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atf animal task force

A European Public-Private Partnership

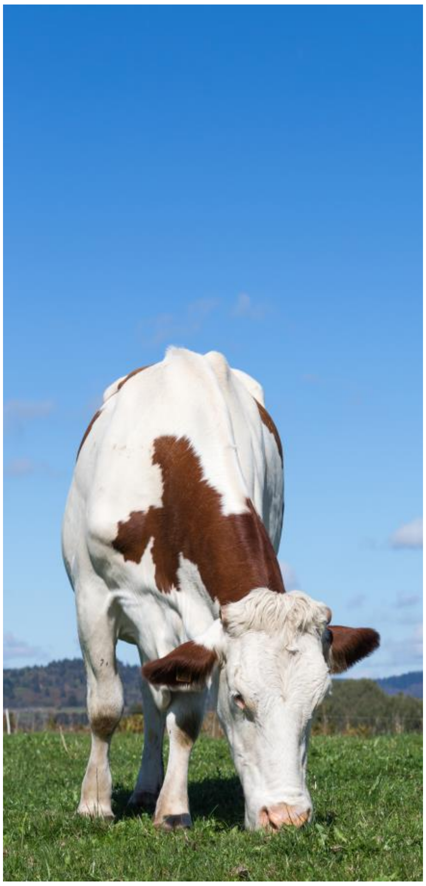
AGRICULTURAL **METHANE**

ASSESSING ITS SIGNIFICANCE AND SEEKING SOLUTIONS

A policy brief from the Animal Task Force

Two events were organised by the ATF in 2022 concerning agricultural greenhouse gas emissions, notably methane: a joint symposium organised by the ATF and the Livestock Farming Systems Commission of the European Federation of Animal Science in Porto (05/09/22), and the ATF seminar organised in Brussels (17/11/22). These events made it possible **to take stock of the latest advances in knowledge concerning agricultural methane emissions from the livestock sector, and possibilities for reducing these emissions.** These events created a dialogue between scientists, policy makers, farmers and industry representatives.

This policy brief draws on the presentations from those two events, the IPCC 6th Assessment Report published in 3 volumes in 2021 and 2022, and the EU Methane Strategy.



NATURAL AND ANTHROPOGENIC SOURCES OF METHANE

Approximately 41% of global methane emissions come from natural sources like wetlands, biomass burning, and other sources (wild ruminants, termites, oceans, permafrost), with the remaining 59% coming from anthropogenic sources[1]. Among them, agriculture accounts for more than 40% and aside from agriculture, fugitive emissions produce a significant amount of methane. **The EU is responsible for just 5% of global anthropogenic methane emissions**. Table 1 shows the percentage share of anthropogenic methane emissions coming from energy, waste and agriculture, globally and in the EU. Agriculture is the biggest contributing sector in both cases. Agriculture looks to be a much bigger source than energy in the EU compared to globally, but the EU contribution from energy underestimates the true contribution of this source because the majority of emissions associated with the fuel imports are emitted before the gas reaches the EU. These data do not include the fact that **ruminant systems can remove CO_2 from the atmosphere by soil carbon sequestration** under grassland and associated agroecological infrastructures.

[1] *Global Methane Budget, B Jackson et al 2020 Environ. Res. Lett. 15 071002*

TABLE 1. SOURCES OF GLOBAL AND EU ANTHROPOGENIC METHANE EMISSIONS (%)

	Global*	EU**
Energy	**37**	**19**
Waste	**19**	**26**
Agriculture	**44**	**53**
Enteric fermentation	*29.5*	*43.3*
Manure management	*3.4*	*9.5*
Rice cultivation	*10.7*	*0.11*
Agric. waste burning	*0.5*	*0.02*

