Keep within 1 trillion tonne carbon budget to avoid 2 °C rise

The total accumulation of carbon in the atmosphere should not exceed one trillion tonnes if dangerous climate change is to be avoided. A new study suggests the amount of carbon collected over time, rather than short-term emissions changes, is crucial to restrict rising temperatures.

Most countries around the world accept that temperatures should not rise by more than 2 °C above pre-industrial levels as part of the United Nations Framework Convention on Climate Change. This measure is designed to avoid the most serious impacts of climate change.

However, there are great uncertainties about climate systems and the carbon cycle. Estimating how much CO₂ emissions must be reduced in order to reach a stable concentration in the atmosphere and desired temperature change is not straightforward. As such, directly relating emissions to temperatures cannot be reliably estimated at present.

The study suggests that if total cumulative CO₂ emissions were used as the limiting factor, peak warming could be related to the total CO₂ released. This target, with an available carbon budget (i.e. a total limit on atmospheric carbon) of carbon emissions, would simplify current targets to tackle global warming. Importantly, the study suggests that very different means of producing the emissions, with the same cumulative total, give the same peak warming.

If one trillion tonnes of carbon (1 TtC), (equivalent to 3,670 billion tonnes of CO₂) accumulate in the atmosphere from long-term human influences (from the pre-industrial baseline 1750 to the year 2500), the most likely temperature rise from climate change would peak at 2 °C above pre-industrial levels. Together with a companion study, it suggests that it has taken 250 years for humankind to burn half a trillion tonnes of carbon. If the current rate continues, it would only take another 40 years to burn the next half trillion tonnes.

CO₂ has a long life in the atmosphere (over 100 years), so accumulated emissions have a clear impact. Therefore, total CO₂ emissions must be limited, not just the emission rate in any particular year. But emission rates of shorter-lived greenhouse gases (GHGs), such as methane, shorter than a few decades) also have an impact on warming. This study considered warming caused by CO₂ alone, so warming from other human influences, such as short-lived gases and aerosols, would add to that caused by the 1 Tt accumulation of carbon.

Although this study suggests the timings of the emissions within the total have little impact on the projected temperature, (it is the cumulative emissions that are related to peak warming), emission reductions of both short-lived GHGs and CO₂ should not be delayed. It might be impossible for future generations to reduce emissions at the very high rates that would be needed to avoid the 2 °C rise in temperature. Shorter-term targets included within the framework of the cumulative carbon budget are required to measure progress towards emissions cuts and a zero carbon society.

1. See: http://unfccc.int/2860.php


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