RAMPING UP METHANE EMISSIONS REDUCTIONS IN THIS DECADE

Implications of methane emissions for near- and medium-term warming

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- Maximum and immediate methane abatement is crucial to limiting temperature increase over the next 12 years, helping achieve global climate goals, and averting the worst impacts of climate change. Swift action to reduce methane emissions, largely from oil and gas operations, can **slash global methane emissions by over 120 million metric tons in 2030 from 2020 levels and achieve an ambitious goal of 30% methane emissions reductions by 2030** from 2020 levels.
- A reduction of 120 million metric tons of methane corresponds to 3.4 gigatons of carbon dioxide equivalent over a 100-year timeframe. However, this understates methane's actual near-term impact. If we use a more appropriate short-term metric of a 20-year global warming potential (GWP 20), **methane reductions over the next twenty years make up nearly 50% of the needed emissions progress until 2030 (accounting for 10 of 21 gigatons carbon dioxide equivalent using GWP20)**. GWP20 reflects the impact of current methane emissions on climate behavior in the 2030s.
- **A robust and effective strategy to meet this ambitious goal includes a reduction of oil and gas emissions by about 85%**, reducing coal methane emissions by at least 50%, and reducing landfill methane emissions by at least 25%.
- **Immediate methane action alongside carbon dioxide mitigation is essential to slow our approach to 1.5°C and reduce a global temperature overshoot.** Cutting methane by 30% would avoid a near-term temperature increase of 0.06°C by 2035—or a rise of 0.28°C instead of 0.34°C without focused methane abatement—marking a tangible shift toward a cooler, more sustainable planet.
- Reducing carbon dioxide emissions is critical to long-term climate stabilization but has only a small impact in the near term due to the longer lifetime of carbon dioxide in the atmosphere and the offsetting role of cooling aerosols. **Rapid abatement of both methane and carbon dioxide over the next decade can moderate near-term temperature change and deliver longer-term temperature stabilization** compared to focusing on only methane or carbon dioxide abatement.
- **Research, demonstration, and above all, deployment within the next few years is crucial to enable near-term methane reductions.** New policies and, in some cases, financial assistance will be needed. But even with today's landscape, we can confidently say that reducing industrial methane emissions from factories, mines, wells, and more is the single biggest deployable, practical, and affordable emissions reduction strategy available to reduce climate risk from 2025-2035.

In the urgent battle against climate change, reducing global methane emissions makes a particularly important near-term impact on mitigation efforts and provides health, environmental, and societal benefits. Unlike carbon dioxide (CO_2) emissions, which linger for centuries, methane's ~10-year lifespan means that slashing its emissions by 30% by 2030—the established goal of the Global Methane Pledge—can rapidly curb the short-term rate of global temperature warming. To understand the impact of such a global effort, we analyze what cutting methane emissions by 30% over the next decade could do for global temperature rise compared to focusing only on reducing CO_2 and associated greenhouse gases (GHG).

Our analysis finds a 30% reduction in methane emissions would avoid a temperature increase over the next 12 years of 0.06°C—or a rise of 0.28°C instead of 0.34°C without dedicated methane abatement—marking a tangible shift toward a cooler, more sustainable planet. On the other hand, reducing only CO_2 emissions has a much slower impact on global temperature rise due to the longer lifetime of CO_2 in the atmosphere and the offsetting role of cooling aerosols, particularly sulfur dioxide (SO_2), that are also reduced when fossil fuel use declines. Immediate reduction of methane and CO_2 emissions play distinct key roles in the global transition, but the role of methane reductions in the near term is underappreciated. Even with steadily decreasing CO_2 emissions, ultimately reaching net-zero around 2050, in 2045, as we approach the finish line, over half of the potential global temperature decrease in our scenario stems from dedicated methane abatement. Prioritizing methane abatement in this decade reflects the reality that addressing methane emissions now is not just a temporary fix but a strategic move, uniquely essential for the 2030s but which continues to make a vital contribution, even as we transition towards a carbon-neutral future.