*Janssens-Maenhout et al. (2017) ; **EU Methane Strategy

Globally methane emissions accounted for 18.4% of total GHG emissions in 2019 and have been rising from 6.7 billion tons in 1990 to 8.3 billion tons in 2019 (Our World in Data[2]). Global anthropogenic methane emissions are projected to increase by nearly 9 percent between 2020 and 2030 (Global Methane Initiative[3]) and notably oil and gas emissions are estimated to increase by 11 percent over current levels. In contrast, in the EU, methane emissions accounted for 11% of total EU GHG emissions in 2019 and decreased by 39% since 1990 (EUNIR 2021). The EU is the only region of the world where methane emissions were lower in 2017 than during the period 2000-2006 (see Global Methane Pledge[4]). According to the EU Methane Strategy, EU energy-sector methane emissions have halved, while emissions from waste and agriculture have fallen by a third and just over a fifth respectively, relative to 1990 levels. Figure 1 illustrates the trajectory of EU methane emissions.

[2] *https://ourworldindata.org/emissions-by-sector#methane-ch4-emissions-by-sector*

[3] *www.globalmethane.org*

[4] *www.globalmethanepledge.org*

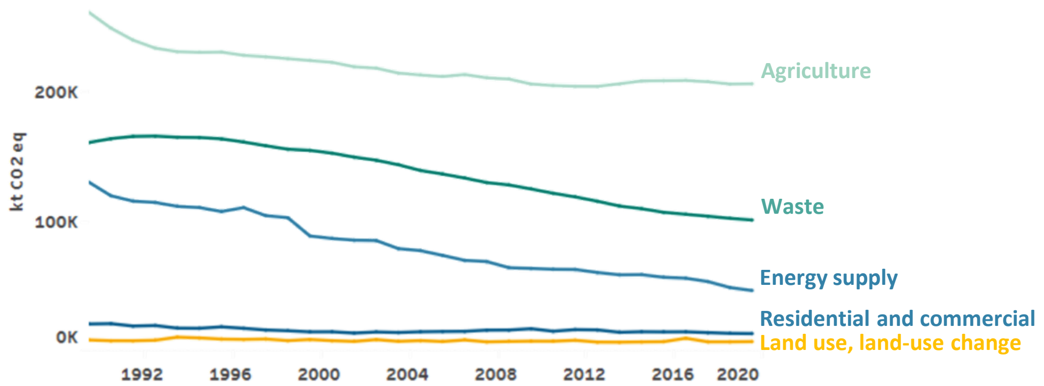


FIGURE 1. TRAJECTORIES OF EU METHANE EMISSIONS *(Source : Forlin V., 2022. EAAP meeting - https://animaltaskforce.eu/Portals/0/ATF/2022/EAAP2022_S02_04_Forlin_Pilzecker_FINAL.pdf)*

BACKGROUND

WHY IS METHANE SO IMPORTANT?

Methane is the second largest contributor to warming after CO_2, and methane emissions account for 14% of global greenhouse gas emissions and are responsible for about 30% of the increase in global temperature. Atmospheric concentration of methane is increasing with subsequent increasing warming (IPCC 6th assessment report, 2021). However, assessing the significance of methane as a greenhouse gas is more complicated than for CO_2. On a 100-year timescale, methane has 28 times greater global warming potential (GWP100) than carbon dioxide and is 84 times more potent on a 20-year timescale. Methane is a potent GHG but is short-lived (half-life ≈ 10 years) and GWP100 is not a good metric to assess its contribution to warming. Alternative metrics to do this have been proposed and are discussed below. Cutting methane emissions has potential to lower the amount of methane in the atmosphere with significant climate change benefits, especially in the near term. For all these reasons, methane emissions are of interest to scientists and policy makers.

IPCC SCENARIOS
AND MEETING THE PARIS AGREEMENT

The IPCC 6th Assessment Report shows 5 indicative scenarios for GHG emissions which have different temperature outcomes.

SSP1-1.9	**SSP1-2.6**	**SSP2-4.5**	**SSP3-7.0**	**SSP5-8.5**
has a likelihood of keeping temperature rise to between 1.0 and 1.9°C.	has a likelihood of keeping temperature rise to between 1.0 and 2.6°C.	has a likelihood of keeping temperature rise to between 2.0 and 4.5°C.	has a likelihood of keeping temperature rise to between 3.0 and 7.0°C.	has a likelihood of keeping temperature rise to between 5.0 and 8.5°C.

