

Limiting global warming to 1.5 °C may still be possible

Analysis suggests that researchers have underestimated how much carbon humanity can emit before reaching this level of warming.

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Florian Gaertner/Photothek via Getty Images

Coal-fired power plants, such as this one in Germany, are a source of greenhouse-gas emissions.

A team of climate scientists has delivered a rare bit of good news: it could be easier than previously thought to limit global warming to 1.5 °C above pre-industrial levels, as called for in [the 2015 Paris climate agreement](#). But even if the team is right — and some researchers are already questioning the conclusions — heroic efforts to curb greenhouse-gas emissions [will still be necessary to limit warming](#).

Published on 18 September in *Nature Geoscience*¹, the analysis focuses in part on the fact that global climate models used in the 2013

report from the Intergovernmental Panel on Climate Change (IPCC) tend to overestimate the extent of warming that has already occurred. After adjusting for that discrepancy and running further models, the authors of the latest study found that the amount of carbon that humanity can emit from 2015 onward while holding temperatures below 1.5 °C is nearly three times greater than estimated by the IPCC — or even larger if there is aggressive action on greenhouse gases beyond carbon dioxide.

The implications for global policymakers are significant. Humanity is poised to blow through the IPCC's carbon budget for a 1.5 °C rise within a few years, leading many scientists to declare the goal impossible. But the new analysis suggests that it could be met with a modest strengthening of the current Paris pledges up to 2030, followed by sharp cuts in carbon emissions thereafter.

“The Paris goal of 1.5 °C is not impossible — *it's just very, very difficult,*” says lead author Richard Millar, a climate researcher at the University of Oxford, UK.

Debate rages on

The work is receiving mixed reviews. Some argue that the analysis is fundamentally flawed, because it centres on a period of slower warming that began around the turn of the millennium. This period, *often referred to as the climate hiatus*, continued until 2014. Scientists think that natural variability in the climate system temporarily suppressed temperatures during this period.

The team's estimate for the amount of warming that humans have caused so far — 0.93 °C — could thus be artificially low, because it calculates the human contribution to warming during this cooler time, says Ben Sanderson, a climate modeller at the National Center for Atmospheric Research in Boulder, Colorado.

At the same time, he says, the oceans and the land were probably absorbing more carbon than normal during this period. Natural processes will eventually dump some of that back into the atmosphere, thus reducing the amount of carbon that humanity can emit before reaching 1.5°C.

“These two effects, to my mind, explain away their result and reinforce

the original IPCC conclusion,” Sanderson says.

But Millar and his colleagues argue that the effects of the hiatus would be minimal. The team used multiple methodologies to estimate the actual warming due to greenhouse gases, independent of short-term climate variability. The scientists calculated how much carbon would be needed to push the temperature up by another 0.6 °C, to 1.5 °C. But they also calculated how much carbon it would take to reach that threshold if the amount of human-caused warming so far was lower or higher than their estimate of 0.93 °C.

In all cases, Millar says, the amount of carbon that humans could emit before Earth warms to that 1.5 °C threshold is larger than previously estimated.

Counting carbon

Nathan Gillett, a climatologist at the Canadian Centre for Climate Modelling and Analysis in Victoria, says that other teams have previously documented the slight discrepancy between the warming projected by climate models and that shown by actual observations. But Gillett credits Millar’s team with teasing out the implications of this gap, and of reducing the uncertainty surrounding the amount of emissions that would produce warming of 1.5 °C. “I think their central conclusion is robust,” Gillett says.

The debate over how close the world is to the 1.5 °C warming threshold is unlikely to be resolved any time soon, but one thing is clear: modelling scenarios that enable Earth to remain below that target poses a new kind of challenge. Uncertainty about the details of humanity’s carbon budget don’t matter so much when scientists are modelling the cumulative effect of greenhouse gases over the course of centuries. But fine details matter a great deal when researchers are looking at what level of greenhouse-gas emissions would bump warming to 1.5 °C, because, in that case, scientists’ goal is to tease out the precise effects of heat-trapping gases over a few decades.

“When we start thinking about really ambitious mitigation goals in the really near term, everything starts to matter,” Millar says.

That is true for science as well as for climate policy. “For a lot of people,

it would probably be easier if the Paris goal was actually impossible,” Millar says. “We’re showing that it’s still possible. But the real question is whether we can create the policy action that would actually be required to realize these scenarios.”

