The Global Methane Pledge and 1.5°C

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Summary

- 53 countries have signed up to the Global Methane Pledge, committing to cut methane emissions by 30% in 2030 from 2020 levels. In 2019, these countries made up 30% of global methane emissions and around 34% of total global greenhouse gas (GHG) emissions. They also constitute 59% of global GDP. Roughly 25 further countries have reportedly signed up to the pledge, however, this list has not been confirmed. We do know it does not yet include the large methane emitters Russia, China, or Brazil.
- Global IPCC pathways consistent with the Paris Agreement's 1.5°C limit reduce methane emissions by 34% [25-53%] in 2030 relative to 2020 levels. The Global Methane Pledge is close to, but not fully in line with 1.5°C scenarios.

The impact on the emissions gap

- If all countries committed to, and achieved, the Global Methane Pledge, **methane reductions alone would close the 2030 emissions gap by 14%.** The emissions gap is the difference between where global greenhouse gas emissions are heading under current pledges and where we would need to be for 1.5°C in 2030.

It is extremely important to recognise that methane and CO_2 reductions are interlinked

- Stringent methane emissions reductions are directly linked to deep reductions of CO_2 needed by 2030 in 1.5°C compatible pathways. This is because a significant share of methane and CO_2 emissions originate from the same source: fossil fuel use. In emission pathways consistent with the Global Methane Pledge, 60% of methane reductions **would be achieved by curbing future use of fossil fuels.**
- Scenarios aligned with the methane pledge would also see stronger reductions in CO_2 than in current climate targets. On average CO_2 emissions fall by 37% between 2020 and 2030 in those scenarios, mostly driven by energy-related emissions reductions. Countries could strengthen the credibility of this pledge by demonstrating how they will achieve it by setting stringent emission targets for all greenhouse gases.
- If total GHG emissions reductions were aligned with the ambition implied in the **Global Methane Pledge, 50% of the 2030 emissions gap to 1.5°C would be closed**. This is because cost-effective methane reductions are a result of cost-effective CO_2 reductions.

Cooling from methane reductions is crucial to balance warming from reducing dangerous air pollution

- If fossil fuel use is reduced in line with 1.5°C pathways, the cooling effects of lower levels of methane would balance the warming effects of lower levels of aerosols (also emitted by fossil fuel combustion).
- The claim that methane reductions would cool the planet is not necessarily correct, as they would not take place in isolation. However, reductions will play a critical role if accompanied by rapid CO_2 emissions reductions.

The Global Methane Pledge indicates a significant and substantial signal towards stronger mitigation efforts. Its achievement would make an important dent in the total 2030 emissions gap. However, governments need to come forward with equivalent action on CO_2, in order to make significant progress towards achieving the Paris Agreement.

If governments implement the level CO_2 reductions implied by this pledge through curbing fossil fuel use - then we'd really be getting somewhere.

The Global Methane Pledge compared with the IPCC's 1.5°C Scenarios

Methane is a powerful greenhouse gas that needs to be reduced along with CO_2 in order to achieve the 1.5°C warming limit of the Paris Agreement. In an effort spearheaded by the European Union and United States, 53 countries to date have joined a Global Methane Pledge[1], promising to reduce methane emissions 30% by 2030 relative to 2020 levels. In 2019, these countries made up 30% of global methane emissions and around 34% of total global greenhouse gas (GHG) emissions. They also constitute 59% of global GDP. Roughly 25 further countries have reportedly signed up to the pledge, however, this list has not been confirmed. We do know it does not yet include the large methane emitters Russia, China, or Brazil.

In the most recent G20 communique, there was also a nod to methane, and countries committed to curb methane emissions in a "cost-effective" manner.[2]

In the IPCC's Special Report on 1.5°C[3], 53 individual emissions pathways were assessed as limiting warming to 1.5°C with no or very limited overshoot, in line with Articles 2 and 4 of the Paris Agreement. In all such pathways, methane emissions are reduced substantially by 2030. These cost-effective 1.5°C pathways are defined by mitigation measures which are either cheapest, most effective, or a combination of both.