SSP = Shared Socioeconomic Pathways

These 5 scenarios are presented in Figure 2. There are a number of important points about this figure.

-1.5°C : A TARGET DIFFICULT TO REACH

Only scenario SSP1-1.9 has a strong likelihood of keeping temperature rise within the 1.5°C target of the Paris Agreement. Scenario SSP1-2.6 has a reduced likelihood.

WARMING : IMPORTANCE OF CO_2

CO_2 is the key gas in terms of warming: *'total warming is dominated by past and future CO_2 emissions'*. So, CO_2 emissions must be reduced to net zero as soon as possible.

ROLE OF AGRICULTURE IN CH_4 EMISSIONS

In scenario SSP1-1.9, CO_2 emissions reach net zero shortly after 2050 (left hand side of Figure 2). Methane emissions in 2050 are about 50% of emissions in 2015 (right hand side, top chart). Agriculture is responsible for approximately 44% of global methane emissions currently and technologies do not exist to reduce agricultural emissions to zero.

N_2O EMISSIONS WILL REMAIN HIGH

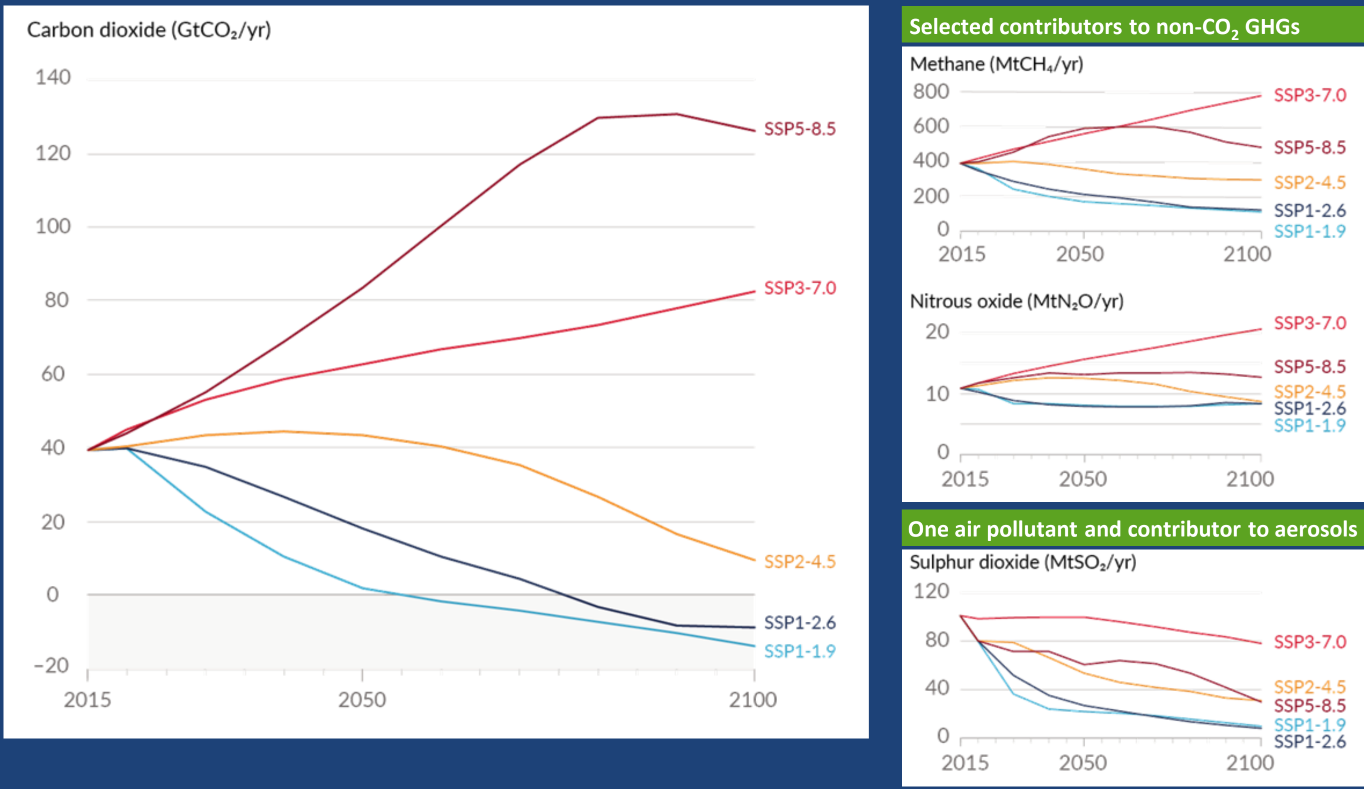
In scenario SSP1-1.9, nitrous oxide emissions remain about 70-75% of 2015 levels in 2050 (right hand side, middle chart). This is a smaller reduction but agriculture is responsible for over 75% of the total nitrous oxide emissions.

