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Overview of Greenhouse Gases

Overview

Carbon Dioxide

Methane

Nitrous Oxide

Fluorinated Gases

Carbon Dioxide Emissions

Properties of Carbon Dioxide

Chemical Formula: CO₂

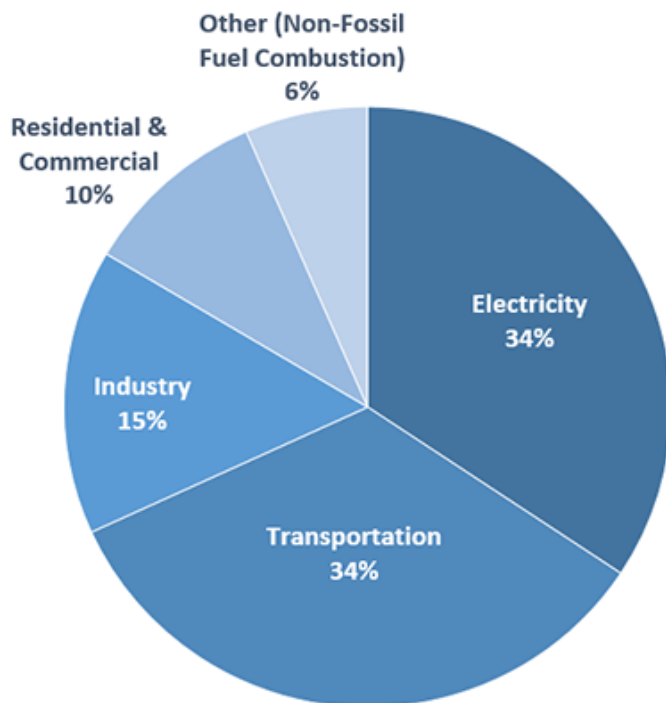
Lifetime in Atmosphere:

See below*

Global Warming Potential (100-year): 1

Carbon dioxide (CO₂) is the primary greenhouse gas emitted through human activities. In 2016, CO₂ accounted for about 81.6% of all U.S. greenhouse gas emissions from human activities. Carbon dioxide is naturally present in the atmosphere as part of the Earth's carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals). Human activities are altering the carbon cycle—both by adding more CO₂ to the atmosphere and by influencing the ability of natural sinks, like forests, to remove CO₂ from the atmosphere. While CO₂ emissions come from a variety of natural sources, human-related emissions are responsible for the increase that has occurred in the atmosphere since the industrial revolution.¹

2016 U.S. Carbon Dioxide Emissions, By Source



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2016*.

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The main human activity that emits CO₂ is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation, although certain industrial processes and land-use changes also emit CO₂. The main sources of CO₂ emissions in the United States are described below.

- **Electricity.** Electricity is a significant source of energy in the United States and is used to power homes, business, and industry. In 2016 the combustion of fossil fuels to generate electricity was the largest single source of CO₂ emissions in the nation, accounting for about 34 percent of total U.S. CO₂ emissions and 28 percent of total U.S. greenhouse gas emissions. The type of fossil fuel used to generate electricity will emit different amounts of CO₂. To produce a given amount of electricity, burning coal will produce more CO₂ than oil or natural gas.
- **Transportation.** The combustion of fossil fuels such as gasoline and diesel to transport people and goods was the second largest source of CO₂ emissions in 2016, accounting for about 34 percent of total U.S. CO₂ emissions and 27 percent of total U.S. greenhouse gas emissions. This category includes transportation sources such as highway vehicles, air travel, marine transportation, and rail.
- **Industry.** Many industrial processes emit CO₂ through fossil fuel combustion. Several processes also produce CO₂ emissions through chemical reactions that do not involve combustion; for example, the production and consumption of mineral products such as cement, the production of metals such as iron and steel, and the production of chemicals. Fossil fuel combustion from various industrial processes accounted for about 15 percent of total U.S. CO₂ emissions and 12 percent of total U.S. greenhouse gas emissions in 2016. Note that many industrial processes also use electricity and therefore indirectly cause the emissions from the electricity production.

