Rethinking how to measure methane's climate impact

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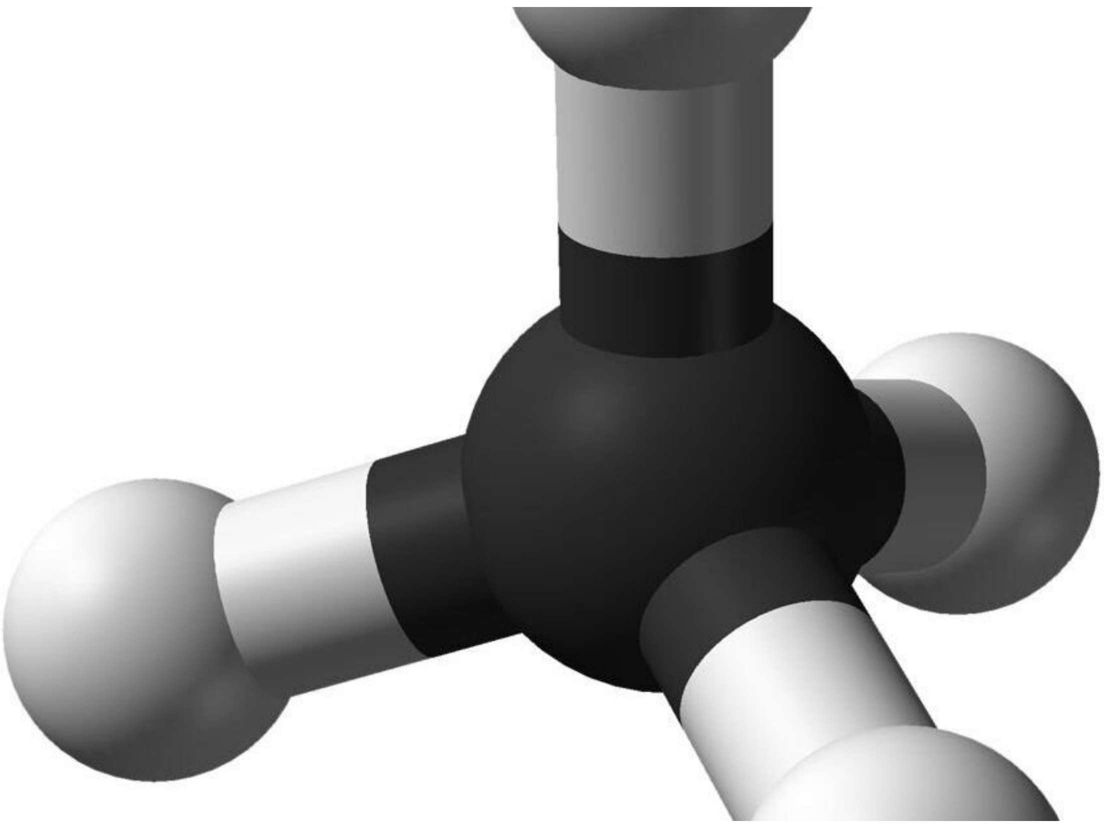

Ball and stick model of methane. Credit: Ben Mills/Public Domain

Like boxers whose punching power declines over their careers, greenhouse gasses lose their warming impact at different rates. So, to compare gasses' climate changing potential to the most common greenhouse gas—carbon dioxide—international negotiators often use a metric that measures their influence on global warming over a 100-year timeframe.

A new Stanford University study published Jan. 26 in *Environmental Research Letters* indicates that approach underestimates methane's importance in achieving the Paris Agreement climate goals by up to 87%. Instead, the scientists propose using a 24-year timeframe instead, consistent with the goal of keeping global temperature increases below 1.5 degrees Celsius above pre-industrial levels. The researchers argue their approach would ensure emissions of methane, a potent but comparatively short-lived gas, are weighted correctly over the time period before such temperature thresholds are crossed. This, in turn, could help countries more quickly prioritize reducing methane emissions—an essential step toward slowing global warming.

Below, the study's lead author, Sam Abernethy, and senior author, Rob Jackson, discuss the history of the current global warming potential metric, how a shorter timeframe could help policymakers realign their climate commitments and more.

Jackson is the Michelle and Kevin Douglas Provostial Professor of Energy and Environment in Stanford's School of Earth, Energy & Environmental Sciences, and a senior fellow at the Stanford Woods Institute for the Environment and the Precourt Institute for Energy. Abernethy is a Ph.D. student in applied physics and earth system science who works in Jackson's lab.

Why is the 100-year time horizon commonly used for emissions metrics?

Jackson: Carbon dioxide lingers in the atmosphere for thousands of years. Nitrous oxide tends to last a century or so. Methane's lifetime is closer to a decade. The 100-year timeframe is both a compromise and a convenient round number acknowledging the different lifetimes of greenhouse gases.

Abernethy: Going back to the early Intergovernmental Panel on Climate Change reports, 20, 100 and 500-year time horizons were used as representative examples for which time horizons could be chosen. It seems like 100 years was chosen for the Kyoto Protocol and subsequent climate policy mainly just because it is the middle value of these three.

If international climate change agreements, such as the Paris Agreement, target temperature goals, why haven't they incorporated into emissions metrics time horizons that specifically account for those goals?

Abernethy: That question led me to do this research, and write this paper. One answer is that there wasn't previously a way to do this before the development of a scenario database of potential future climate pathways. I think another aspect is that the Paris Agreement goals are sufficiently vague that you have to pick one specific aspect to focus on. I looked at the temperature goal, but there is also a goal to have net zero emissions.

How might a 24-year time horizon alter the way we judge countries' climate commitments and what the world needs to do to reach goals set by the Paris Agreement?

Jackson: We need to reduce emissions of carbon dioxide in all scenarios, near and far. The more aggressive the temperature goal is, however, the more important potent, shorter-lived greenhouse gases such as methane become. To keep global temperature increases below 1.5 or 2 degrees Celsius above pre-industrial levels—the two Paris Agreement goals—countries need to commit to reducing methane emissions faster. In truth, some countries have yet to make methane commitments at all.

Abernethy: Using a shorter time horizon, such as 24 years, would alter the magnitudes of commitments already made by valuing methane reductions significantly more. It would also align the commitments with the Paris Agreement temperature goals. This would result in countries with aggressive methane mitigation plans and pledges having their actions towards methane reduction be more highly valued and therefore more incentivized.

What are some examples of how and why political perspectives and vested interests might favor certain time horizon?

Abernethy: Since the variation in emission metrics is so huge between 20- and 100-year time horizons, there is substantial opportunity to use whichever number best suits you for your application. Perhaps countries with huge dairy and agricultural industries would prefer to downplay methane and use a 100-year timeframe. Those who want to draw attention to methane, such as opponents of liquefied natural gas, would prefer a 20-year timeframe.

What are some likely examples of how your approach could be used by policymakers to plan for specific climate goals, e.g. net zero emissions?

Abernethy: I think that our approach should be used by policymakers to choose emission metrics that align with the specific climate goal of temperature stabilization, and then use these emission metrics to define what it means to have net zero emissions.

Jackson: The Biden administration's explicit goal is to stabilize global temperature increases below 1.5 °C. Yet the EPA uses a GWP for methane of 25, below even the commonly used value for a 100-year timeframe. The EPA's value for methane mitigation is out of step—at least three times too low—with realizing the administration's target.

More information: Global temperature goals should determine the time horizons for greenhouse gas emission metrics, *Environmental Research Letters* (2022). DOI: 10.1088/1748-9326/ac4940

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