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A Brief Guide to the Greenhouse Gases

Greenhouse gases are those that trap heat in the atmosphere.

Carbon dioxide: Human activities released 37.4 billion tons of carbon dioxide into the atmosphere in 2023. It's the most abundant greenhouse gas emitted, and the most significant one driving climate change.

It's difficult to say exactly how long CO₂ stays in the atmosphere, since the gas participates in a global carbon cycle—some will immediately be soaked up by oceans, forests, or other ecosystems, while the rest lingers in the atmosphere for centuries.

Carbon dioxide comes from nearly every corner of our economy—the largest source is power plants, followed by transportation and then industrial activities.

Methane: Methane is also a powerful contributor to climate change, making up about 30% of the warming we've experienced to date, even though carbon dioxide is roughly 200 times more abundant in the atmosphere. What's most different about methane is that the gas is very short-lived, having a lifetime of around a decade in the atmosphere before it breaks down. But in that time, methane can cause about 86 times more warming than an equivalent amount of carbon dioxide. Comparisons of greenhouse gases are usually made over a specific period of time, since gases all have different lifetimes. Methane's largest sources are the fossil-fuel industry, agriculture, and waste.

Nitrous oxide: its effects on climate change are serious, as the gas makes up about 6% of warming to date. Nitrous oxide emissions come almost entirely from agriculture. Applying certain nitrogen-based fertilizers can release the gas as bacteria break those chemicals down. Emissions can also come from burning certain agricultural wastes.

Nitrous oxide emissions grew roughly 40% from 1980 to 2020. The gas lasts in the atmosphere for roughly a century, and over that time it can trap over 200 times more heat than carbon dioxide does in the same period. Cutting down on these emissions will largely require careful adjustment of soil management practices in agriculture. Decreasing use of synthetic fertilizers, applying the fertilizer we do use more efficiently.

Fluorinated gases; fluorinated gases are some of the most powerful greenhouse gases that we emit. A variety of them fall under this umbrella, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and SF₆. They last for centuries (or even millennia) in the atmosphere and have some eye-popping effects, with each having at least 10,000 times more global warming potential than carbon dioxide. The Montreal Protocol was designed to heal the ozone layer.

HFCs are refrigerants, used in air conditioners, refrigerators, and similar appliances. The chemicals are also used in aerosol cans, as well as in fire retardants and solvents. SF₆ is used in high-voltage power equipment, and it's the single worst greenhouse gas that's been covered by the International Panel on Climate change, clocking in at 23,500 times more powerful than carbon dioxide over the course of a century.

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