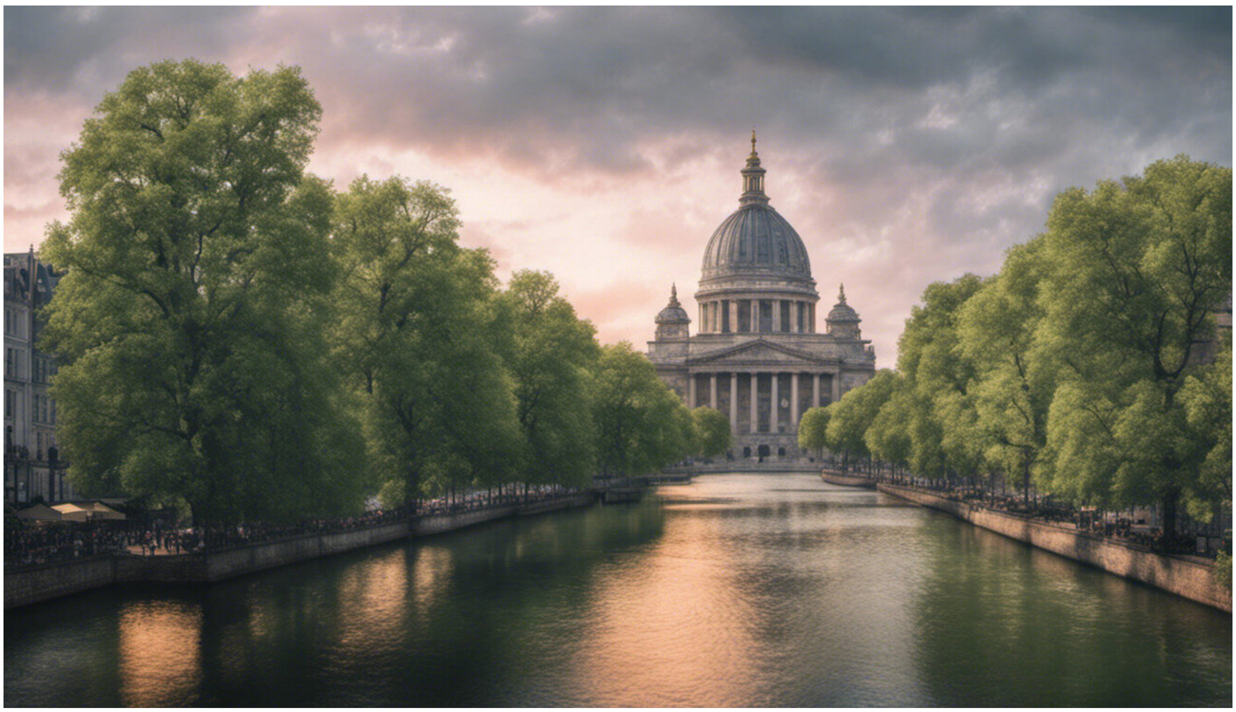
A new way of comparing greenhouse gases could help us meet Paris Agreement goals

June 2 2021, by Katsumasa Tanaka, Johannes Morfeldt and Olivier Boucher



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According to the Paris Agreement, the world needs to limit global warming to well below 2°C and to strive toward a 1.5°C increase above pre-industrial levels. How can we meet this goal at the lowest cost? In a May 2021 study, we try to answer this question. Our research found that we can meet the goals at a lower cost if we change how we value different greenhouse gases.

Not all greenhouse gases affect global temperature in the same way. Long-lived gases build up in the atmosphere over a long period while short-lived ones will disappear relatively soon from the atmosphere after they are emitted.

Carbon dioxide is an example of a long-lived climate gas and methane is an example of a short-lived one. Emissions of carbon dioxide cause an increase in temperature that lasts for centuries. Methane emissions, on the other hand, affect the temperature for just a few decades. This means we need to value them differently over different time periods.

The cost of climate actions per ton of reduced emissions depends on the type of action taken and when it is put into place. For example, you might consider choosing either to insulate your house (a mature technology) or to switch to an electric car (a less mature and still expensive technology). It is less costly to choose the first option today, and do the second later. New technologies become both cheaper and more efficient as they mature and that's why we need to properly analyse when it is appropriate to do what.

