

Limiting warming to 2 C requires emissions reductions 80% above Paris Agreement targets

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In 2017, a widely cited study used statistical tools to model how likely the world is to meet the Paris Agreement global temperature targets. The analysis found that on current trends, the planet had only a [5% chance](#) of

staying below 2 degrees Celsius warming this century—the international climate treaty's supposed goal.

Now, the same authors have used their tools to ask: What [emissions cuts](#) would actually be required to meet the [goal](#) of 2 C warming, considered a threshold for climate stability and climate-related risks such as excessive heat, drought, extreme weather and sea level rise?

The University of Washington study finds that [emissions reductions](#) about 80% more ambitious than those in the Paris Agreement, or an average of 1.8% drop in emissions per year rather than 1% per year, would be enough to stay within 2 degrees. The results were published Feb. 9 in Nature's open-access journal *Communications Earth & Environment*.

"A number of people have been saying, particularly in the past few years, that the emissions targets need to be more ambitious," said lead author Adrian Raftery, a UW professor of statistics. "We went beyond that to ask in a more precise way: How much more ambitious do they need to be?"

The paper uses the same statistical approach to model the three main drivers of human-produced greenhouse gases: national population, gross domestic product per person and the amount of carbon emitted for each dollar of economic activity, known as carbon intensity. It then uses a [statistical model](#) to show the range of likely future outcomes based on data and projections so far.

Even with updated methods and five more years of data, now spanning 1960 through 2015, the conclusion remains similar to the previous study: Meeting Paris Agreement targets would give only a 5% probability of staying below 2 degrees Celsius warming.

Assuming that climate policies won't target population growth or economic growth, the authors then ask what change in the "carbon intensity" measure would be needed to meet the 2 degrees warming goal.

Increasing the overall targets to cut carbon emissions by an average of 1.8% annually, and continuing on that path after the Paris Agreement expires in 2030, would give the planet a 50% chance of staying below 2 degrees warming by 2100.

"Achieving the Paris Agreement's temperature goals is something we're not on target to do now, but it wouldn't take that much extra to do it," said first author Peiran Liu, who did the research as part of his doctorate at the UW.

The paper looks at what this overall plan would mean for different countries' Paris Agreement commitments. Nations set their own Paris Agreement emissions-reductions pledges. The United States pledged a 1% drop in carbon emissions per year until 2026, or slightly more ambitious than the average. China pledged to reduce its carbon intensity, or the carbon emissions per unit of economic activity, by 60% of its 2005 levels by 2030.

"Globally, the temperature goal requires an 80% boost in the annual rate of emissions decline compared to the Paris Agreement, but if a country has finished most of its promised mitigation measures, then the extra decline required now will be smaller," Liu said.

Assuming that each country's share of the work remains unchanged, the U.S. would need to increase its goal by 38% to do its part toward actually achieving the 2 degrees goal. China's more ambitious and fairly successful plan would need only a 7% boost, and the United Kingdom, which has made substantial progress already, would need a 17% increase. On the other hand, countries that had pledged cuts but where

emissions have risen, like South Korea and Brazil, would need a bigger boost now to make up for the lost time.

The authors also suggest that countries increase their accountability by reviewing progress annually, rather than on the five-year, 10-year or longer timescales included in many existing climate plans.

"To some extent, the discourse around climate has been: 'We have to completely change our lifestyles and everything,'" Raftery said. "The idea from our work is that actually, what's required is not easy, but it's quantifiable. Reducing global emissions by 1.8% per year is a goal that's not astronomical."

From 2011 to 2015, Raftery says, the U.S. did see a drop in emissions, due to efficiencies in industries ranging from lighting to transportation as well as regulation. The pandemic-related economic changes will be short-lived, he predicts, but the creativity and flexibility the pandemic has required may usher in a lasting drop in emissions.

"If you say, 'Everything's a disaster and we need to radically overhaul society,' there's a feeling of hopelessness," Raftery said. "But if we say, 'We need to reduce emissions by 1.8% a year,' that's a different mindset."

More information: *Communications Earth & Environment*, [DOI: 10.1038/s43247-021-00097-8](https://doi.org/10.1038/s43247-021-00097-8)

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