Uncertainty about methane emissions by source is still larger than, for example, estimates for CO_2 emissions from fossil fuels. Advances in measurement, both on-site and remotely via satellites, point to a larger contribution from oil and gas production than implied by national emission inventories. This uncertainty, however, merely makes it more vital to eliminate every possible ton of escaped methane. A robust and effective strategy to achieve a 30% reduction by 2030 includes a reduction of oil and gas emissions by more than 85%, reducing coal methane emissions by at least 50%, and reducing landfill methane emissions by at least 25%. These reductions can compensate for only limited increases in agriculture methane to ensure adequate food production due to increased demand. Our scenario foresees slightly higher reductions from oil and gas at 86%, in line with a combined leakage rate of 0.2% for oil and gas production. Of the overall methane abatement of 120 metric tons of methane ($MtCH_4$) from 2020 to 2030, 84 $MtCH_4$ are thus achieved in oil and gas, with the remainder of the reductions coming from waste and coal.

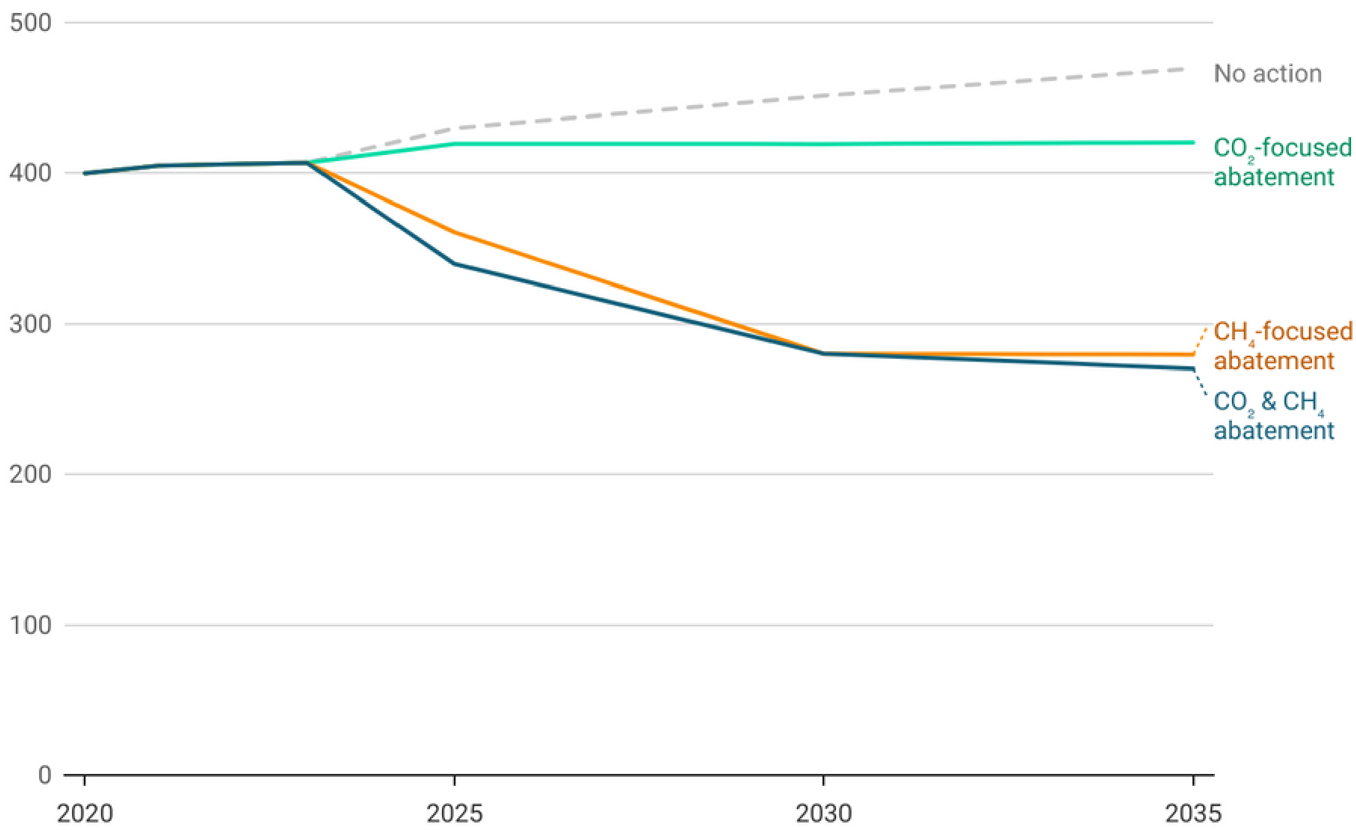

Figure 1: Methane emissions reductions potential. Impact on methane emissions reductions ($MtCH_4$) potential given varying prioritization of methane abatement in comparison to action to reduce other GHGs through 2035. If only CO_2 is the focus of abatement, methane emissions will somewhat decline as fossil fuel production decreases. A dedicated focus on methane abatement has a much larger impact on methane emissions. The combined CO_2 and methane abatement scenario also includes abatement of all other GHGs (N_2O, HFCs and other F-gases).