The IPCC 6th Assessment Report clearly states that CO_2 emissions need to be reduced to net zero in order to limit human-induced global warming. Importantly, it does not call for methane (or nitrous oxide) emissions to be reduced to net zero even in its most challenging scenario (SSP1-1.9). The implication of this is that **separate targets are needed for CO_2, methane and nitrous oxide** (further discussed below). In scenario SSP1-1.9, the target for CO_2 must be net zero emissions as soon as possible. The target for methane (from all sources) is a reduction of approximately 50% by 2050. Clearly the gases must be treated differently and already New Zealand has set a separate target for methane (a 10% reduction by 2030 and a 24 - 47% reduction by 2050).

FUTURE EMISSIONS CAUSE FUTURE ADDITIONAL WARMING,

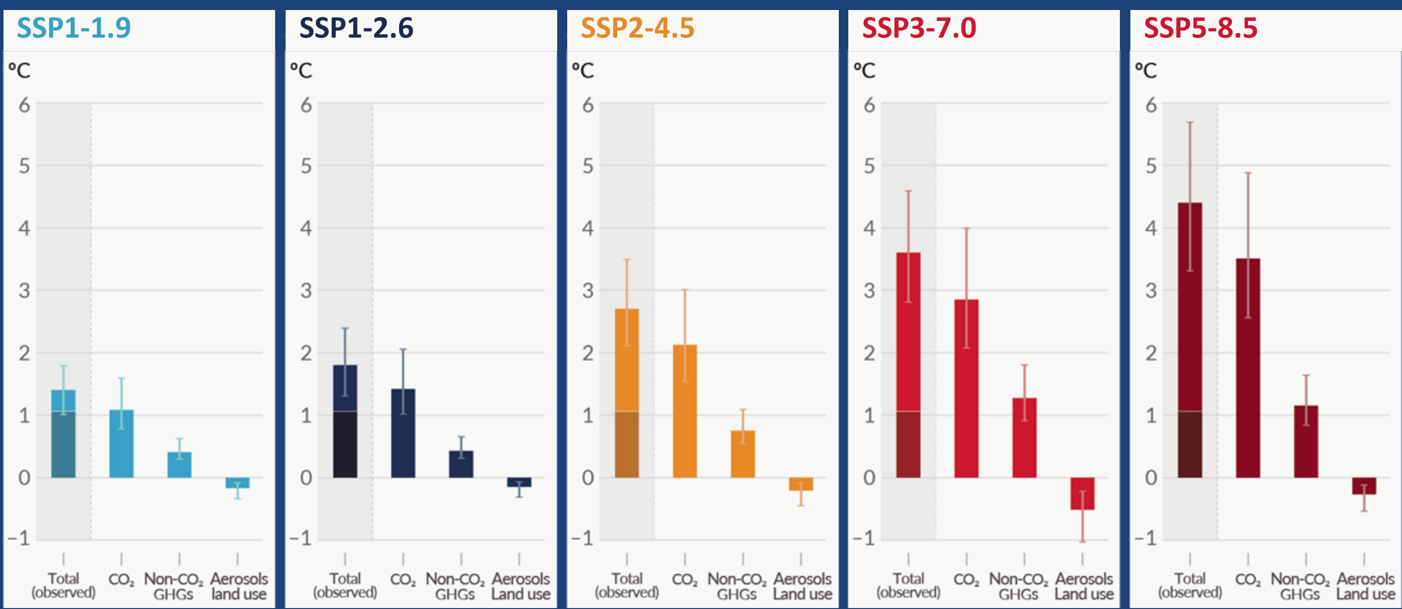
FUTURE EMISSIONS CAUSE FUTURE ADDITIONAL WARMING, WITH TOTAL WARMING DOMINATED BY PAST AND FUTURE CO_2 EMISSIONS

