



GWP*

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Seeing Stars

The New Metric That Could Allow The Meat And Dairy Industry To Avoid Climate Action

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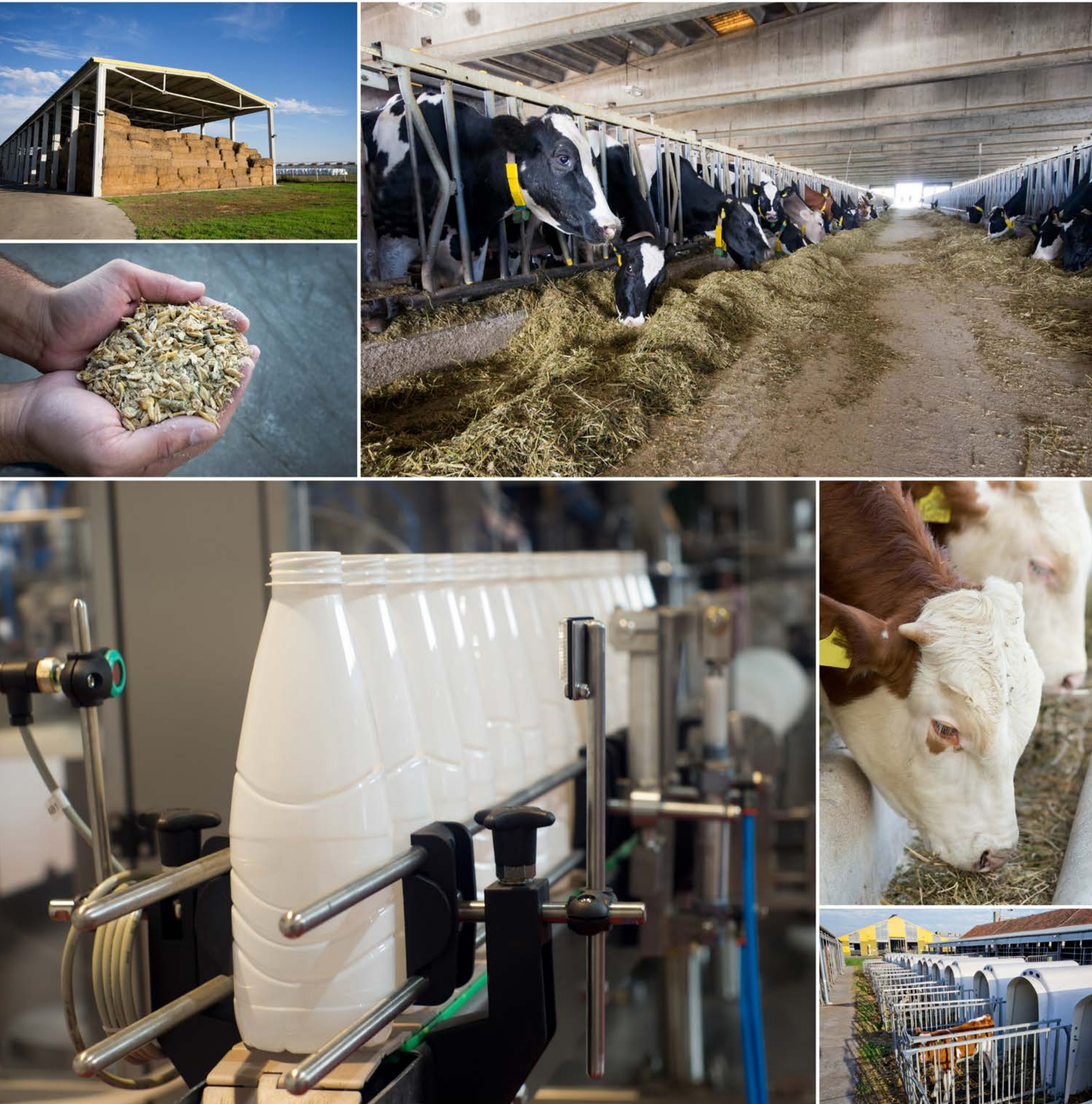
Technical review

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Executive summary

Addressing methane emissions is essential to limiting the impacts of the climate crisis and keeping the global temperature increase under 1.5°C, as set out in the Paris Agreement. Methane has extremely powerful effects on the climate in the short term, so cutting methane emissions now represents our best chance to put a brake on temperature rises and avoid potentially catastrophic tipping points.

