

# Paying for emissions we've already released

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The planet is committed to global warming in excess of 2 degrees Celsius (3.6 degrees Fahrenheit) just from greenhouse gases that have already been added to the atmosphere. This is the conclusion of new research by scientists from Nanjing University, Lawrence Livermore National Laboratory (LLNL) and Texas A&M University, which appears in the latest edition of *Nature Climate Change*.

The team used observations and climate model simulations to re-evaluate how much warming is "in the pipeline" from past emissions. Their estimate is higher than previous estimates because it accounts for changes in the geographic pattern of surface warming.

"Typically, committed warming is estimated assuming that changes in the future will pretty much follow changes in the past," said LLNL atmospheric scientist Mark Zelinka, a co-author of the paper. "But we now know that this is a bad assumption."

While most of the planet's surface has warmed, several important regions, like the Southern Ocean, have not. The lack of surface warming

favors the buildup of low-level clouds over these regions, which reflect sunlight back to space and strongly cool the planet. Eventually, these regions will warm up. When they do, the low clouds will decrease, which will allow more sunlight to be absorbed by Earth and give the world additional warming.

"The important thing to realize is that this has not yet happened—it is not in the historical record," said lead author Chen Zhou, a researcher at Nanjing University. "After accounting for this effect, the estimated future warming based on the historical record would be much higher than previous estimates."

Specifically, the team found that future warming with radiative forcing fixed at present-day levels (equivalent to freezing the atmospheric composition as it is today) has a most likely value of +2.3 degrees Celsius (4.1 degrees Fahrenheit) above pre-industrial levels. This exceeds the limits set in the Paris Agreement, in which the world's countries agreed to limit [global warming](#) to well below 2 degrees Celsius (3.6 degrees Fahrenheit) above pre-industrial temperatures, while pursuing efforts to limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit).

"The bad news is that our results suggest that we have most likely already emitted enough carbon dioxide to exceed 2°C," said Andrew Dessler, Texas A&M researcher and co-author of the study. But he pointed out that there is good news. Once net emissions get to near zero, the rate of continued, committed warming will be very slow. "So if we can get net emissions to near zero soon, it may take centuries to exceed 2 degrees Celsius."

"The uncertainty on estimates of committed warming is large, but we can have high confidence that committed [warming](#) is larger than one would expect based on assuming the past is prologue," Zelinka added. "This finding increases the urgency of reducing greenhouse gas emissions in order to achieve the Paris Agreement targets."

**More information:** Chen Zhou et al. Greater committed warming after accounting for the pattern effect, *Nature Climate Change* (2021). DOI: [10.1038/s41558-020-00955-x](https://doi.org/10.1038/s41558-020-00955-x)

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