(a) Future annual emissions of CO_2 (left) and of a subset of key non-CO_2 drivers (right), across five illustrative scenarios



(b) Contribution to global surface temperature increase from different emissions, with a dominant role of CO_2 emissions

▶ Change in global surface temperature in 2081-2100 relative to 1850-1900 (°C)



Total warming (observed warming to date in darker shade), warming from CO_2, warming from non-CO_2 GHGs and cooling from changing in aerosols and land use

FIGURE 2. FUTURE ANTHROPOGENIC EMISSIONS OF KEY DRIVERS OF CLIMATE CHANGE AND WARMING CONTRIBUTIONS BY GROUPS OF DRIVERS FOR 5 ILLUSTRATIVE SCENARIOS

Reproduced from IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3–32, doi:10.1017/9781009157896.001.

METHANE AND **INTERNATIONAL AGREEMENTS**

The **Paris Agreement** (Article 1 (a)) aims to hold the increase in global temperature to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C. Article 1 (b) requires this to be done in a way that does not threaten food production.

The objective of the '**Global Methane Pledge**' is to reduce global methane emissions by at least 30% below 2020 levels by 2030, and to take comprehensive domestic action to achieve this. This would avoid 0.22°C warming by 2050. This initiative is led by the EU and US and over 150 countries have signed up to it.

EU POLICY OBJECTIVE FOR GREENHOUSE GAS EMISSIONS

In the EU plan for climate neutrality (Figure 3), total emissions of CO_2, methane and nitrous oxide are at net zero by 2050, which is more ambitious than the most challenging scenario of IPCC (scenario SSP1-1.9) where only CO_2 is at net zero. In 2050, it is envisaged that there are still significant non-CO_2 agricultural emissions (i.e. methane and nitrous oxide), but these are completely balanced by CO_2 removals, mainly by land use and forestry. Importantly, because the EU objective of requiring all methane and nitrous oxide emissions to be balanced by CO_2 removals is more challenging than even the most challenging IPCC scenario, it will require more CO_2 removals than if the IPCC scenario SSP1-1.9 was followed.