Our analysis of these scenarios shows that in the ensemble median, a 34% (25-53% interquartile range) reduction in methane emissions is necessary to be compatible with the Paris Agreement's temperature goal. The Global Methane Pledge is short of the 1.5C limit, but within the range assessed by the IPCC in 1.5C pathways. It is important to note that the uncertainty range is uneven around the median, and the mean (the average over all pathways) shows a 40% reduction.

[1] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4785
[2] https://www.g20.org/wp-content/uploads/2021/10/G20-ROME-LEADERS-DECLARATION.pdf
[3] https://www.ipcc.ch/sr15/

The most recent IPCC WG1 report looked at illustrating pathways for a range of different climate outcomes, which were then run through complex climate system models - it assesses only five individual scenarios, given the long lead and execution times required to perform the complex climate simulations experiments. Among these, only one illustrative scenario can be considered 1.5°C compatible, the so-called SSP1-1.9 scenario. In this scenario, methane emissions reduce by 32% between 2020 and 2030. This is largely in line with the scenarios assessed previously in the SR15.

The methane pledge's impact on the emissions gap

The Climate Action Tracker (CAT), UNEP Gap Report, and UNFCCC Synthesis report all find a significant gap between current climate pledges and emissions reductions needed to achieve the Paris Agreement.

The CAT estimates the existing gap between 1.5°C compatible emissions and existing 2030 pledges to be approximately 21-23 Gt CO_2e. For our calculations, we use the conservative upper bound of this estimate.

If all countries were to join the Pledge and enact policies to achieve the 30% methane emissions reduction by 2030, that gap would narrow by 14%, assuming near-constant methane emissions in line with the UNFCCC synthesis report current targets scenario.[4] When we investigate cost-effective mitigation scenarios consistent with the Methane Pledge, we observe significantly more overall emissions reductions.

In other words, if countries were to align overall mitigation ambition with the levels implied by scenarios that meet the Methane Pledge, the emission gap to 1.5°C would close by 50%.

In a recent report, we estimated that the G20 has the potential to close three quarters of the gap to 1.5°C. If all countries were to reach the level of ambition implied by the Methane Pledge, the reductions would be equivalent to 75% of what the G20 has the potential to do on its own.

Methane and CO_2 reductions are interlinked

Stringent methane emission reductions are an integral part of, and to a significant extent, driven by, the deep reductions of CO_2 needed by 2030 in 1.5°C compatible pathways.

In 1.5°C compatible IPCC pathways, CO_2 is reduced by half (41-61% interquartile range) between 2020 and 2030. Large CO_2 reductions are seen in the energy supply sector, which

[4] This is the SSP2-45 scenario as published in Gidden, *et al*: Global emissions pathways under different socioeconomic scenarios for use in CMIP6: a dataset of harmonized emissions trajectories through the end of the century, Geosci. Model Dev., 12, 1443–1475, https://doi.org/10.5194/gmd-12-1443-2019, 2019.

also drives reduction in methane emissions through fuel switching, energy efficiency, and other measures.

Carbon emissions reductions form the largest component of total mitigation in these pathways, and drive substantial methane emissions reductions as part of an overall cost-effective mitigation strategy.