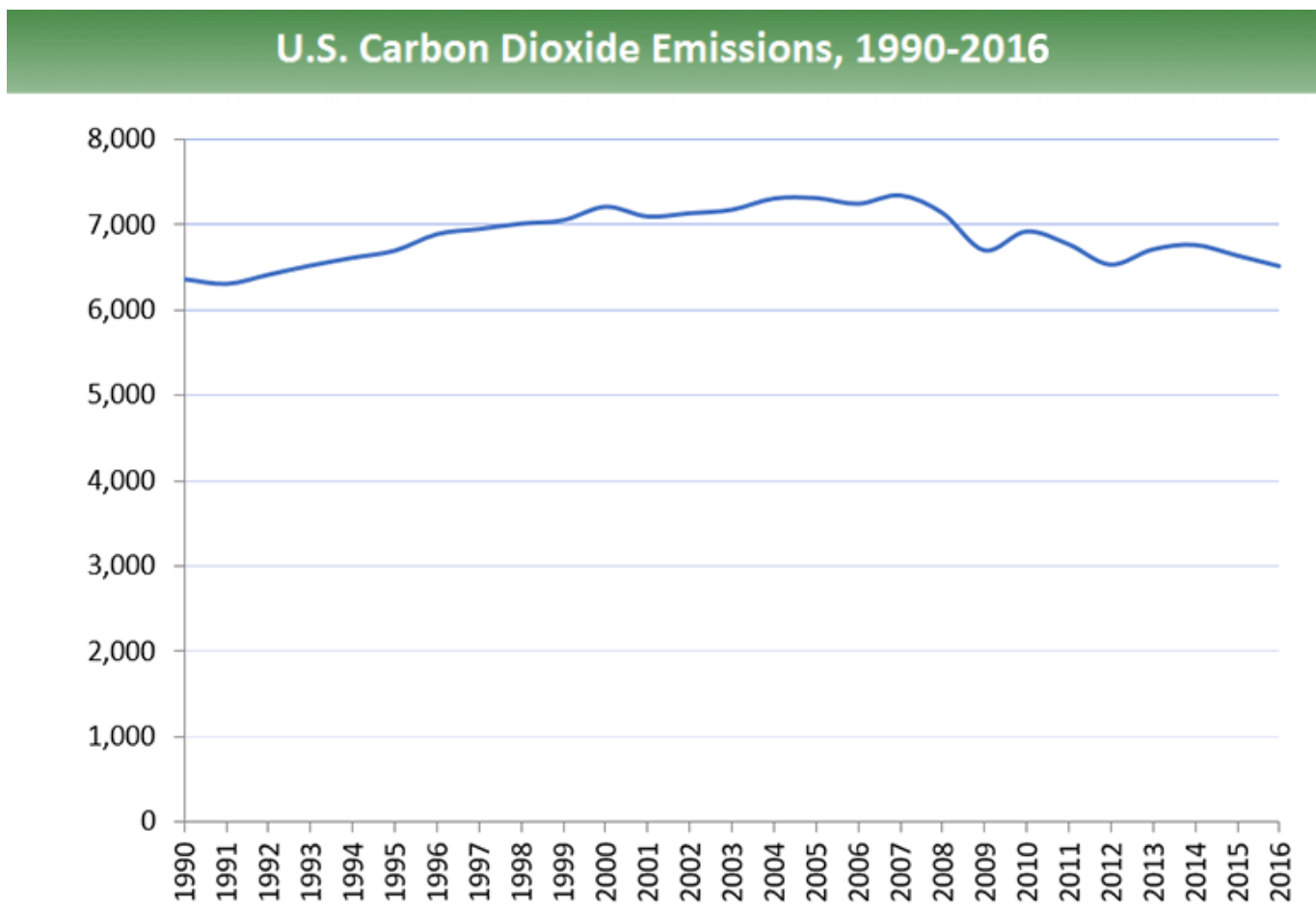
Carbon dioxide is constantly being exchanged among the atmosphere, ocean, and land surface as it is both produced and absorbed by many microorganisms, plants, and animals. However, emissions and removal of CO₂ by these natural processes tend to balance. Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding CO₂ and other heat-trapping gases to the atmosphere.

