

EXHIBIT

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We only have a 5 percent chance of avoiding 'dangerous' global warming, a study finds

By **Chris Mooney** July 31

In recent years, it has become increasingly common to frame the climate change problem as a kind of countdown — each year we emit more carbon dioxide, narrowing the window for fixing the problem, but not quite closing it yet. After all, something could still change. Emissions could still start to plunge precipitously. Maybe next year.

This outlook has allowed, at least for some, for the preservation of a form of climate optimism in which big changes, someday soon, will still make the difference. Christiana Figueres, the former head of the United Nations' Framework Convention on Climate Change, recently joined with a group of climate scientists and policy wonks to state there are three years left to get emissions moving sharply downward. If, that is, we're holding out hope of limiting the warming of the globe to below 2 degrees Celsius (3.6 degrees Fahrenheit) above pre-industrial temperatures, often cited as the threshold where "dangerous" warming begins (although in truth, that's a matter of interpretation).

Yet a battery of recent studies call into question even that limited optimism. Last week, a group of climate researchers published research suggesting the climate has been warming for longer than we thought due to human influences — in essence, pushing the so-called "preindustrial" baseline for the planet's warming backwards in time. The logic is clear: If the Earth has already warmed more than we thought due to human activities, then there's even less remaining carbon dioxide that we can emit and still avoid 2 degrees of warming.

Two new studies published Monday, meanwhile, go further towards advancing this pessimistic view which asserts that there's little chance of the world will stay within prescribed climate limits.

The first new study calculates the statistical likelihood of various amounts of warming by the year 2100 based on three trends that matter most for how much carbon we put in the air. Those are the global population, countries' GDP (on a per capita basis), and carbon intensity, or the volume of emissions for a given level of economic activity.

The research finds that the median warming is likely to be 3.2 degrees Celsius, and further concludes that there's only a 5 percent chance that the world can hold limiting below 2 degrees Celsius and a mere 1 percent chance that it can be limited below 1.5 degrees Celsius (2.7 degrees Fahrenheit). That will come as bad news for vulnerable small island nations in particular, which have held out for a 1.5 degree target, along with other particularly vulnerable nations.

"There is a lot of uncertainty about the future, our analysis does reflect that, but it also does reflect that the more optimistic scenarios that have been used in targets seem quite unlikely to occur," said statistician Adrian Raftery of the University of Washington, Seattle. Raftery conducted the study, which was just published in *Nature Climate Change*, alongside colleagues at the University of California, Santa Barbara and Upstart Networks.

Here's a figure from the study, showing the range of expected temperatures that the study found:

The research is significant because 2 degrees Celsius has often been regarded as the threshold for so-called "dangerous" climate change. Figueres herself put it this way in an interview with CBS News: "Science has established for quite a while that we need to respect a threshold of 2 degrees, that being the limit of the temperature increase that we can afford from a human, economic and infrastructure point of view."

The second new study, meanwhile, takes a different approach, analyzing how much global warming the world has already committed to, since the warming due to some emissions has not yet arrived. Nonetheless, with the planet at a so-called energy imbalance, that warming is inevitably coming, and the study — conducted by Thorsten Mauritsen of the Max Planck Institute for Meteorology in Germany and Robert Pincus of the University of Colorado, Boulder — finds that it probably pushes us several slivers of a degree beyond where we are now.

The upshot is that we may already have firmly committed to 1.5 degrees Celsius of warming even if emissions were to stop immediately and entirely (which is not going to happen). One scenario presented in the study finds a 13 percent chance that 1.5 degrees is already baked in; another finds a 32 percent chance. And again, the margin for avoiding 2 degrees C narrows accordingly.

So what should we make of all of this?

On Monday I spoke with Glen Peters, a climate policy expert at the Center for International Climate Research in Oslo, about the two latest papers. Peters is a researcher who is on the record stating that he thinks there's little chance of holding warming to 2 degrees Celsius unless we come up with so-called "negative emissions" technologies that allow us to actively withdraw carbon dioxide from the atmosphere later in the century.

Somewhat surprisingly, though, Peters actually felt that the first new study, finding only a 5 percent chance of staying below 2

degrees, might be a tad too negative. It takes into account past climate policies, he notes, but not the possibility of a major upsurge in global climate action in coming years, unlike what we've seen previously. Indeed, the study notes that "Our forecasting model does not explicitly incorporate future legislation that could change future emissions."

"Less than 2 degrees of warming is unlikely if we don't try," said Peters. "I'm one that says that 2 degrees is not likely anyway — but if we try, at least it's an option that we can get to 2 degrees."

(Raftery, speaking about this aspect of his study, noted to me that "I think it's possible that the future might be completely different, and there'll be a sudden big jump forward, but past data would suggest that's being a bit optimistic.")

However, at the same time Peters also admitted that the study about committed warming reinforced a troubling conclusion, since "it's in a sense impossible that we're not going to emit any more." The upshot is that "We're starting from 1.5 and going up from there in the future emissions that we have," he said.

This again means that negative emissions, based on technologies that don't exist yet at the relevant scale, would probably be required at some point in the future. The new research "emphasizes the importance of removing carbon from the atmosphere," said Peters.

None of this news brings us into the range of the worst-case climate scenarios portrayed in a recent New York Magazine article, whose conclusions — many of which were disputed by many climate scientists — were based on levels of warming far beyond 2 degrees Celsius.

The upshot of all the latest research, however, is that while limiting warming to 2 degrees is seeming unlikely, and 1.5 degrees nearly impossible, staying within something like 2.5 degrees still seems quite possible if there's concerted action. And who knows whether in thirty years, negative emissions may appear much more feasible than they do now, providing the option of cooling the planet back down again at some point.

In sum, climate pessimism has indeed had a strong run lately — but you have to keep in context. It's pessimism that we'll hit our current goals. It's not fatalism, or the idea that we'll accomplish nothing, or that present momentum doesn't matter.

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