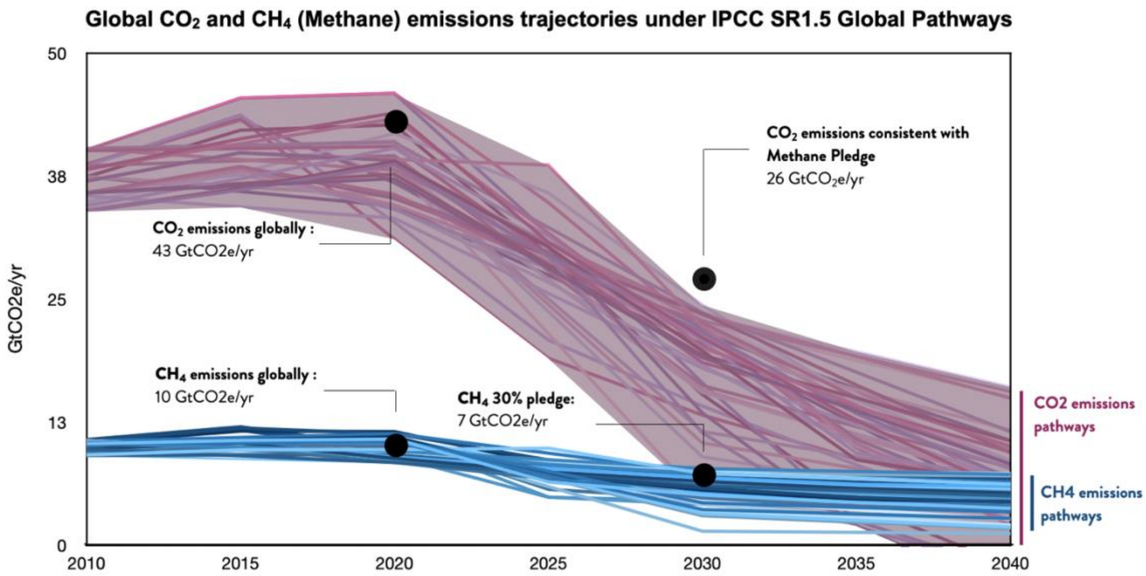

Figure 1. Global CO_2 and methane emission pathways consistent with the Paris Agreement 1.5°C goal including estimates of present day emissions and 2030 emissions under scenarios compatible with the Global Methane Pledge.

Cooling from methane balances warming from aerosols in 1.5°C pathways

After welcome calls to enhance mitigation and utilising best-in-class inventory quantification methodologies, the Global Methane pledge states that "[d]elivering on the Pledge would reduce warming by at least 0.2 degrees Celsius by 2050."[5]

This statement is somewhat misleading in the context of the overall temperature effect of mitigating all anthropogenic climate forcers, including aerosols, in 1.5°C pathways.

According to the IPCC AR6 Working Group 1 report, historic methane emissions have contributed to about 0.5°C of global temperature increase between 1850-1900 to 2010-2019. Over the same period anthropogenic aerosol emissions (air pollution) have contributed to cooling of about the same amount.

As aerosol emissions are linked to fossil fuel combustion, aerosol concentrations are expected to decrease rapidly under Paris Agreement compatible pathways, which would

[5] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4785

contribute to additional, and rapid warming.[6] But substantial methane emissions are also linked to fossil fuel production and use, and as a consequence, similarly fast methane reductions occur in 1.5°C compatible pathways that would roughly compensate for this effect.

This result was strongly emphasised in the IPCC AR6 Summary for Policymakers[7] which found with *high confidence* that:

> *"In the low and very low GHG emissions scenarios, assumed reductions in anthropogenic aerosol emissions lead to a net warming, while reductions in CH4 and other ozone precursor emissions lead to a net cooling. Because of the short lifetime of both CH4 and aerosols, these climate effects partially counterbalance each other and reductions in CH4 emissions also contribute to improved air quality by reducing global surface ozone."*

Methane reductions this decade are mostly tied to fossil fuel decline

Approximately 360 Mt/yr of methane is emitted annually across the world from a variety of sectors of economic activity.[8] A significant portion of methane emissions is a result of energy supply activities – both from natural-gas based electricity generation as well as its use as a fuel, for process heat in industry, and as residential heating.

The methane supply chain also requires transport over long areas, resulting in transmission-based losses (so-called methane leakage) and resulting in significantly higher greenhouse gas (equivalent) emissions than through normal combustion. Energy-related methane emissions total around 140 Mt each year and are rising.