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References

1. Millar, R. J. *et al. Nature Geosci.* <http://dx.doi.org/10.1038/NGEO3031> (2017).
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Paris climate aim 'still achievable'

By Paul Rincon
Science editor, BBC News website
8 hours ago



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Image caption

Renewable energy in Nicaragua

The 2015 Paris agreement's ambitious goal of limiting global warming to 1.5C remains within reach, a study suggests.

The study is one of several to address the "carbon budget", which - among other things - determines how much CO₂ the planet can emit and still reach a given limit for global warming.

It indicates the 2015 target, perceived by some as tough, could be met with very

stringent emissions cuts.

It used computer models that project climate behaviour into the future.

What is climate change?

What is in the Paris climate agreement?

The aim of the Paris deal was "holding the increase in global average temperature to well below 2C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5C."

But scientists admit they were taken by surprise by the ambition of the 1.5C figure.

The results of the work with computer models have been **published in Nature Geoscience**. This type of work necessarily contains uncertainties regarding the way the Earth's climate will respond in future and how quickly societies can move away from fossil fuel use.

But the study authors say: "Pursuing 'efforts to limit the temperature increase to 1.5C' is not chasing a geophysical impossibility".

Co-author Michael Grubb, from University College London, said: "This paper shows that the Paris goals are within reach, but clarifies what the commitment to 'pursue efforts to limit the temperature increase to 1.5C' really implies."

Those commitments would require strengthening the nationally determined contributions (NDCs) - the pledges to cut emissions contained in the Paris agreement.

Previous estimates of the remaining 1.5C carbon budget, based on the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment of the climate, were around four times lower.

But unlike those figures, which relied on one line of evidence, the new study uses multiple approaches to examine the same question, arriving at a rather different result.

Co-author Prof Pierre Friedlingstein, from the University of Exeter, said: "This is very good news for the achievability of the Paris targets."

Prof Myles Allen, another author, from the University of Oxford, told BBC News: "In the main body of the IPCC assessment, what it would take to meet a 1.5C goal wasn't assessed in any detail. To be honest, it wasn't thought to be the policy priority at the time.

"Perhaps it should have been, but that was the view of the academic community then. But the ambition of Paris caught a lot of people by surprise."

Analysis by David Shukman, BBC Science Editor:

The climate models are exaggerating. The predictions are too alarmist. The Tuvaluans and other islanders are safer than we thought. These are among the conclusions that some might reach from this latest work. In reality, nothing is quite that straightforward. The models are simulated approximations of possible futures. Inevitably they are going to be at least slightly adrift of reality, either in the amount of warming or its timing.

They come with caveats and margins of error. In many ways, it's remarkable that these computer constructs are even roughly on track. And models designed to come

up with very broad potential outcomes for the end of the century may not be fine-tuned enough to give more detailed forecasts year-by-year.

The authors themselves are anxious that their research is not misunderstood. The need for urgent action to reduce emissions is unchanged, they say. It's just that the most ambitious of the Paris Agreement targets is not as unachievable as many once thought, that there is time to act, though the task remains a monumental one.

Myles Allen added: "For a two in three chance of keeping temperatures within 1.5C, we'd have to reduce emissions in a straight line to zero from where we are now over the next 40 years.

"It's possible, but extremely challenging. So if people are saying: can we now relax? That's not the right message to take at all."

Different take

Scientists agree urgent action will be needed to tackle the effects of rapid temperature increase over the next century.

But a study earlier this year in the journal Nature Climate Change suggested the allowable carbon budget had probably been overestimated.

It said the "pre-industrial baseline" used to benchmark present day warming was probably older than the IPCC had assumed.

Therefore, the degree of warming since that baseline was probably greater than had been believed.

On Twitter, one of the authors of that report, Prof Michael Mann, said the latest research in Nature Geoscience, "doesn't account for [the] pre-industrial baseline issue we examined".

He added: "There is some debate about [the] precise amount of committed warming if we cease emitting carbon immediately. We're probably very close to 1.5C."

Meanwhile, **another paper in Nature Geoscience**, by Gunnar Myhre, from the Center for International Climate and Environmental Research, in Oslo, and colleagues, suggests the greenhouse effect caused by human-induced CO2 emissions is now half-way to doubling compared with pre-industrial conditions.

Although the concentrations themselves have not yet reached the halfway mark, this is being described as an iconic watermark.