
550 | 450 | 350 | What CO2 target is safe?

Climate crunch: A burden beyond bearing

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The climate situation may be even worse than you think. In the first of three features, Richard Monastersky looks at evidence that keeping carbon dioxide beneath dangerous levels is tougher than previously thought.

In 2007, environmental writer Bill McKibben approached climate scientist James Hansen and asked him what atmospheric concentration of carbon dioxide could be considered safe. Hansen's reaction: "I don't know, but I'll get back to you."

After he had mulled it over, Hansen started to suspect that he and many other scientists had underestimated the long-term effects of greenhouse warming. Atmospheric concentration of CO₂ at the time was rising past 382 parts per million (p.p.m.), a full 100 ticks above its pre-industrial level. Most researchers, including Hansen, had been focusing on 450 p.p.m. as a target that would avoid, in the resonant and legally binding formulation of the United Nations Framework Convention on Climate Change, "dangerous climate change". McKibben was aware of this: he was thinking of forming an organization called 450.org to call attention to the number, and his question to Hansen was by way of due diligence.

As he thought about McKibben's question, Hansen, who runs NASA's Goddard Institute for Space Studies in New York, began to wonder if 450 p.p.m. was too high. Having spent his career working on climate models, he was aware that in some respects the real world was outstripping them. Arctic sea ice was reaching record lows; many of Greenland's glaciers were retreating; the tropics were expanding. "What was clear was that climate models are our weakest tool, in that you can't trust their sensitivity in any of these key areas," he says. Those warning signs — and his studies of past climate change — led Hansen to conclude that only by pulling CO₂ concentrations down below today's value could humanity avert serious problems. He came back to McKibben with not 450 but 350. In 2008, he published a paper spelling out his rationale for that target.

The difference between 350 and 450 is not just one of degree. It's one of direction. A CO₂ concentration of 450 p.p.m. awaits the world at some point in the future that might conceivably, though with difficulty, be averted. But 350 p.p.m. can be seen only in the rear-view mirror. Hansen believes that CO₂ levels already exceed those that would provide long-term safety, and the world needs not just to stop but to reverse course. Although his view is far from universal, a growing number of scientists agree that the CO₂ challenge is even greater than had previously been thought.

Several recent studies, for example, indicate that it may be exceedingly difficult to cool the climate down from any eventual peak or plateau, no matter what CO₂ concentration is chosen as a target by the international community. And by looking at the problem in a new sort of way — by tallying the total amount of carbon injected into the atmosphere across human history — two papers in this issue of Nature reveal how close the world has come to the danger point (pages 1158 and 1163). "It's tougher than people have appreciated. We have less room to manoeuvre," says Malte Meinshausen, an author of one of the papers and a senior researcher at the Potsdam Institute for Climate Impact Research in Germany.

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