However, the animal farming industry is promoting a new metric for measuring methane emissions, called GWP*, that could undermine these efforts. GWP*, which focuses on changes in emissions over decadal timescales rather than the absolute level of emissions, is presented as a more accurate way to measure the warming impact of changes in methane emissions over time. However, by taking current levels of methane emissions as their baseline, high-polluting countries and companies can use GWP* to present even minor reductions in methane as negative emissions or cooling. This briefing reveals attempts by the farming lobby groups from high meat and dairy producing countries, and their scientists, to promote GWP*

accounting, in order to make meat and dairy production appear “climate neutral” and escape significant transformation of the industry.

For the purposes of this report, we calculated different levels of emissions reductions for one meat and one dairy company, as well as for New Zealand - a country where a significant share of emissions come from agricultural methane. We compared emissions reductions calculated using GWP100, the well-established metric which measures the global warming potential of a gas over a 100-year period, and GWP*.

Using GWP100, emissions estimates for Tyson, one of the world’s largest processors of chicken, beef and pork, show that with a 30% emissions reductions by 2030, the company would be assessed as responsible for roughly 58.5 million tonnes of CO₂ equivalent - similar to the annual emissions of Peru. However, using GWP*, the company could claim negative emissions of roughly minus 82.6 million tonnes of CO₂ equivalent for the same reductions. For Fonterra, the largest dairy exporter in the world, a 30% reduction between 2020 and 2030 calculated with GWP* would enable the company to claim to be taking around 19 million tonnes of CO₂ equivalent from the atmosphere, while according to GWP100 calculations it would still be responsible for roughly 21.6 million tonnes of CO₂ equivalent - similar to annual emissions of Sri Lanka. Both companies could claim climate neutrality with tiny levels of annual emissions reductions, 1.4% and 1.7% respectively.

We calculated a similar trend for New Zealand, where half of all emissions come from agriculture, mostly methane. With a modest 10% reduction in methane emissions, the country could report negative methane using GWP* by 2038. Falsely accounting this as cooling could allow less accountability for emissions reduction in other sectors, which proponents of the GWP* methodology have put forward as a benefit.^{1,2}

These calculations show how the biggest methane polluters can use the GWP* metric to manipulate their overall greenhouse gas (GHG) emissions accounting and escape accountability.

We found evidence of the big agriculture lobby pushing the GWP* methodology from New Zealand to Ireland to the United States and elsewhere. With this, they are trying to avoid the introduction of robust climate policies, which would address the 332% increase in methane emissions from the farmed animal sector between 1890 and 2014. The GWP* metric also raises fundamental ethical concerns, as countries with less production of meat and dairy, which are also often the most affected by the climate crisis, will be penalised the most, while major emitters can use minor methane reductions to greenwash their climate commitments, and could even declare their products or the whole dairy/meat sectors as climate neutral.

The following report unveils the profound implications the adoption of the GWP* methodology could have on climate policies, equity and the transformation of the food system. It urges caution on the part of policymakers, who must resist lobbying attempts by the meat and dairy industry and avoid adopting the GWP* metric.



1. Introduction

Human civilisation is on a path to warm the Earth's average global surface temperatures well beyond 1.5°C. A key to reversing the damage lies in addressing methane (CH₄) emissions. This is why mitigation efforts cannot be sufficiently addressed without food system changes away from animal agriculture, the leading emitter.^{3,4} Some 40% of human-caused methane emissions come directly from agriculture, with about 80% of that from the animal farming industry (mostly ruminant enteric fermentation and manure).^{5,6} Despite this, the Global Methane Pledge - where more than 150 countries pledged to reduce methane emissions by 30% by 2030 - has a glaring issue in its much weaker language when it comes to agricultural emissions, as opposed to waste and energy sectors.⁷ Instead of achieving all feasible reductions, The Pledge states governments should focus on incentives and partnerships with farmers - a special treatment of the sector that beef lobbyists celebrated.⁸

Crucial for global climate commitments is the ability to easily compare the contributions of different gases to climate change to assign accountability and set fair goals.⁹ The chosen metric under the Paris Agreement and the

primary tool for setting emissions reduction targets is global warming potential (GWP), commonly evaluated over a 100-year timeline (GWP100). GWP measures the warming effect of a quantity of a non-CO₂ greenhouse gas (GHG),^A emitted at a given point in time, relative to an equal amount of CO₂. It acts as a single per-emission exchange rate by which different greenhouse gases are valued in relation to CO₂. Essentially, it attempts to show how much CO₂ would have to be emitted to produce a similar warming effect to that of another gas. This is referred to as the ‘carbon dioxide equivalent’ (CO₂e) value. Using GWP, the impact of other GHGs can be explained in relation to CO₂.^{10,11}