Table 1: Temperature effects in 2035 and 2045 across the four scenarios and the impact of temperature increase and avoided temperature increase compared to the "no action" scenario

	2035	**2045**
	Global temperature increase from 2023	
No action	0.34°C	0.65°C
	Avoided global warming relative to the "no action" scenario	
CO_2-focused abatement	0.00°C	-0.10°C
CH_4-focused abatement	-0.06°C	-0.13°C
CO_2 & CH_4 abatement	-0.06°C	-0.22°C

In our scenario with combined reductions of all GHGs—"CO_2 & CH_4 abatement"—methane reductions account for roughly 25% of the overall abatement (3.4 of 14.2 $GtCO_2e$) if measured in the typical 100-year global warming potential (GWP100) metric, which is the commonly used metric for aggregating emissions across different gases. This metric, however, measures the impact over a 100-year time horizon and is thus irrelevant for the next few crucial decades, which especially makes a difference in understanding the role of the relatively short-lived greenhouse gas methane. Using the alternative metric of a 20-year global warming potential (GWP20), methane contributes roughly 50% of overall emissions reductions until 2030 (10.1 of 20.9 $GtCO_2e$), reflecting better the crucial role of methane emission reduction for the short-term evolution of global temperature.

This illustrates the care that must be taken to compare methane and CO_2 emission reductions. Because the time horizon over which these impact global temperature are so different (see Figure 2), it is impossible to define a methane emissions "equivalent" in any precise manner. Over the next 15-20 years, CO_2-focused reduction has minimal impact on global temperatures. However, early CO_2 reductions are critical for long-term temperature stabilization. In contrast, near-term methane reductions can reduce temperatures in the near-term.

Given inertia in the global climate (and energy) system, it is inevitable that global temperature will continue to increase over the next two decades, which will also result in increases in the various impacts of climate change, such as the severity and frequency of extreme heat, changes in rainfall patterns, melting of ice sheets and sea level rise which results both from the melting of ice sheets on land masses, and the thermal expansion of the oceans. The speed at which temperatures and the associated impacts increase matters greatly, as a lower rate of increase allows for better adaptation. Our analysis of the differentiated impact of dedicated methane abatement shows that methane emissions reductions is our single biggest tool for slowing down global warming in the coming years. Some methane reductions are fairly easy to implement and can even pay for themselves, as recovered methane that has not leaked into the atmosphere can be sold as natural gas or used productively on-site and thus has economic value. However, the deep reductions assumed in our scenario will also require more costly measures, dedicated funding, additional policy actions, and the development of more novel and better technologies to measure methane emissions and their control.

