Greenhouse Gases

There is concern that emissions of greenhouse gases are causing harm to the environment. This information sheet describes the greenhouse effect and the gases that are enhancing it.

What is the greenhouse effect?

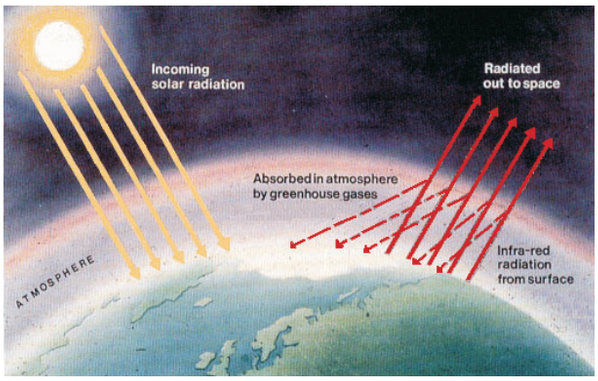
When sunlight reaches the earth's surface, it is converted into heat. This heat is re-radiated back to space in the form of infra-red radiation. Although visible light passes through the atmosphere, some of the infra-red radiation is absorbed by so-called greenhouse gases. This "greenhouse effect" is a natural phenomenon and keeps the planet 33°C warmer than would otherwise be the case, making it possible for life to exist.

The level of greenhouse gases in the atmosphere is increasing as a result of human activity. This is a cause for concern as it will affect the earth's climate.

Gases produced by human activity are also causing other environmental problems. Of particular importance are acid rain and the hole in the ozone layer - the latter allows more harmful ultra-violet rays to reach the earth's surface. Some of the gases that are responsible for these problems also contribute to the greenhouse effect. However, acid rain and the ozone hole are quite different problems from the greenhouse effect and climate change.

What are the main greenhouse gases?

The main greenhouse gases produced by human activity are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and some specialist chemicals (halogenated compounds). Some other



A simplified illustration of the greenhouse effect

gases contribute indirectly to the greenhouse effect. Water vapour is the main contributor to the natural greenhouse effect but, emissions of water from human activities have little effect on the amount of water in the atmosphere.

Carbon dioxide

The main source of CO_2 from human activity is the burning of fossil fuels, namely oil, coal and natural gas. However changes in tropical land use, such as deforestation, contribute about a quarter of the effect of fossil fuels and are therefore also important. The concentration of CO_2 in the atmosphere has increased by about a third since pre-industrial times and is continuing to increase at 0.4% per year.

Methane

Over half of the emissions of methane from human activity arise from agriculture, in particular ruminant animals, rice fields, and the burning of biomass. The rest is from fossil fuel production (particularly natural gas transmission and coal mining) and from waste disposal. The concentration of methane in the atmosphere has more than doubled since pre-industrial times and is increasing at 0.6% per year.

Nitrous oxide

About 80% of nitrous oxide emissions from human activity come from agriculture, especially the use of nitrogen-based fertilisers. The rest is from industrial processes, combustion of fossil fuels and waste treatment. The concentration of N_2O in the atmosphere has increased by about 15% since pre-industrial times and is increasing at 0.25% per year.

Halogenated compounds

These are compounds containing fluorine, chlorine, bromine or iodine, which generally only exist in the atmosphere because of human activities. They have a wide range of uses, such as in foams, refrigerators and electrical switchgear. Emissions of some of these compounds are already being controlled because they are causing a hole in the natural ozone layer in the upper atmosphere - their concentrations are expected to reduce in future. Other compounds of this type are expected to stay in the atmosphere for a very long time.

Ozone and aerosols

Some emissions from human activities contribute indirectly to the greenhouse effect. Some halogenated compounds destroy ozone, a natural greenhouse gas, in the upper atmosphere thereby reducing their overall contribution to the greenhouse effect. However, carbon monoxide, nitrogen oxides and hydrocarbons can react to form ozone in the lower atmosphere. Aerosols (small particles suspended in the atmosphere formed by combustion) scatter and absorb sunlight and affect the formation of clouds - the net effect of this is to cool the earth.

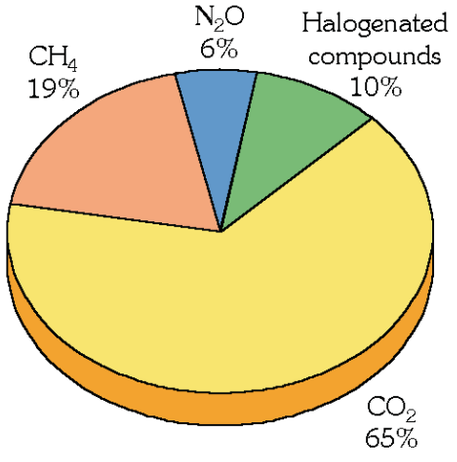
Which greenhouse gases have most effect?

The contribution of different gases to the greenhouse effect is often expressed in relation to the effect that the same amount of CO_2 would have. This is measured by their Global Warming Potential (GWP). This is not a precise measure, as greenhouse effects depend on complex interactions. However, it is a useful indicator.

Different gases remain in the atmosphere for different lengths of time, so the GWP varies depending on the time horizon (see table). Methane has a shorter average life in the atmosphere than CO_2, so its GWP is higher when looking at a short time horizon.

	Global Warming Potential (for various time horizons)		
	20 years	100 years	500 years
CO_2	1	1	1
CH_4	56	21	6.5
N_2O	280	310	170

The amount of CO_2 emitted to the atmosphere by human activity is much greater than that of other gases. As a result, CO_2 makes the greatest contribution to the greenhouse effect despite its low GWP. The contributions of each gas over 100 years, based on current emissions, is shown in the pie chart. This shows the net contribution of halogenated compounds, as these both enhance and reduce the greenhouse effect. The contributions from emissions of aerosols and ozone in the lower atmosphere are hard to assess and are not included.



Direct contributions to climate change from pre-industrial times

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