

Difference Between CO₂ and CO_{2e}

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Key Difference - CO₂ vs CO_{2e}

The terms CO₂ and CO_{2e} seem similar but are different terms by their definitions. However, they are related to each other because they are the major [greenhouse gas](#) components. CO₂ is carbon dioxide gas. It is a colourless gas. The [density](#) of this gas is higher than the dry air. It is one of the major gaseous compounds that is released due to human activities. The term CO_{2e} stands for carbon dioxide equivalents. It is a measure of how much [global warming](#) is given by a particular greenhouse gas as a function of the amount or concentration of carbon dioxide gas. The **key difference** between CO₂ and CO_{2e} is that **CO₂ is a gaseous compound whereas CO_{2e} is a measure of the greenhouse effect.**

What is CO₂ ?

CO₂ is carbon dioxide gas. It is a colourless gas with a higher density than that of dry air (about 65% higher). The carbon dioxide molecule is composed of a [carbon](#) atom [covalently bonded](#) to two oxygen atoms, and the molecule comprises a linear geometry. When it naturally occurs, carbon dioxide present in trace amount in earth's atmosphere (0.03%).

Carbon dioxide is the most common greenhouse gas that is emitted as a result of human activities when considered based on the quantity released and the contribution to the global warming. It is the most prevalent greenhouse gas after water vapour.

Carbon dioxide is a colourless gas, and at lower concentrations, it is odourless as well. At higher concentrations, carbon dioxide has a strong acidic odour. Moreover, this compound has no liquid state at standard temperature and pressure conditions.

The major source where carbon dioxide is produced and released is from the combustion of carbon-based fuels. These fuels include [hydrocarbons](#) such as [methane](#), [ethane](#) and petroleum oil, coal, organic materials such as wood, etc. And also, carbon dioxide gas is released from factories at higher quantities where mineral processing is done. Ex: carbon dioxide is a byproduct of iron production from hematite in blast furnaces.

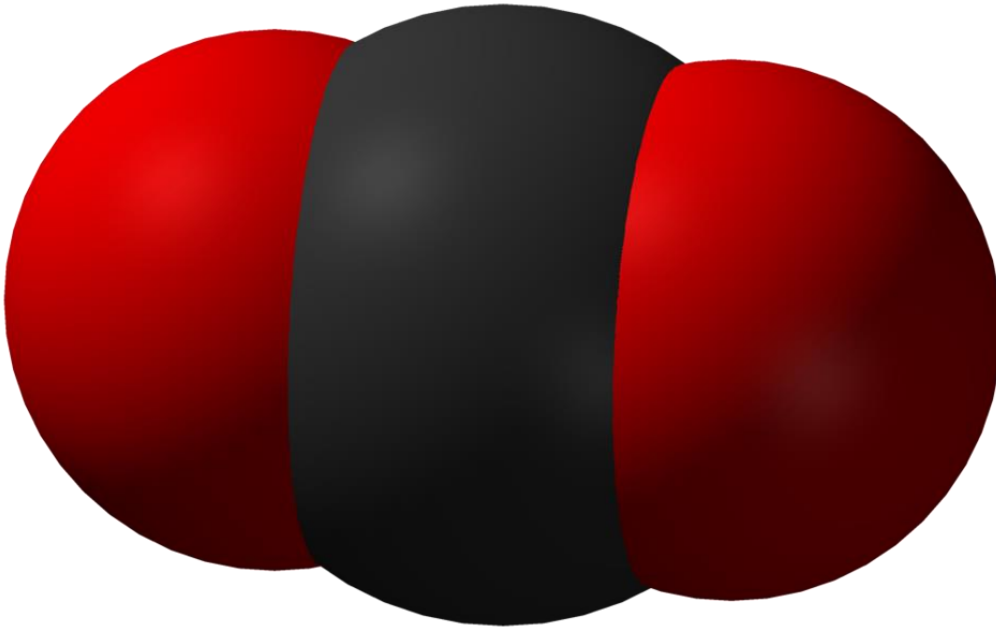


Figure 01: Molecular structure of carbon dioxide

Although the natural carbon dioxide content in atmosphere is very low, human activities in past few decades have increased the CO₂ content rapidly. Deforestation, fuel combustion, industrialization are among the major reasons. Carbon dioxide is a greenhouse gas because it can absorb and emit IR radiation (infrared radiation) coming from the sun. this gas can capture the heat coming from the light, but the emission is multidirectional (back to the sun and also on to the earth's surface). This case global warming.

What is CO_{2e} ?

The term CO_{2e} stands for carbon dioxide equivalents. It is a measure of how much global warming is given by a particular greenhouse gas as a function of the amount or concentration of carbon dioxide gas. Hence it measures the greenhouse effect of other components taking carbon dioxide as a reference. It is also a standard unit for measuring carbon footprint. The Carbon footprint is the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization, or community.