The same can be said for different greenhouse gases—the value of carbon dioxide and the value of methane should change based on the time period and the different global warming scenarios we are facing.

There is no argument that carbon dioxide emissions need to be cut significantly to achieve the long-term temperature goal of the Paris Agreement. But our study shows that, during certain periods, it may be useful to focus more on reducing short-lived climate gases.

Global warming potential

The current metric used to compare the effects of different greenhouse gases is known as global warming potential, or GWP. It helps us understand how the earth's energy balance is affected by emissions of each greenhouse gas over a given timeframe. Depending on the timeframe, the scale can flip in favour of short-lived or long-lived greenhouse gases.

The current timeframe for global warming potentials is 100 years has been criticized since it does not relate unequivocally to the goals of the Paris Agreement.

In our study, we found that we don't need to fundamentally change the concept of how to value greenhouse gases. It's instead enough to change the timeframe used for global warming potential as we go, rather than keeping it fixed at 100 years.

Overshoot scenarios

Our finding are most relevant if we enter an "overshoot scenario." Such a scenario is one where we don't manage to hold the global temperature increase to below 1.5°C (or 2°C), overshooting the target during a certain period before we bring the increase back down.

Emission reductions of methane and other short-lived climate gases could play an important role in such a scenario, especially when the temperature needs to be lowered. That's because methane has a greater short-term effect on temperatures than carbon dioxide.

The figure below shows five pathways for the global mean temperature (the first panel). The 1.5 degree C medium overshoot and 2 degree C stabilization can be considered in line with the goals of the Paris Agreement, while the remaining overshoot scenarios show cases where those goals are not met. We covered a wide range of future scenarios, including a case with a peak warming up to about 3°C, reflecting the current climate policies. The figure shows the adopted timeframe that would achieve each pathway at the lowest cost (the second panel).

We see a gradual shift from using the 100-year timeframe to a 20-year timeframe as we approach the year when the overshoot has passed. We would use the methane to bring the temperature level back down after overshooting the target. This is done by giving the gas a higher value during that period (one ton of methane is worth 28 tons of carbon dioxide for the 100-year timeframe but as much as 84 tons of carbon dioxide for the 20-year timeframe). Giving methane a higher global warming value will mean we emit less of it during the overshoot period, which will bring temperatures back down more quickly.

We found that the 100-year timeframe works pretty well for the coming decades in all scenarios that we analyzed. So, this is not an urgent matter. But it is an important safeguard for us to get back on track at a relatively low cost in case we do enter an overshoot scenario.

Changing timeframes

One of the important stepping stones in getting there was the adoption of the Paris Rulebook at COP24 in Katowice. The rulebook essentially lays out how countries should work together in order to achieve the goals of the Paris Agreement. One of the rules is which method to use when weighing different greenhouse gases, known as "common metrics" in climate circles.

The common metrics that countries decided on are the 100-year time-horizon global warming potential values from the IPCC Fifth Assessment Report. The method is not only used for statistics but also when designing future scenarios, countries' plans for reducing emissions, and in implementing climate policies, for example the EU Renewable Energy Directive.

The fact that the method is common to all countries is an important step forward to make it easier to compare emissions and actions between countries. Therefore, this rule might be tricky to change in the future without opening a new discussion.

Instead, we suggest to assess the costs of using different timeframes for global warming potentials as our future temperature pathway unfolds. This could be part of the technical assessment of the five-year cycle for increasing ambition. The five-year cycle is a cornerstone of the Paris Agreement and includes the "global stocktake" where countries meet to discuss their collective progress toward the goals.

This would be a great opportunity to also discuss whether the timeframe of the "global warming potential" for the possible temperature pathway is suitable and suggest adjustments accordingly. An adjustment of the timeframe, if it is made at right time, will save costs and allow us to more effectively manage the effects of climate change through mitigation.

Provided by The Conversation

Citation: A new way of comparing greenhouse gases could help us meet Paris Agreement goals (2021, June 2) retrieved 26 April 2024 from https://phys.org/news/2021-06-greenhouse-gases-paris-agreement-goals.html