The time horizon used to determine the GWP is important because it affects how much weight is given to short-term warming. According to the Intergovernmental Panel on Climate Change (IPCC), the choice of time horizon (10, 20, 100 or even 500 years) “is a value judgement because it depends on the relative weight assigned to effects at different times”.¹²

A central plank of the animal agriculture’s attempts to address its emissions issue is the adoption of a new method for measuring the impact of methane emissions called GWP* (so-called ‘GWP-star’). The industry and trade groups are heavily lobbying for it to be used in government policy, international standards and private carbon counting initiatives.¹³

GWP* was developed in 2016 by a team of researchers from Oxford University, led by Professor Myles Allen and Dr Michelle Cain. The academics who developed the concept argued it was more accurate than the current systems used to report national methane emissions at the international level. Advocates for the

GWP* metric from the animal agriculture sector never fail to highlight that their preferred measurement originated from the University of Oxford.¹⁴

However, GWP* has never been useful to characterise the impacts of emissions that could be stopped. The application of GWP* at a national or corporate level requires setting certain parameters that can radically alter how the impact of the same emissions are presented. Depending on the choice of baseline year, the same volume of methane emissions can be described as causing warming, no warming or even cooling.¹⁵ This has meant it can be used by major methane emitters to justify continuing business as usual, resulting in lack of action to cut methane emissions.

This analysis clearly explains what GWP* is in the context of the global methane debate, outlines the major controversies with its application, and gives some examples of how and where it is being used currently.

1.1 The global methane debate

To understand GWP*, it is helpful to understand the impact of methane and its role in global warming. The next 20 years are especially important to achieving climate goals. During this time period, methane emissions are predicted to warm the planet almost as much as CO₂.¹⁶ This is why the IPCC sixth assessment report working groups I and III (AR6 WGI and WGIII) recommend strong, rapid and sustained reductions in methane emissions.^{17,18}

Net human-caused methane emissions have been responsible for 0.5°C of the approximately 1.1°C of global warming since industrialisation (2010-2019 relative to 1850-1900).^{19,20, B} This is even higher than previously estimated²¹ since it

A For the Global Warming Potential, the warming effect is based on the emissions’ resulting radiative forcing

B Other GHGs have been less problematic with regards to climate change but have caused extensive air pollution or ozone issues. Notably, sulphur dioxide (SO₂) emissions have actually cooled the atmosphere and are a reason we have only warmed 1.1°C so far.

accounts for the cooling effect of reflective aerosols that are primarily co-emitted along with CO₂ during coal and diesel combustion.^{22,23}

Methane's impacts go beyond warming. Methane concentration also contributes to ground-level ozone formation (otherwise known as smog) which causes roughly one million premature deaths each year around the world.²⁴ Surface ozone can also negatively impact important crops such as cotton, peanuts, soybeans, winter wheat, rice and corn.²⁵

Methane could be the final straw for a number of tipping points and feedback loops.²⁶ For example, changes in temperature and rainfall are causing Arctic permafrost to thaw. This process, if left unchecked, could release billions of tonnes of additional methane into the atmosphere, causing a feedback loop that could tip the planet into uncontrolled warming. Conversely, while with the current trajectory we could have an ice-free Arctic summer by around 2060, rapid cuts in methane emissions could play a crucial role in stopping this.²⁷

There is now wider consensus that we need to address methane as urgently as carbon dioxide.²⁸ A kilogram of methane's radiative forcing is presently more than 300 times more powerful than a kilogram of carbon dioxide. Radiative forcing provides an immediate measure of the heat-trapping capacity of gases but does not consider the decay of gases over time. If measured using GWP over 20 years, methane is around 80 times as potent as carbon dioxide in the two decades or so after it is emitted - meaning it traps 80 times more heat than CO₂.²⁹

Methane lasts for on average 12 years in the atmosphere after which most of it is broken down by hydroxyl radicals (OH). The higher the methane concentration

in the atmosphere, the longer on average it lasts due to pressure on OH.³⁰ In pre-industrial times (c.1750), methane lifetime was around 25% lower than today.