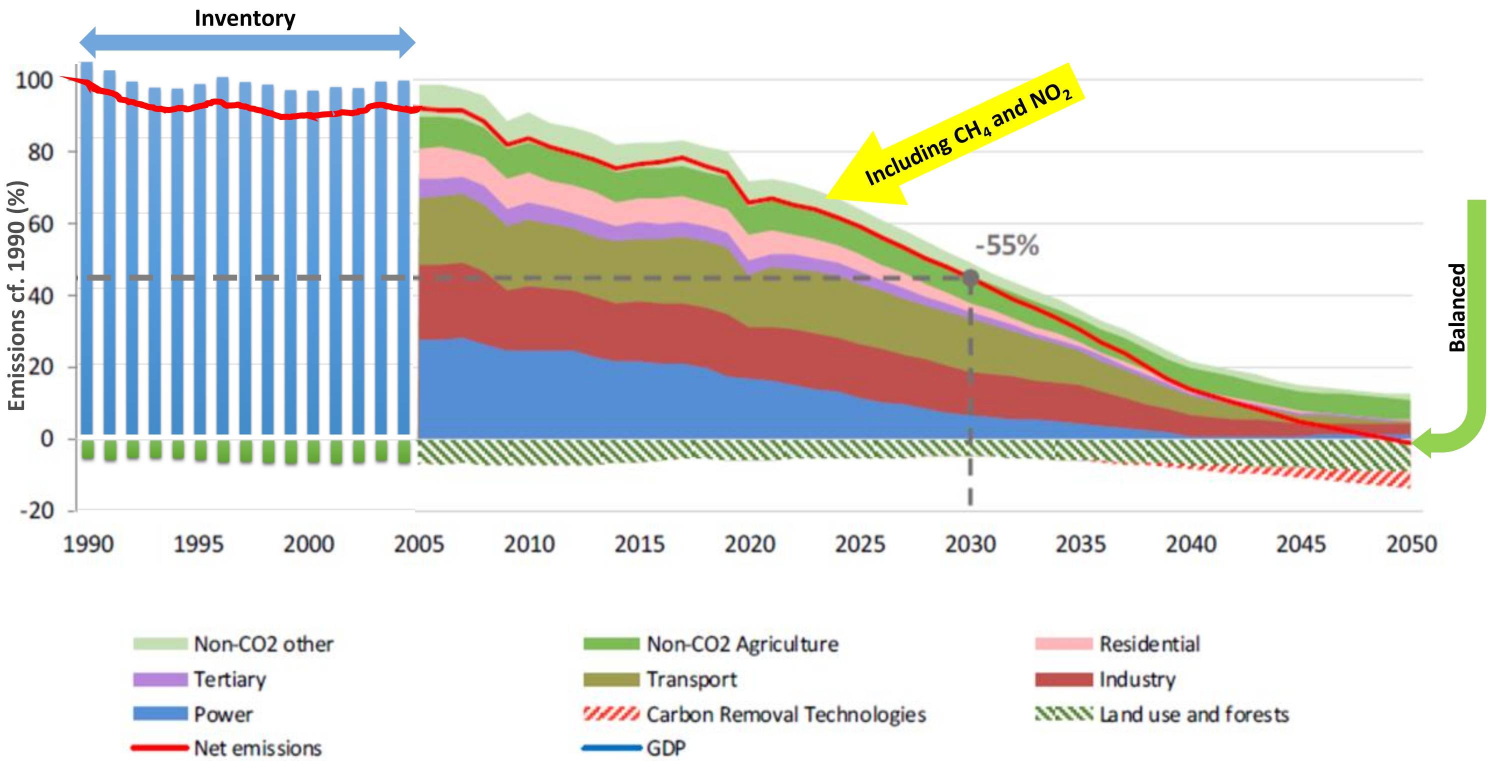


FIGURE 3. EU PATHWAY TO CLIMATE NEUTRALITY (EU COMMISSION)

WHY DO ENTERIC METHANE EMISSIONS NOT NEED TO GET TO ZERO FOR ACHIEVING COP21 OBJECTIVE?

Methane emissions are different to CO_2 because of the short life of methane. Hydroxy radicals oxidise methane to CO_2 in the atmosphere with a half-life of about 10 years. So, if net methane emissions are stable over a long period, the atmospheric concentration of methane is stable and its warming effect is stable (strictly speaking a 3% reduction would be required per decade to keep it absolutely stable). The Global Warming Potential (GWP*) metric has been proposed as a step-pulse metric to better account for the effect of the short life of methane on temperature. In comparison, CO_2 has a very long lifetime and it will take thousands of years for CO_2 levels to return to pre-industrial levels naturally. The negative impact of CO_2 will only stop increasing when CO_2 emissions are reduced to net zero.

This difference between CO_2 and methane must be integrated into the setting of reduction targets. According to Cain[5] (2022), ***methane emissions** do not have to reach net-zero (as defined by GWP100) to stop further warming and are therefore **not a pre-requisite** to achieve Paris goals. If global methane emissions decline at 3% per decade, methane's contribution to global warming remains roughly constant. A 30% cut by 2030 on 2020 levels, and a slower decline after that, gives approximately 0.1°C lowering of temperature by 2050.*

These points are illustrated in Figure 4. It is the rationale for having separate targets for methane and CO_2.

