

Stabilizing climate requires near-zero carbon emissions

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Now that scientists have reached a consensus that carbon dioxide emissions from human activities are the major cause of global warming, the next question is: How can we stop it" Can we just cut back on carbon, or do we need to go cold turkey" According to a new study by scientists at the Carnegie Institution, halfway measures won't do the job. To stabilize our planet's climate, we need to find ways to kick the carbon habit altogether.

In the study, to be published in *Geophysical Research Letters*, climate scientists Ken Caldeira and Damon Matthews used an Earth system model at the Carnegie Institution's Department of Global Ecology to simulate the response of the Earth's climate to different levels of carbon dioxide emission over the next 500 years. The model, a sophisticated computer program developed at the University of Victoria, Canada, takes into account the flow of heat between the atmosphere and oceans, as well as other factors such as the uptake of carbon dioxide by land vegetation, in its calculations.

This is the first peer-reviewed study to investigate what level of carbon dioxide emission would be needed to prevent further warming of our planet.

"Most scientific and policy discussions about avoiding climate change have centered on what emissions would be needed to stabilize greenhouse gases in the atmosphere," says Caldeira. "But stabilizing greenhouse gases does not equate to a stable climate. We studied what

emissions would be needed to stabilize climate in the foreseeable future.”

The scientists investigated how much climate changes as a result of each individual emission of carbon dioxide, and found that each increment of emission leads to another increment of warming. So, if we want to avoid additional warming, we need to avoid additional emissions.

With emissions set to zero in the simulations, the level of carbon dioxide in the atmosphere slowly fell as carbon “sinks” such as the oceans and land vegetation absorbed the gas. Surprisingly, however, the model predicted that global temperatures would remain high for at least 500 years after carbon dioxide emissions ceased.

Just as an iron skillet will stay hot and keep cooking after the stove burner’s turned off, heat held in the oceans will keep the climate warm even as the heating effect of greenhouse gases diminishes. Adding more greenhouse gases, even at a rate lower than today, would worsen the situation and the effects would persist for centuries.

"What if we were to discover tomorrow that a climate catastrophe was imminent if our planet warmed any further" To reduce emissions enough to avoid this catastrophe, we would have to cut them close to zero — and right away," says Caldeira.

Global carbon dioxide emissions and atmospheric carbon dioxide concentrations are both growing at record rates. Even if we could freeze emissions at today’s levels, atmospheric carbon dioxide concentrations would continue to increase. If we could stabilize atmospheric carbon dioxide concentrations, which would require deep cuts in emissions, the Earth would continue heating up. Matthews and Caldeira found that to prevent the Earth from heating further, carbon dioxide emissions would, effectively, need to be eliminated.

While eliminating carbon dioxide emissions may seem like a radical idea, Caldeira sees it as a feasible goal. “It is just not that hard to solve the technological challenges,” he says. “We can develop and deploy wind turbines, electric cars, and so on, and live well without damaging the environment. The future can be better than the present, but we have to take steps to start kicking the CO₂ habit now, so we won't need to go cold turkey later.”

Source: Carnegie Institution

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