The second main source of methane today is the agricultural sector, due largely to enteric fermentation in bovine species from animal husbandry as well as vegetation deterioration during rice production. Agriculture also accounts for some 140 Mt/yr of total present-day methane emissions.

Finally, waste management, e.g., aeration of landfills, wastewater treatment, and waste incineration, also contributes to current methane emissions at a rate of around 80 Mt/yr.

In mitigation pathways, methane reductions are not equal across sectors. In Figure 2 we consider pathways from the SR15 that are approximately consistent with the Global

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[6] https://climateanalytics.org/briefings/is-the-15c-limit-still-in-reach-faqs/

[7] https://www.ipcc.ch/report/ar6/wg1/#SPM

[8] Gütschow, J.; Jeffery, L.; Gieseke, R.; Gebel, R.; Stevens, D.; Krapp, M.; Rocha, M. (2016): The PRIMAP-hist national historical emissions time series, Earth Syst. Sci. Data, 8, 571-603, https://doi.org/10.5194/essd-8-571-2016

Methane Pledge – having between 25-35% reductions in methane from 2020 to 2030, with a median value of 29%.

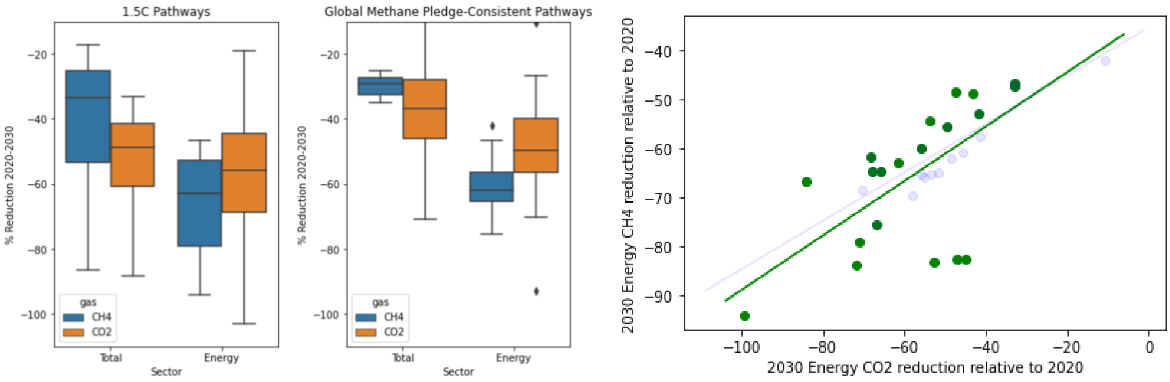

Figure2. CH_4 and CO_2 emissions reductions by sector in pathways consistent with the Global Methane Pledge between 2020 and 2030. The mitigation relationship between the two is shown for energy system emissions reductions, with 1.5°C scenarios in green and Pledge scenarios in blue.

It is clear from this figure that methane emission reductions are concentrated in the energy supply sector, where emissions reductions are due to reduced reliance on natural gas for energy production, rather than in agriculture: the median reduction in agriculture is 13% whereas methane emissions from energy reduce by 62%.

In pathways consistent with the Global Methane Pledge, the level of methane reductions in the energy sector is similar to reductions seen in 1.5°C pathways, indicating similar mitigation strategies between both sets of scenarios.

These same scenarios also see stronger reductions in CO_2 than in current climate targets. On average CO_2 emissions fall by 37% between 2020 and 2030, mostly driven by energy-related emissions reductions.

Across both 1.5°C and methane pledge scenarios, methane emissions reductions are driven by overall reduction of fossil fuel consumption for energy, allowing for both CO_2 and CH_4 mitigation.

Greenhouse gas emission reductions are required across all gases and sectors, but from our analysis we can see methane reductions observed in 1.5°C pathways reinforce the need to cut fossil-based energy sector emissions first and foremost, as cost-effective CO2 mitigation drives the required levels of methane reductions.