Methane's shorter lifespan than carbon dioxide, but far stronger effects, is a main reason positions differ on its particular impacts. Since methane is short lived in the atmosphere, decreasing it now would lead to rapidly observable declines in the rate of warming within a decade or two. In contrast, CO₂ reductions, while still urgently needed, take much longer to show atmospheric changes. In this sense, methane is key to quickly addressing climate change before irreversible feedback loops³¹ occur: not as a substitute for tackling CO₂, but a vital part of climate actions that minimise warming.

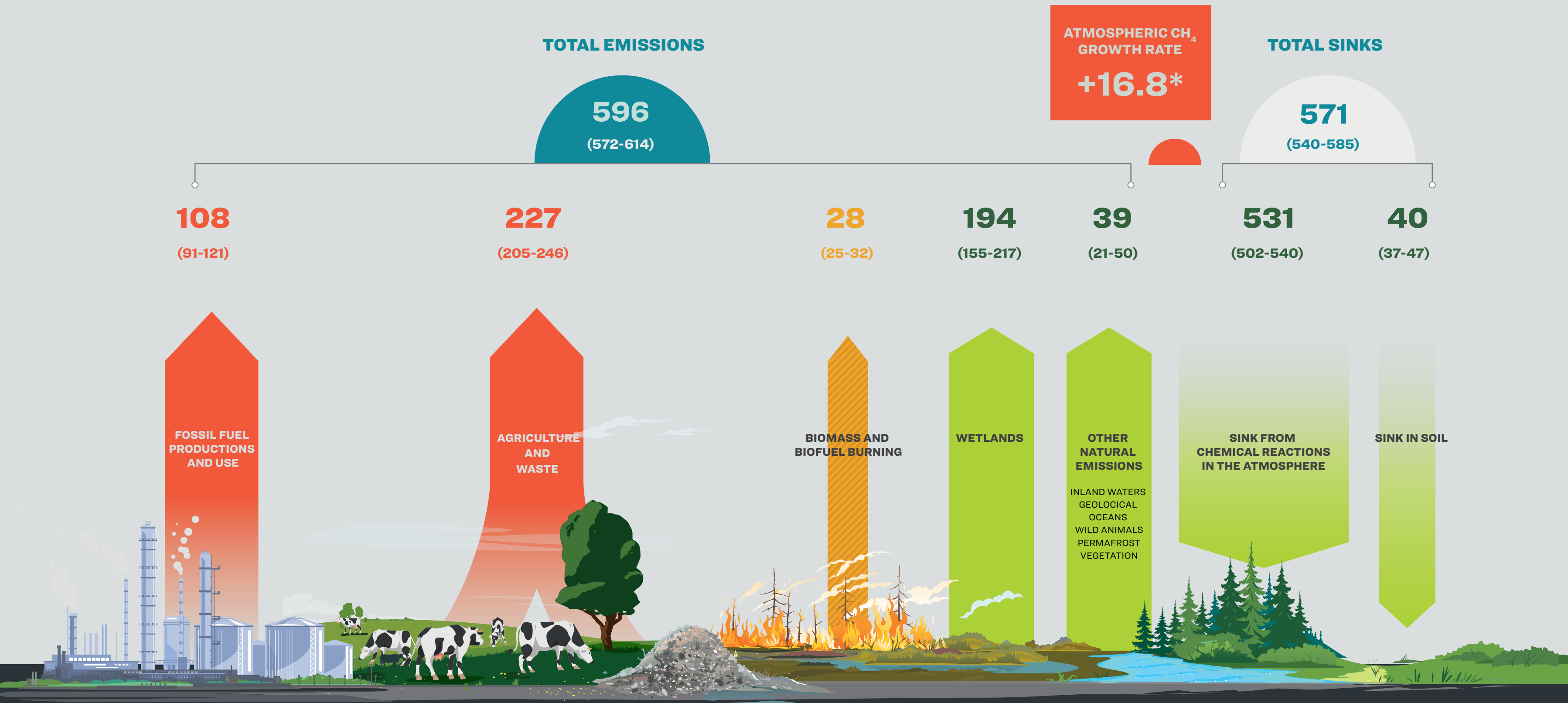
1.2 Predecessor of GWP*: Methane as part of a natural cycle?

