



Greenhouse gases

Carbon dioxide (CO₂)

Carbon dioxide is one of the most important greenhouse gases. For millions of years, trillions of tonnes of carbon were taken out of the atmosphere by plants and buried in sediments that eventually became deposits of coal, oil and natural gas.



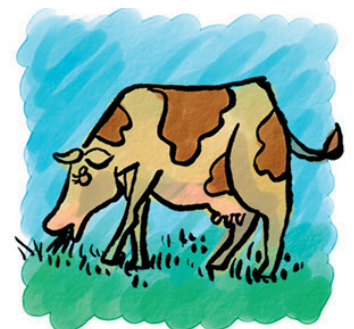
For the past two centuries, humans have extracted and ignited these fossil fuel resources at an increasing rate. As a result, about 5-6 billion tons of carbon are released into the atmosphere every year. Another 1.5 billion tonnes per year are released through land-use changes, such as deforestation. When trees are cut, they stop absorbing carbon. If the trees are then burned, the carbon is immediately released back into the atmosphere. These releases result in an increase of atmospheric CO₂ of about 0.5 percent per year. Since pre-industrial times, the concentration of atmospheric CO₂ has increased by 30 percent.

Carbon sinks are forests and oceans that extract and retain CO₂ from the air. In this way, they partially offset greenhouse gas emissions. That is why planting trees is a means of reducing greenhouse gases, as trees absorb carbon from the air.

The use of fossil fuels for energy production and transport needs is the most significant source of CO₂ emissions worldwide.

Methane (CH₄)

Methane is another greenhouse gas that is emitted during the production and transport of coal, natural gas and oil, as well as in livestock farming and the decomposition of organic matter from municipal waste in landfills. Methane is 23 times more efficient at retaining heat than carbon dioxide and thus contributes 23 times more to the greenhouse effect



Methane is released from energy, industry, agriculture, land use, waste management activities and others:

- **Agriculture** – Domestic animals such as cattle, pigs, sheep and goats produce CH₄ as part of their normal digestive process. Also, when animal manure is

stored or managed in tanks, CH_4 is produced. Because humans raise these animals for food and other products, methane emissions are considered human-related. The combination of ruminant and manure emissions identifies agriculture as the largest source of CH_4 emissions worldwide. Less significant are CH_4 emissions from land use and land management activities (eg. forest fires, stubble burning, decomposition of organic matter in coastal wetlands, etc.).

- **Energy and industry** – Methane is the main component of natural gas. Methane is released into the atmosphere during the production, refining, storage, transmission and distribution of natural gas, as well as during the production, refining, transportation and storage of crude oil. Coal mining is also a source of CH_4 emissions.
- **Waste from homes and businesses** – Methane is generated in landfills, where waste is decomposed, as well as during the treatment of domestic and industrial wastewater and from composting and anaerobic digestion.
- Methane is also emitted from a number of natural sources. Natural wetlands are the largest source of CH_4 due to the work of bacteria that decompose organic materials in the absence of oxygen. Smaller sources of methane include termites, oceans, sediments, volcanoes and forest fires.

Nitrous oxide (N_2O)

Human activities such as agriculture, fuel combustion, wastewater treatment and some industrial processes increase the amount of N_2O in the atmosphere. Nitrous oxide is also naturally present in the atmosphere as part of the Earth's nitrogen cycle and has various natural sources. Nitric oxide molecules remain in the atmosphere for an average of 114 years before being destroyed by chemical reactions.



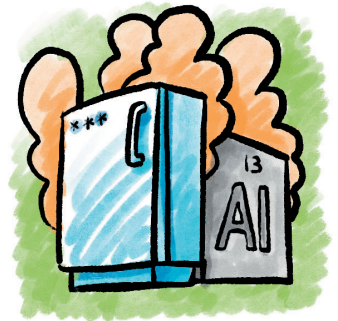
Nitrous oxide is released from agriculture, land use, transport, industry and other activities:

- **Agriculture** – The release of nitrous oxide may be the result of various activities in the cultivation of agricultural soils, such as the application of synthetic and organic fertilizers and other cultivation practices, manure storage or incineration of agricultural residues. Less significant are N_2O emissions from land management activities (eg forest and pasture fires, stubble burning, application of synthetic nitrogen fertilizers on lawns, golf courses and forest lands, etc.).
- **Combustion of fuels** – Combustion of fuels releases nitrous oxide, the amount of which depends on the type of fuel and combustion technology, operating practices and maintenance of fuel systems.

- **Industry** – Nitrous oxide is generated as a by-product during the production of chemicals such as nitric acid, which is used for the production of synthetic commercial fertilizers, and in the production of adipic acid, which is used for the production of synthetic fibers and products.
- **Waste** – Nitrous oxide is generated during the treatment of domestic wastewater.

Fluorinated gases

Unlike many other greenhouse gases, fluorinated gases are not of natural origin, and their occurrence is the result of human activity. Their emission into the atmosphere, for example, is due to the use of some of them as substitutes for ozone-depleting substances (used as refrigerants) or accompanying various industrial processes such as the production of aluminum and semiconductors. Many fluorinated gases have a very high global warming potential (GWP) compared to other greenhouse gases, so even low atmospheric concentrations can have disproportionately large effects on global temperatures. They can also have a long atmospheric life — in some cases lasting thousands of years. Like other long-lived greenhouse gases, most fluorinated gases mix well with other gases in the atmosphere, spreading around the world. Many fluorinated gases are removed from the atmosphere only after interaction with sunlight in the far upper atmosphere.



There are four main categories of fluorinated gases:

- fluorocarbons (HFCs) – life expectancy in the atmosphere up to 270 years;
- perfluorocarbons (PFCs) – 2,600 -50,000 years;
- sulfur hexafluoride (SF_6) – 740 years;
- nitrogen trifluoride (NF_3). – 3,200 years .

In general, fluorinated gases are the most powerful and long-lasting type of greenhouse gases emitted by human activity.