



Overview of Greenhouse Gases

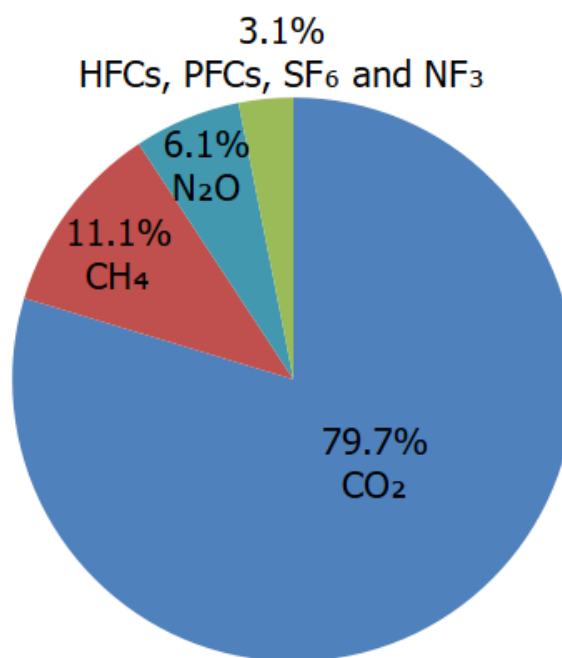
On this page:

- Greenhouse Gas Emissions Overview
- Greenhouse Gas Effects on Climate

Gases that trap heat in the atmosphere are called greenhouse gases. This section provides information on emissions and removals of the main greenhouse gases to and from the atmosphere. Click on a greenhouse gas below to learn about its emissions in more detail.

- **Carbon dioxide (CO₂)**
<<https://epa.gov/ghgemissions/carbon-dioxide-emissions>>: Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and also as a result of certain chemical reactions (e.g., cement production). Carbon dioxide is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

Greenhouse Gas Emissions Overview, by Type of Gas: 2022



Total U.S. Emissions in 2022 = 6,343 Million Metric Tons of CO₂ equivalent (excludes land sector). Percentages may not add up to 100% due to independent rounding. Land Use, Land-Use Change, and Forestry in the United States is a net sink and offsets 13% of these greenhouse gas emissions. This net sink is not shown in the above diagram. All emission estimates are sourced from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022*

<<https://epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>>.

- **Methane (CH₄)**

<https://epa.gov/ghgemissions/methane-emissions>

>: Methane is emitted

during the production and

transport of coal, natural gas, and

oil. Methane emissions also result from livestock and other agricultural practices,

land use, and by the decay of organic waste in municipal solid waste landfills.

- **Nitrous oxide (N₂O)** <https://epa.gov/ghgemissions/nitrous-oxide-emissions>: Nitrous oxide is emitted during agricultural, land use, and industrial activities; combustion of fossil fuels and solid waste; as well as during treatment of wastewater.

- **Fluorinated gases** <https://epa.gov/ghgemissions/fluorinated-gas-emissions>:

Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic, powerful greenhouse gases that are emitted from a variety of

household, commercial, and industrial applications and processes. Fluorinated

gases (especially hydrofluorocarbons) are sometimes used as substitutes for

stratospheric ozone-depleting substances <https://epa.gov/ozone-layer-protection> (e.g.,

chlorofluorocarbons, hydrochlorofluorocarbons, and halons). Fluorinated gases are

typically emitted in smaller quantities than other greenhouse gases, but they are

potent greenhouse gases. With global warming potentials (GWPs)

<https://epa.gov/ghgemissions/understanding-global-warming-potentials> that typically range from

thousands to tens of thousands, they are sometimes referred to as high-GWP gases

because, for a given amount of mass, they trap substantially more heat than CO₂.

Additional compounds in the atmosphere including solid and liquid aerosol and other greenhouse gases, such as water vapor and ground-level ozone can also impact the climate. Learn more about these compounds and climate change on our Basics of Climate Change page <https://epa.gov/climatechange-science/basics-climate-change#othergases>.

