



Climate Change : Greenhouse Effect

Allianz Expert: What is Carbon Dioxide?

Carbon dioxide is the number-one reason for man-made climate change. But what is carbon dioxide, actually? Where does it come from? And why are governments and businesses now scrambling to reduce their carbon dioxide emissions?



Carbon Dioxide (CO₂)

Protestors dressed in CO₂ molecule costumes, demonstrate in Essen June 1, 2007, as part of the initiative 'ByeBye CO₂' against carbon dioxide pollution (Photo: Reuters)

A molecule of carbon dioxide (CO₂) consists of one carbon and two oxygen atoms. Colorless and odorless, it is hard to detect. The amount of carbon dioxide in the atmosphere has been in flux throughout the Earth's history, but the United Nations Intergovernmental Panel on Climate Change estimates that in pre-industrial times CO₂ made up around 280 ppmv (parts per million volume) of the Earth's atmosphere.

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While there are other greenhouse gases like methane and ozone that trap more heat per molecule, carbon dioxide is the second-most important greenhouse gas behind water vapor. Methane and ozone are more efficient, but have less effect on climate change due to their smaller atmospheric concentration.

Man-induced increase

Since the beginning of the industrial revolution, the average amount of carbon dioxide in the atmosphere has increased by nearly 40 percent from an estimated 280 to more than 380 ppmv percent. This increase in CO₂'s share of the atmosphere is mostly due to anthropogenic (man-induced) factors, such as burning fossil fuels, deforestation and industrial production.

In total, humans emit around 32 gigatons of carbon dioxide each year. Half of this stays in the atmosphere; the rest is absorbed by oceans and vegetation. With sharp increases in man-made CO₂ emissions, the natural CO₂ cycle gets thrown out of balance: vegetation can no longer

transform the increased amount of CO₂ into oxygen, and oceans are steadily reaching saturation level. The result of the increasing amount of carbon dioxide in the atmosphere is an enhanced greenhouse effect and subsequently, climate change. While CO₂ is only responsible for 20 percent of the natural greenhouse effect, it accounts for about 60 percent of the anthropogenic greenhouse effect that is causing the latest wave of global warming.

Sources

Carbon dioxide has always been with us. Scientists say Earth's earliest atmosphere was made up mostly of steam, carbon dioxide, and ammonia from volcanic eruptions. Today, carbon dioxide is mostly produced by the combustion of organic matter like coal, oil, and wood, the fermentation, and the respiration processes of living organisms.

Most CO₂ is produced by energy production and transport. Cement production, among many other chemical processes, also releases the gas. Rotting materials release CO₂, so landfills are contributors too. People are another source. The air we exhale is made up of about 4.5 percent CO₂. Bacteria in the soil release CO₂ when they digest leaves and carcasses. Even plants that usually absorb CO₂ "exhale" it at night.

Role and Uses

While CO₂ has gotten some bad press lately, it is one of the most important substances on Earth. Besides providing warmer temperatures it is also the world's most important fertilizer. Plants, phytoplankton, and algae need the gas for their photosynthesis to produce sugar and to grow. Doing so they absorb and bind carbon dioxide and produce oxygen. That is why forests are one of the world's most important CO₂-sinks.

Theoretically, rising CO₂ levels should be compensated by plants and algae. Up to a certain concentration, more CO₂ means more photosynthesis and more growth. Unfortunately, under hot and dry conditions many plants close their pores to prevent the loss of water and switch to a process called photorespiration during which they consume oxygen and produce carbon dioxide. So rising CO₂ levels will only lead to higher growth in areas with enough precipitation and fertile soils.

Besides these fundamental natural processes, there are a number of artificial uses of carbon dioxide. Dry ice, for example, used for cooling devices, is nothing but deep-frozen, super-cold carbon dioxide. CO₂ can also be found in fire extinguishers and, as the food additive E 290, adds the fizz to soft drinks and sparkling water.

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Astrid Zwick, Head of Allianz Group Sustainability Office (Photo: AZT)

Astrid Zwick is Head of the Allianz Group Sustainability Office. Since 2005, she also acts as chairman of the strategy and steering team "sustainability research programme" of the German Ministry of Education and Research.

Before her career at Allianz SE Mrs. Zwick was in charge of policy advice on the analysis of political, technological and economic options for the reduction of greenhouse gases at the Joint Research Center (JRC) of the European Commission.

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