[5] http://animaltaskforce.eu/Portals/0/ATF/2022/ATFSeminar2022/05_Another_look_at_Methane_MCain.pdf

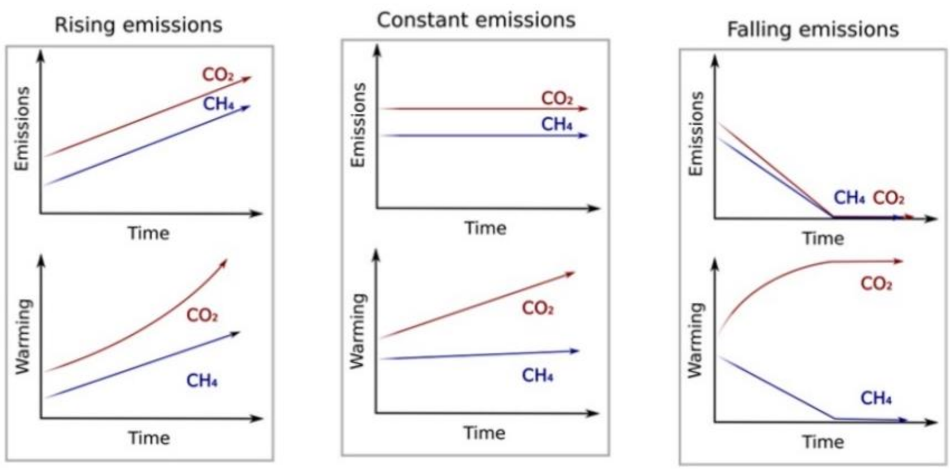
DEFINITION

BIOGENIC AND FOSSIL METHANE

Methane is divided into two types for the purpose of assessing its warming potential :

- Biogenic methane is produced by plants and animals as a result of carbon recycling in the carbon cycle. So in effect, it is derived from CO_2 that is already in the atmosphere.
- Methane from fossil fuels is from a source which has been deep in the earth for millions of years. When burned for energy, it adds to the CO_2 concentration in the atmosphere.

This difference is recognised in the Global Warming Potentials assigned to the two types of methane in the AR6 report. For example, the GWP100 of fossil and non-fossil methane is 29.8 and 27, respectively.



CH_4 emissions rise → temperature rises

CO_2 emissions rise → temperature rises

CH_4 emissions stable → temperature rises slowly until reaches equilibrium

CO_2 emissions stable → temperature rises

CH_4 emissions falling → temperature declines

CO_2 emissions falling → temperature rises (until emissions are zero)

FIGURE 4. HOW CHANGES TO METHANE EMISSIONS AFFECT TEMPERATURE *(https://www.oxfordmartin.ox.ac.uk/publications/climate-metrics-for-ruminant-livestock)*

While stabilising at current concentrations would mean there would be little further increase in its warming effect, actually reducing methane emissions will lead to lower atmospheric concentrations and will reverse some of the current warming effect as outlined above. The 'cooling' effect from reducing methane can also 'buy time' while CO_2 emissions are reduced over the coming decades. If this is an objective of policy, it should first be directed at methane from sources that should be eliminated anyway (e.g. fossil energy and waste).

WHICH SOURCE OF METHANE
SHOULD BE REDUCED THE MOST?

All sectors must reduce their emissions as much as possible, but the size of the reduction which is possible and desirable will vary according to the sector.

ENERGY SECTOR

Reductions in methane from the energy sector should be prioritised and this is in line with the plans for the energy system to reduce its dependence on fossil fuels. The EU Methane Strategy identified that ***energy is where emissions can be cut the quickest with the least costs.*** Every effort should also be made to reduce methane from waste. Minimising the amount of biodegradable waste going into landfills should be a high priority objective and this is a crucial step to avoid methane formation from this source. Cost-effective mitigation technologies and practices to address methane emissions from oil and gas, wastes, coal mining are available and in use all over the world (e.g. recovery and use of methane as fuel for electricity generation, or gas sale).