See Emissions Information and Reduction Strategies by Gas

Carbon Dioxide <https://epa.gov/ghgemissions/carbon-dioxide-emissions>

Methane <https://epa.gov/ghgemissions/methane-emissions>

Nitrous Oxide <https://epa.gov/ghgemissions/nitrous-oxide-emissions>

Fluorinated Gases <https://epa.gov/ghgemissions/fluorinated-gas-emissions>

Image to save or print

<https://epa.gov/system/files/images/2024-04/gases-by-source-2024.png>

Greenhouse Gas Effects on Climate

Each gas's effect on climate change depends on three main factors:

How abundant are greenhouse gases in the atmosphere?

Concentration, or abundance, is the amount of a particular gas in the air. Larger emissions of greenhouse gases lead to higher concentrations in the atmosphere. Greenhouse gas concentrations are measured in parts per million, parts per billion, and even parts per trillion. One part per million is equivalent to one drop of water diluted into about 13 gallons of liquid (roughly the fuel tank of a compact car). To learn more about the

increasing concentrations of greenhouse gases in the atmosphere, visit the Climate Change Indicators: Atmospheric Concentrations of Greenhouse Gases

<https://epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases> page.

Greenhouse Gases and Climate

Visit EPA's Basics of Climate Change <https://epa.gov/climatechange-science/basics-climate-change> page to learn more about the effect of greenhouse gases on the Earth's climate.

How long do greenhouse gases stay in the atmosphere?

Each of these gases can remain in the atmosphere for different amounts of time, ranging from a few years to thousands of years. All these gases remain in the atmosphere long enough to become well mixed, meaning that the amount that is measured in the atmosphere is roughly the same all over the world, regardless of the source of the emissions.

How strongly do greenhouse gases impact the atmosphere?

Some gases are more effective than others at making the planet warmer and "thickening the Earth's atmospheric blanket."

For each greenhouse gas, a Global Warming Potential (GWP)

<https://epa.gov/ghgemissions/understanding-global-warming-potentials> was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, typically a 100-year time horizon, relative to the emissions of 1 ton of carbon dioxide (CO₂). Gases with a higher GWP absorb more energy, per ton emitted, than gases with a lower GWP, and thus contribute more to warming Earth.

Note: All emission estimates are sourced from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022* <https://epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>. The *Inventory* uses 100-year GWPs from IPCC's Fifth Assessment Report (AR5).

Explanation of Units

A million metric tons of CO₂: What does that mean?

A million metric tons equals about 2.2 billion pounds, or 1 trillion grams. For comparison, a small car is likely to weigh a little more than 1 metric ton. Thus, a million metric tons is roughly the same mass as 1 million small cars!

The U.S. GHG Inventory uses metric units for consistency and comparability with other countries. For reference, a metric ton is slightly more (approximately 10%) than a U.S. "short" ton.

GHG emissions are often measured in carbon dioxide (CO₂) equivalent. To convert emissions of a gas into CO₂ equivalent, its emissions are multiplied by the gas's Global Warming Potential (GWP) <https://epa.gov/ghgemissions/understanding-global-warming-potentials>. The GWP takes into account the fact that many gases are more effective at warming Earth than CO₂, per unit mass.

The GWP values appearing in the Overview of Greenhouse Gases

<https://epa.gov/ghgemissions/overview-greenhouse-gases> and Sources of Greenhouse Gas

<https://epa.gov/ghgemissions/sources-greenhouse-gas-emissions> web pages reflect the values used in the U.S. GHG Inventory, which are drawn from the IPCC's Fifth Assessment Report (AR5). For further discussion of GWPs and an estimate of GHG emissions using updated GWPs, see Annex 6 of the U.S. GHG Inventory

<<https://epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021>> and the IPCC's discussion on GWPs (pdf) [🔗](#)
<https://www.ipcc.ch/site/assets/uploads/2018/02/syr_ar5_final_full.pdf>.

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