Will Earth truly cool down after net-zero, or are we locked into millennia of Anthropocene heat?

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We imagine that if global emissions are reduced, the problem will sort

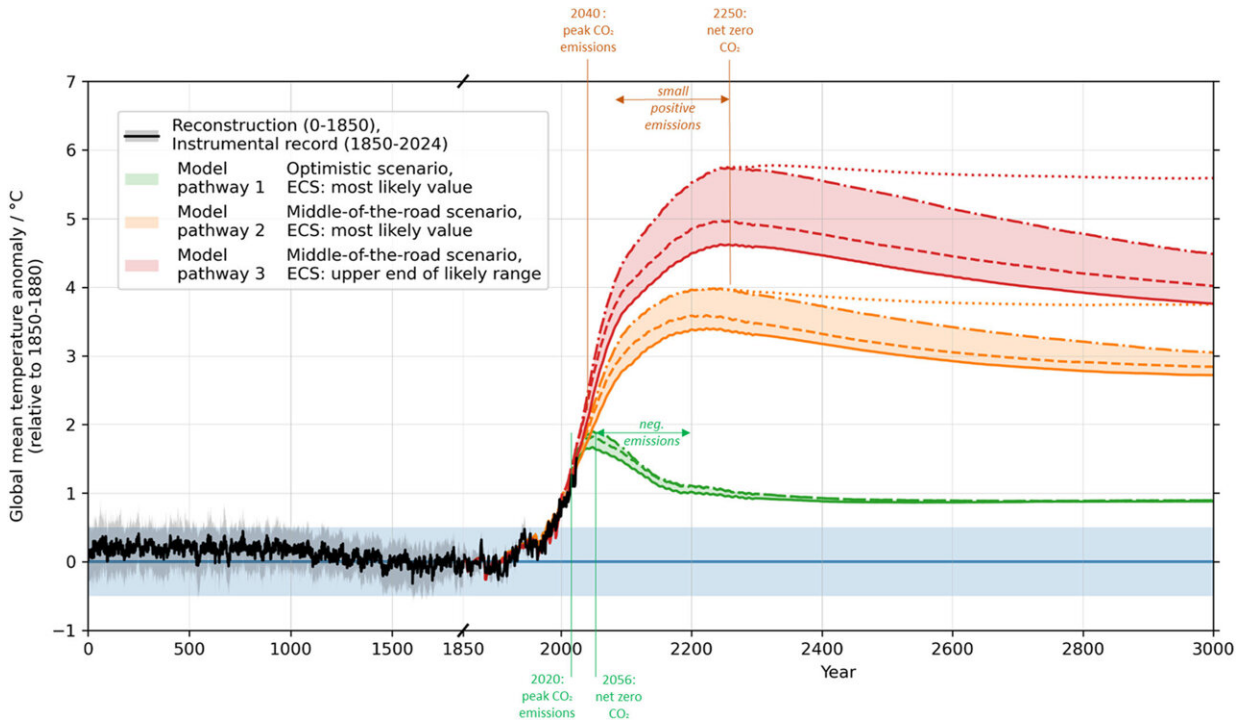
itself out. It actually takes much more time than we can imagine—sometimes hundreds or even thousands of years. We have entered a very crucial stage called the Anthropocene, which literally means the effect of humans on Earth in a deep sense and raises an essential question of what our modified planet may have in store for the future.

Scientists are warning that due to minor unavoidable emissions, the planet will remain stuck in a warmer state for thousands of years. That means we may be stuck in the "quicksand" of the Anthropocene. A new study published in *Earth's Future* focuses on a long-term perspective associated with climate.

Locked in long-lasting heat

Even if we slashed emissions tomorrow, the climate wouldn't quickly snap back. One reason: Carbon dioxide lingers. Studies estimate that roughly 20% of CO_2 stays in the air for centuries, with the very last 10% taking tens of thousands of years to disappear. Once emitted, CO_2 warms the planet for a very long time.

The new study highlights a striking result: "The smallest unavoidable residual emissions (e.g., from the food sector) risk perpetuating global warming even without other human forcing."



Three roads ahead: Visualizing Earth's temperature future. This chart maps out potential global temperature changes until the year 3000 under different scenarios. Notice how even the most optimistic path (green) shows a sustained warming, while others (orange and red) climb much higher, revealing a long-term commitment to heat. Credit: *Earth's Future* (2026). DOI: 10.1029/2025ef007730

Even negligible ongoing emissions—say, from agriculture or land use—could lock Earth into a warm state. This is alarming because the Intergovernmental Panel on Climate Change (IPCC) says many climate changes, such as melting ice and ocean warming, are basically irreversible on timescales of centuries to millennia.