By using carbon dioxide equivalents, the carbon footprint can be expressed in simple values that can be used for further comparisons. Hence it is the common unit to indicate the contribution of different gases on global warming.

The quantitative expression of the greenhouse effect can be given as carbon dioxide equivalents by multiplying the amount of greenhouse gas by the global warming potential

(GWP) of that gas. The global warming potential depends on the absorption of IR radiation by the gas, the location of its absorption in the spectrum (the wavelength that the gas can absorb) and the lifetime of the gas in the atmosphere.

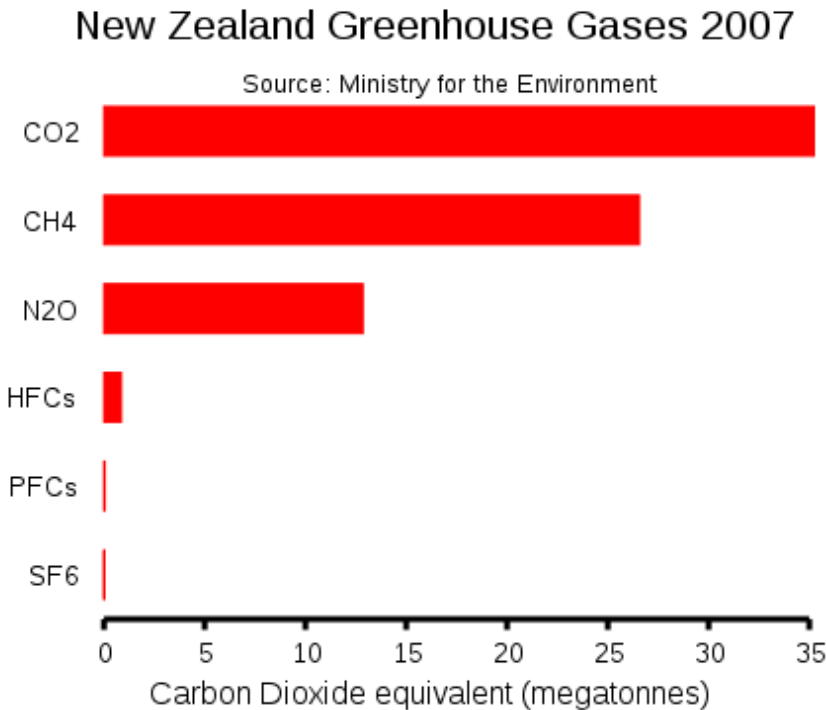


Figure 02: A graph showing the effect of greenhouse gases in terms of carbon dioxide equivalents

Hence there are few advantages of using CO_{2e} measurements; it gives the effect of gases on global warming by simple numbers, and it allows to compare the greenhouse effects of different gases. the other ways of expressing carbon dioxide equivalents include “CO_{2eq}”, “CO₂equivalent” or “CDE”.

What is the Difference Between CO₂ and CO_{2e} ?

CO ₂ vs CO _{2e}	
CO ₂ is carbon dioxide gas.	The term CO _{2e} stands for carbon dioxide equivalents.
Nature	

CO ₂ is a colourless gas that can be found naturally in the atmosphere in trace amounts.	CO _{2e} is a measure of the greenhouse effect.
Relation to the Greenhouse Effect	
CO ₂ is a greenhouse gas; It can absorb IR radiation coming from the sun and re-emit in different directions that cause global warming.	CO _{2e} is used to measure how much impact is on global warming by a particular greenhouse gas as a function of the amount or concentration of carbon dioxide gas emitted. This is also used to express the carbon footprint.

Summary - CO₂ vs CO_{2e}

Carbon dioxide is a major greenhouse gas that has an impact second only to water vapour. The impact of other greenhouse gases is measured quantitatively using carbon dioxide as a reference. It is given as carbon dioxide equivalents of CO_{2e}. The difference between CO₂ and CO_{2e} is that CO₂ is a gaseous compound whereas CO_{2e} is a measure of the greenhouse effect.

Reference:

1. "Climate Science Glossary." Skeptical Science. [Available here](#)
2. "What are CO_{2e} and global warming potential (GWP)?" The Guardian, Guardian News and Media, 27 Apr. 2011. [Available here](#)
3. "Carbon dioxide equivalent." Wikipedia, Wikimedia Foundation, 17 Feb. 2018. [Available here](#)

Image Courtesy:

1. 'Carbon-dioxide-3D-vdW' (Public Domain) via [Commons Wikimedia](#)
2. 'Nzghg gases red-7 6-07' By Mrfebruary - Own work Data Source: Ministry for the Environment (2009) New Zealand's Greenhouse Gas Inventory 1990–2007, Ref. ME 928, April 2009, Ministry for the Environment, Wellington, New Zealand. Figure 2: Trends in greenhouse gas emissions by gas: 1990–2007., [\(CC BY-SA 3.0\)](#) via [Commons Wikimedia](#)

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