AGRICULTURE SECTOR

Methane from agriculture should also be reduced as much as possible keeping in mind that some methane emissions from livestock are unavoidable because it results from the unique ability of ruminants to convert non-edible feeds into highly nutritious food products. **Agricultural methane emissions are particularly complex to reduce, as they are diffuse and mainly linked to natural processes**. Technologies do not exist to reduce enteric emissions to zero. In the EU Methane Strategy, the main strategies identified to reduce emissions are the promotion of best practices and technologies, feed and breeding changes, and carbon farming. The **production of biogas** (to be used as an energy source) **from agricultural manures** is also identified as a strategy to reduce methane emissions. The Strategy also commits to establishing an Expert Group with a mandate to establish and maintain an inventory of best practices and technologies to reduce methane emissions, especially from enteric fermentation and consider actions to promote the wider uptake of innovative mitigation actions.

LIVESTOCK SECTOR

Looking in more detail at practices to reduce methane from livestock, there are options in both the short term (e.g. **lifetime efficiency of fattening animals and dairy cows, feed additives** now coming on the market, **changes to manure management, changes to animal diets** including use of legumes, **more efficient use of biomass** through the reuse and recycling of waste and residues) and the long term (e.g. **improved animal genetics and animal health**) which have potential to deliver significant reductions in methane without the need to reduce production and agricultural activity. **Increasing soil carbon sequestration** can also contribute to a decrease in net emissions. This will allow livestock to be preserved as a key global provider of food and nutrition and for their ecosystem services, for more resilient food systems and to have a positive impact on other fields of bioeconomy (e.g. leather, wool, energy from biomethane). Livestock can also contribute significantly to carbon sinks in agricultural soils by maintaining grasslands and better using livestock manure as fertilizer in substitution to mineral fertilizer (spared emissions for other sectors). Modern 'smart' manure management strategies with application of digitalization techniques have to be developed for different types of animal farms (conventional, organic, absolute grassland regions, mixed farming).

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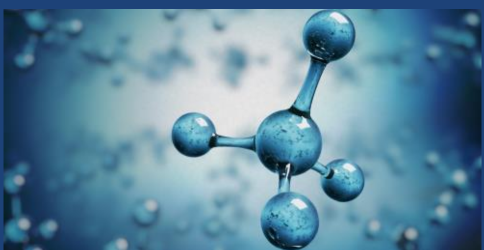
KEY IMPLICATIONS

- Reductions in methane emissions are very important for limiting human-induced warming. But methane emissions do not need to reach net zero by 2050 to keep within the Paris Agreement.
- This is in contrast to CO_2 emissions which do need to be reduced to net zero. The implication of this is that separate targets are needed for methane, nitrous oxide and CO_2.
- Methane from agriculture should also be reduced as much as possible, keeping in mind that some methane emissions are unavoidable because it results from the unique ability of ruminants to convert non-edible feed materials into highly nutritious food products and grassland areas must be maintained as much as possible for the ecosystem services they provide.
- Reductions in methane from energy and waste sectors should be prioritised as *this is where methane emissions can be cut the quickest and with least costs with available technology.*
- Livestock farming has the potential to increase soil carbon sequestration thus reducing its net emission from better management of forage systems and grassland.
- Best practices and technologies (including animal health), feeding strategies including feed additives, and breeding are the most promising strategies to reduce enteric methane emissions. *For methane emissions from manure management, production of biogas and manure amendments must also be considered.*

RECOMMENDATIONS



- **Recommendation 1**

  The appropriate reduction target for methane, particularly agricultural methane, should be assessed using the scientific basis that accounts for the short-lived nature of methane.

- **Recommendation 2**

  Developing and deploying methane mitigation options should be high priorities for EU research and innovation activity. The Expert Group on methane emissions to promote the uptake of innovative mitigation actions should be re-activated.

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