In the United States, since 1990, the management of forests and other land has acted as a net sink of CO₂, which means that more CO₂ is removed from the atmosphere, and stored in plants and trees, than is emitted. This carbon sink offset is about 12 percent of total emissions in 2016 and is discussed in more detail in the [Land Use, Land-Use Change, and Forestry](#) section.

To find out more about the role of CO₂ warming the atmosphere and its sources, visit the [Climate Change Indicators](#) page.

Emissions and Trends

Carbon dioxide emissions in the United States increased by about 4 percent between 1990 and 2016. Since the combustion of fossil fuel is the largest source of greenhouse gas emissions in the United States, changes in emissions from fossil fuel combustion have historically been the dominant factor affecting total U.S. emission trends. Changes in CO₂ emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population growth, economic growth, changing energy prices, new technologies, changing behavior, and seasonal temperatures. Between 1990 and 2016, the increase in CO₂ emissions corresponded with increased energy use by an expanding economy and population, an overall growth in emissions from electricity generation, and increased demand for travel.



Note: All emission estimates from the [Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2016](#).

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Reducing Carbon Dioxide Emissions

The most effective way to reduce CO₂ emissions is to reduce fossil fuel consumption. Many strategies for reducing CO₂ emissions from energy are cross-cutting and apply to homes, businesses, industry, and transportation.

EPA is taking common sense regulatory actions to reduce greenhouse gas emissions.

- Learn about EPA's [motor vehicle standards](#).

| Examples of Reduction Opportunities for Carbon Dioxide | |
|---|--|
| Strategy | Examples of How Emissions Can be Reduced |
| Energy Efficiency | <p>Improving the insulation of buildings, traveling in more fuel-efficient vehicles, and using more efficient electrical appliances are all ways to reduce energy consumption, and thus CO₂ emissions.</p> <ul style="list-style-type: none"> • See EPA's ENERGY STAR® program for more information on energy-efficient appliances. • See EPA's and DOE's fuel economy.gov site for more information on fuel-efficient vehicles. • Learn about EPA's motor vehicle standards that improve vehicle efficiency and save drivers money. |
| Energy Conservation | <p>Reducing personal energy use by turning off lights and electronics when not in use reduces electricity demand. Reducing distance traveled in vehicles reduces petroleum consumption. Both are ways to reduce energy CO₂ emissions through conservation.</p> <p>Learn more about What You Can Do at Home, at School, in the Office, and on the Road to save energy and reduce your carbon footprint.</p> |
| Fuel Switching | <p>Producing more energy from renewable sources and using fuels with lower carbon contents are ways to reduce carbon emissions.</p> |
| Carbon Capture and Sequestration | <p>Carbon dioxide capture and sequestration is a set of technologies that can potentially greatly reduce CO₂ emissions from new and existing coal- and gas-fired power plants, industrial processes, and other stationary sources of CO₂.</p> |

* Atmospheric CO₂ is part of the global carbon cycle, and therefore its fate is a complex function of geochemical and biological processes. Some of the excess carbon dioxide will be absorbed quickly (for example, by the ocean surface), but some will remain in the atmosphere for thousands of years, due in part to the very slow process by which carbon is transferred to ocean sediments.

References

¹ [NRC \(2010\). *Advancing the Science of Climate Change*. EXIT National Research Council. The National Academies Press, Washington, DC, USA.](#)

LAST UPDATED ON OCTOBER 9, 2018