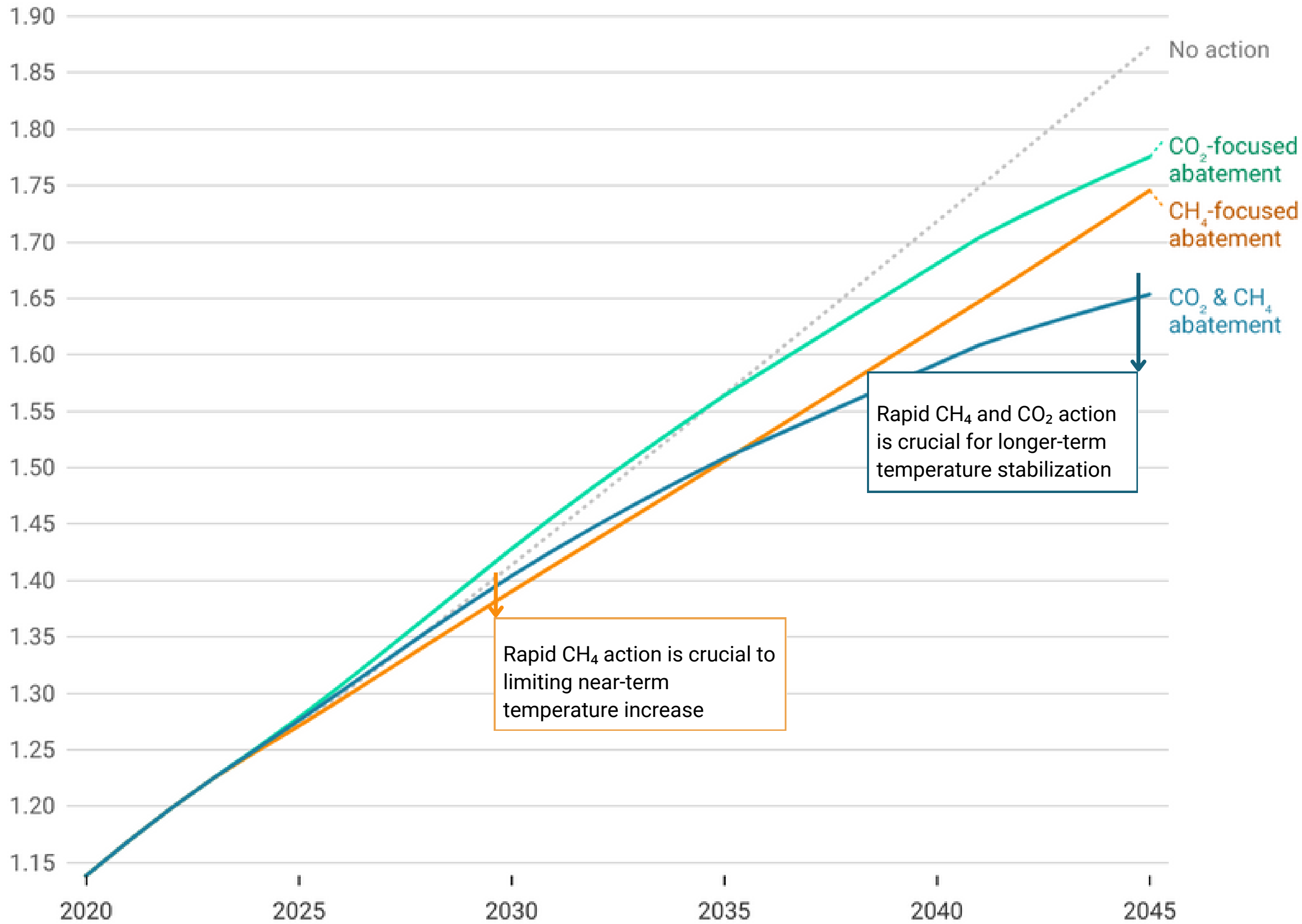

Figure 2. Carbon & methane global warming from 2020-2045. Global temperature projections in degrees Celsius under varying prioritization levels of methane abatement.

Methodological summary: The analysis used the integrated assessment model GCAM, version 7.0. Scenarios assume abatement along a defined marginal abatement cost path, either on only CO_2, methane, or all GHGs. Considering that we are at the end of 2023, only limited abatement is assumed for the model period 2025 (GCAM operates in 5-year time steps). Global temperature change is calculated by feeding each GHG and air pollutant emissions into GCAM's internal climate emulator HECTOR. We use annual historical emission trajectories through 2022 and a projected estimate for 2023, so the scenarios do not start diverging until 2024. For the CO_2-focused policy, CO_2 emissions are constrained within GCAM to decline roughly linearly from 2024 to zero around 2050, reducing methane and air pollutants emissions.

For this analysis, we have further recalibrated the methane emissions from oil and gas in GCAM and HECTOR to match the higher numbers in various countries from the IEA. We also use the assumptions on marginal abatement cost curves for methane abatement in the oil and gas sector from IEA. Given various inertia in the representation of abatement in GCAM, the model internal results still indicate a gap between modeled mitigation and the 30% methane target in 2030, illustrating the need for dedicated support for such a target. In the emission pathway shown above and the numbers cited, which are the basis for the temperature assessment, we thus assume additional abatement becomes available such that global anthropogenic methane emissions are reduced by 30% by 2030.

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