

CLIMATE CHANGE

What is CO2e and how is it calculated?

The one term you need to know to understand global warming



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fossil fuels, industrial production, and land use.

However, CO₂ is not the only greenhouse gas that is driving climate change. There are a number of other gases that significantly contribute to global warming, all of which together are quantified in one single metric called CO₂e.

In this article, we'll take a look at what CO₂e is in more detail, how exactly it is calculated, and why it is important to do so when measuring emissions.

The Speed Read:

1. CO₂ and CO₂e are two different things.
2. CO₂e is more accurate when it comes to calculating emissions.
3. CO₂e allows "bundles" of greenhouse gases to be expressed as a single number.
4. And it also allows different bundles of greenhouse gases to be easily compared in terms of their global warming potential.

Back to basics: understanding greenhouse gas emissions

To understand what CO₂e is, we first need to go back to basics and really understand what greenhouse gases are (which are also known as GHS).

Now, here's the first thing to learn about gases: they absorb heat.

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much colder (about -19°C on average, in fact). That's because all gases have a different heat absorption capacity, so together they create that perfect, "just warm enough" environment for our planet to give us all life as we know it. Without the gases, the heat that Earth generates would simply escape through the atmosphere.

But what happens when the concentration of the gases is too high?

The greenhouse effect:

Warming that results when the atmosphere traps heat radiation from Earth toward space.

Not all of the gases in the atmosphere drive global warming and do so equally. Ozone, for example, is actually good for the atmosphere because it protects us from the ultraviolet radiation from the Sun.

When it comes to having direct impact on climate change, the gases to blame are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the so-called F-gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

One thing to remember here is that different greenhouse gas emissions are generated from different human activities. CO_2 , for instance, enters the atmosphere from **burning** fossil fuels (i.e. coal, natural gas, and oil), solid waste,

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All those different gases have a different range of warming effects: one tonne of methane does not, for instance, have the same heat absorption impact as one tonne of CO₂. Also, methane doesn't stay in the atmosphere for the same period of time as CO₂, as every gas' capacity for that is different.

For this reason, there's an individual warming metric assigned to each greenhouse gas called **global warming potential**, or GWP. GWP indicates the amount of warming a gas causes over a given period of time, which is normally 100 years.

Because each greenhouse gas is unique, each one has its own GWP based on their duration and heat absorption.

OK, but what is CO₂e?

So now, back to the original question: what is CO₂e?

As **officially defined** by Eurostat, **CO₂e** (also written as carbon dioxide equivalent, CO₂ equivalent or CO₂eq) **is a metric measure** that is used to compare emissions from various greenhouse gases on the basis of their GWP by **converting amounts of other gases to the equivalent amount of CO₂**.

This way, the main difference between CO₂ and CO₂e is that CO₂ *only* accounts for carbon dioxide, while CO₂e accounts for carbon dioxide *and* all the other gases as well: methane, nitrous oxide, and others. If we calculate emissions based on CO₂ only, we're then ignoring the impact of other gases and, as a result, have an inaccurate picture overall. CO₂e combines everything in one and attempts to convert the warming impact of the range of different gases into one single metric.

To exemplify this in easier terms, think of CO₂e as if you're converting several different currencies into one, e.g. EUR.


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As you might have guessed, to calculate CO2e you need to know the individual value of each gas. This brings us to the next question:

How is CO2e calculated?

Carbon dioxide equivalents are commonly expressed as million metric tonnes of carbon dioxide equivalents (abbreviated as MMTCDE), but often you can see them in kilos too. To quantify CO2e, you need to **multiply the amount of the greenhouse gases by their GWP**.

GWP is an index, with CO2 having the index value of 1, while the GWP for all other greenhouse gases is the number of times more warming they cause when compared to CO2. So, 1kg of methane causes 25 times more warming over 100 years compared to 1kg of CO2, which is why methane's GWP score is 25.

Kyoto Gases (IPCC 2007)

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	25
Nitrous oxide (N ₂ O)	298
Hydrofluorocarbons (HFCs)	124 – 14,800
Perfluorocarbons (PFCs)	7,390 – 12,200
Sulfur hexafluoride (SF ₆)	22,800
Nitrogen trifluoride (NF ₃)	17,200

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Why is it important to account for CO2e?

The first reason why it's important to count CO2e is simple: transparency.

Seeing a real, more complete picture allows you to get a fuller understanding of where we stand in terms of emitting emissions.

Here's a simple example.

In 2018, Germany, Europe's biggest carbon dioxide emitter, **released 760,0 million metric tonnes of CO2**. But if you include other gases in the equation, the country's total emissions are actually higher and work out at 854.4 million tonnes of CO2e. In other words, other gases (methane, etc) added an extra 94.4 million tonnes of CO2e — not something to ignore.

Is it crucial to look for CO2e for yet another reason: to know if you're being **greenwashed**. You know, something that consumer brands sometimes do (both knowingly and unknowingly).

Have you recently seen a product with a 'Climate Neutral' or 'Lower CO2 level' label, a big trend in the consumer industry now? If so, pay attention. Zoom in. Read in. Are you being told the whole story?

A 'Climate Neutral' label, for instance, would only mean that the company has **offset their emissions** instead of reducing them. A cute place to start, but definitely not enough if you're after a serious change.

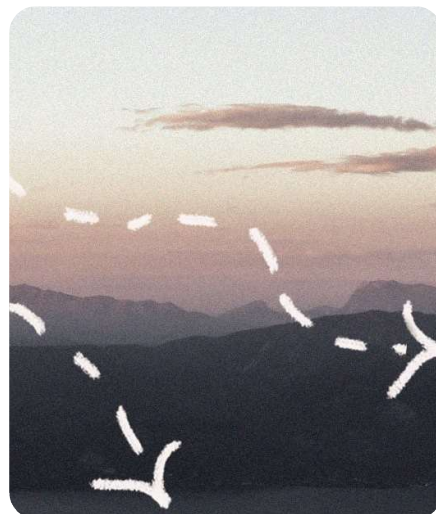
"You need to account all emissions rising directly or indirectly from the business", shares Elina Seppälä, Impact Lead at Cooler Future. "You therefore need to analyze the entire life cycle of your product and your entire supply chain to calculate emissions accurately. Everything counts: from transportation to packaging to the type of energy used when producing the product."

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ELINA SEPPÄLÄ, IMPACT LEAD @ COOLER FUTURE

A Swedish plant-based milk brand Oatly offers a **climate footprint label** on their oat-milk product, displaying a CO₂e/kg calculation clearly. In that calculation, they account for the emissions created in the production of oats, emissions from soils and soil fertilizers, use of electricity for tractors and other machines, manufacturing and transportation of packaging materials — the list goes on and on. If a brand is truly on a mission to reduce their climate footprint, *they'll make it easy* for consumers to find information on how they do their CO₂e calculations and estimations. Hot tip: google everything before you buy. If information is hard to find, it's probably for a reason.

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