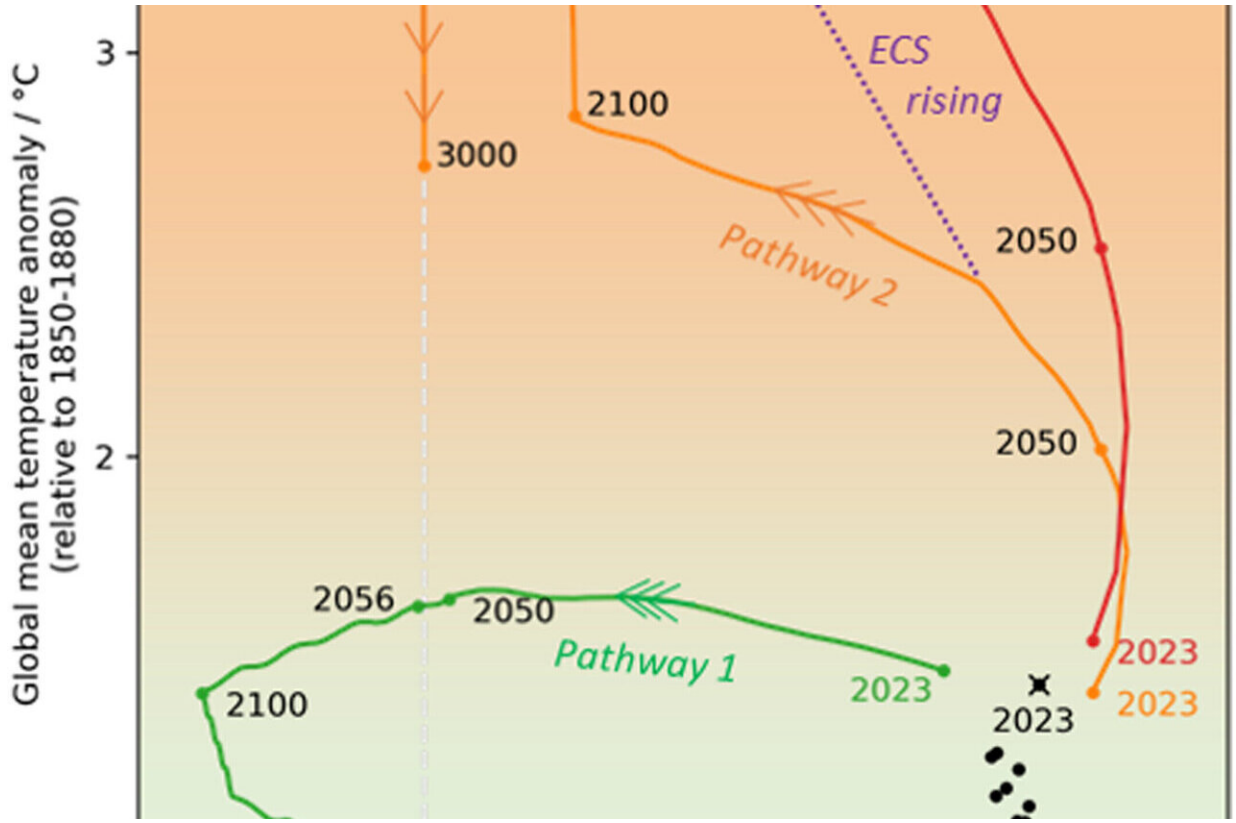
Put together, it means that if we don't reach zero, our temperature rise could be locked in for generations.

Three possible futures

So where do we go from here? The researchers lay out three possible outcomes for the future. A "manageable" Anthropocene, or "green" pathway, is characterized by a sharp reduction in our greenhouse gas emissions, along the lines of the stringent mitigation pathways laid out by the IPCC, such as SSP1–1.9. Under this pathway, global warming peaks at about 1.5°C above preindustrial levels sometime during midcentury and gradually decreases afterward.

The second pathway is that of a "dangerous" Anthropocene, which takes an intermediate path resembling SSP2–4.5. This involves continuing emissions until sometime after midcentury, when global temperatures reach about 2°C above preindustrial levels by the end of the century and subsequently stabilize there.

In the third and most extreme scenario of an "unmanageable" Anthropocene, also referred to as the "red" pathway, dangerous feedback mechanisms act to increase warming. In this case, an intermediate emission scenario, such as SSP2–4.5, combined with high climate sensitivity results in unstoppable global warming.



Navigating the anthropocene: Where human choices meet earth's response. This conceptual map illustrates how our actions (horizontal axis) and Earth's reactions (vertical axis) combine to shape our future. The green, orange, and red zones hint at manageable, dangerous, and unmanageable outcomes, with surprising Earth system shifts potentially pushing us into hotter territories. Credit: *Earth's Future* (2026). DOI: 10.1029/2025ef007730

Trapped in quicksand

No matter the path, feedback looms large. If warming crosses certain thresholds, Earth's own systems—melting permafrost, drying forests, reduced Arctic ice—could feed back to amplify heat.

The authors warn that in such a case, natural feedbacks might dominate

over our direct emissions—a truly "unmanageable" outcome.

In their words, "We are already stuck in a figurative 'Anthropocene quicksand,' where only an active pull can free us from consequences like global heating."

Scientists agree that without human intervention, this feedback could keep the planet dangerously warm for ages. For example, the IPCC finds that if certain tipping points are triggered, sea-level rise and other changes will remain elevated for thousands of years.

Despite best-case emissions reductions, Earth's climate has a long memory. Even if warming is halted, temperatures and sea level stay high for centuries. Ice that melts stays melted, and oceans that warm stay warm.

The study's bleak image is this: Absent aggressive mitigation, the planet might take thousands of years to cool back down.

The long road ahead

Our current actions will have remarkable effects in the future. According to the scientists, the window to keep Earth in a "manageable" state is not yet closed. We can only prevent ourselves from getting stuck in quicksand by urgently driving emissions down to near-zero and even taking carbon out of the atmosphere.

Although there are some worrisome paths in the outlook, they are not fated. There's still time for us to act. The future will experience less warming for every piece of carbon we don't emit.

The study drives home a stark reality: We cannot afford complacency. Even the small but steady emissions that keep coming day in and day out

result in something huge when looked at across thousands of years.

Those at the top need to realize that our choices will have grave consequences. If we do not act, we shall sink ever deeper into the quicksand of the Anthropocene and its climate impacts. By working together to lower emissions and increase the planet's resilience, we could help the planet stay on course for the future.

More information: Johan Rockström et al, We Are in the Anthropocene—Now What?, *Earth's Future* (2026). DOI: 10.1029/2025ef007730