

Washington DC, New York, and Rhode Island experienced overall decreases in carbon dioxide emissions between 1960 and 2001.

* Indicates that carbon dioxide emissions from this fossil fuel decreased between 1960 and 2001.

Appendix F. Carbon Dioxide Emissions from Natural Gas, 1960-2001

in million metric tons (MMT)

State	1960 CO2 Emissions from Natural Gas (MMT)	2001 CO2 Emissions from Natural Gas (MMT)	Change in CO2 Emissions from Natural Gas, 1960-2001 (MMT)	% of State's CO2 Increase from Natural Gas Emissions
AK	0.1	21.7	21.6	56%
AL	10.0	18.0	8.0	12%
AR	11.7	12.2	0.5	1%
AZ	7.4	12.9	5.5	8%
CA	68.4	132.2	63.7	38%
CO	10.2	20.2	10.0	17%
CT	1.5	7.9	6.3	59%
DC	0.7	1.6	0.9	n/a
DE	0.5	2.7	2.2	46%
FL	7.5	30.0	22.4	12%
GA	9.9	19.1	9.2	8%
HI	0	0.2	0.2	1%
IA	10.2	11.8	1.7	4%
ID	1.2	4.3	3.1	38%
IL	28.2	51.0	22.8	60%
IN	11.6	27.0	15.5	16%
KS	19.6	14.4	-5.2	*
KY	8.1	11.4	3.3	3%
LA	52.8	70.4	17.7	17%
MA	4.2	19.1	14.9	100%
MD	3.9	10.1	6.2	23%
ME	0	5.3	5.3	49%
MI	20.1	48.8	28.7	48%
MN	9.8	18.1	8.4	18%
MO	14.2	15.2	1.0	1%
MS	9.9	17.9	8.0	16%
MT	3.0	3.5	0.5	2%
NC	2.5	11.3	8.9	10%
ND	1.4	3.3	1.9	4%
NE	7.4	6.5	-0.9	*
NH	0.2	1.3	1.2	11%
NJ	7.6	30.8	23.2	62%
NM	10.9	13.8	2.9	7%
NV	0.7	9.5	8.9	22%
NY	22.8	63.4	40.6	n/a
OH	38.1	43.9	5.8	14%
OK	16.8	28.8	12.0	17%
OR	1.7	12.4	10.7	44%
PA	28.4	35.2	6.8	27%
RI	0.6	5.2	4.5	n/a
SC	3.2	7.7	4.6	9%
SD	1.3	1.9	0.6	11%
TN	8.0	14.0	6.0	9%

State	1960 CO2 Emissions from Natural Gas (MMT)	2001 CO2 Emissions from Natural Gas (MMT)	Change in CO2 Emissions from Natural Gas, 1960-2001 (MMT)	% of State's CO2 Increase from Natural Gas Emissions
TX	148.0	233.1	85.1	20%
UT	3.8	8.8	5.0	12%
VA	3.6	13.0	9.4	17%
VT	0	0.4	0.4	13%
WA	3.5	17.0	13.5	26%
WI	4.9	19.1	14.2	31%
WV	8.2	8.0	-0.2	*
WY	2.8	5.5	2.7	5%
U.S. TOTAL	**651.1**	**1,201.0**	**549.9**	**20%**

Washington DC, New York, and Rhode Island experienced overall decreases in carbon dioxide emissions between 1960 and 2001.

* Indicates that carbon dioxide emissions from this fossil fuel decreased between 1960 and 2001.

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