There are two main sources of methane in the atmosphere: biogenic (from plants, animals and waste) and fossil. Plants absorb CO₂ from the atmosphere in their leaves through photosynthesis, and in turn ruminants eat these plants, emitting methane in the process through enteric fermentation. By contrast, fossil methane has been locked in the ground for up to millions of years and is also a major contributor of methane emissions, some keep estimating responsible for a slightly higher share than agriculture, especially with recent growth in natural gas.^{32,33}

An increasingly popular narrative is that methane from ruminants is just part of a natural closed-loop cycle.^{34,35,36,37} The claim describes a story of perfect recycling where grass absorbs CO₂ from the atmosphere, cows eat the grass and turn the carbon into methane in their stomachs, the methane is then emitted and breaks down into CO₂ in the atmosphere, only to be absorbed again by plants, with the cycle repeating itself.³⁸

GLOBAL METHANE BUDGET 2017

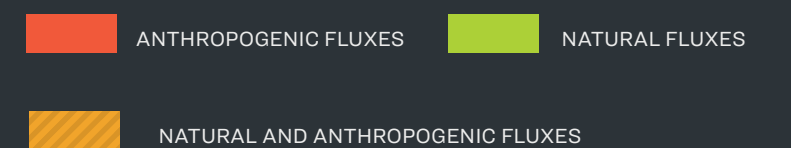
Figure 1. The global methane budget. Methane for the period from 2008 to 2017 is presented in the form of two types of estimates: bottom-up (left) and top-down (right). These estimates are in teragrams of methane per year (Tg CH₄ yr⁻¹) and cover various sources and removal processes. According to top-down estimates, roughly 60% of the total emissions are linked to human activities, with a range of 55% to 70%, while the remaining 40% is associated with natural emissions. Source: Saunio, M., Stavert, A.R., Poulter, B., Bousquet, P., Canadell, J.G., Jackson, R.B., Raymond, P.A., Dlugokencky, E.J., Houweling, S., Patra, P.K. and Ciais, P. (2020) The global methane budget 2000–2017. Earth System Science Data, 12(3): 1561-1623. <https://essd.copernicus.org/articles/12/1561/2020>



EMISSIONS AND SINKS

In teragrams of CH₄ per Year (TgCH₄/yr), for year 2017, from top-down approaches

*This shows the observed atmospheric growth rate. Budget imbalance of a few Tg CH₄/yr effects uncertainties of models in capturing the observed growth rate.



Based on the Global Carbon Project, 2020

This narrative conveniently ignores the warming effects of methane emissions by only focusing on the CO₂. Photosynthesis takes CO₂ from the atmosphere, while cows emit CH₄: this is far from climate neutral as CH₄ has a much larger warming effect while it persists in the atmosphere. The fact that the carbon atoms in methane come from the atmosphere initially is virtually irrelevant to the total warming impacts.

The IPCC shows that biogenic and fossil methane have roughly the same effects: non-fossil fuel sources of methane are 27.2 times as potent as CO₂, averaged out over a 100-year timeframe, and 80.8 times as potent over 20 years; this is only slightly less than fossil-fuel sources of methane, at 29.8 times as potent as CO₂ over 100 years and 82.5 times over 20 years.³⁹ Crucially, atmospheric concentrations of methane, their warming and damaging air pollution effects are a function of the rate of emissions, independent of the biogenic or fossil source origin.

	IPCC AR5		IPCC AR6	
	GWP ₁₀₀	GWP ₂₀	GWP ₁₀₀	GWP ₂₀
CH ₄ (non-fossil)	28/34*	84/86*	27.0	79.7
CH ₄ (fossil)	29/35*	86/88*	29.8	82.5
N ₂ O	264/268	265/298	273	273
CO ₂	1	1	1	1

Figure 2. Changes in Global Warming Potentials (GWP) of different GHGs in the last two IPCC reports.

* the higher number in AR5 includes climate-carbon feedbacks in response to emissions of the indicated non-Co2 gases. AR6 factors include the carbon cycle response for non-Co2 gases.

Reference: Based on table 8.7 p.714, IPCC ar5 report: https://archive.ipcc.ch/pdf/assessment-report/ar5/wg1/Wg1ar5_Chapter08_final.pdf and table 7.15 p. 1017, ar6 report: https://www.ipcc.ch/report/ar6/wg1/downloads/report/iPCC_ar6_Wgi_Chapter07.pdf

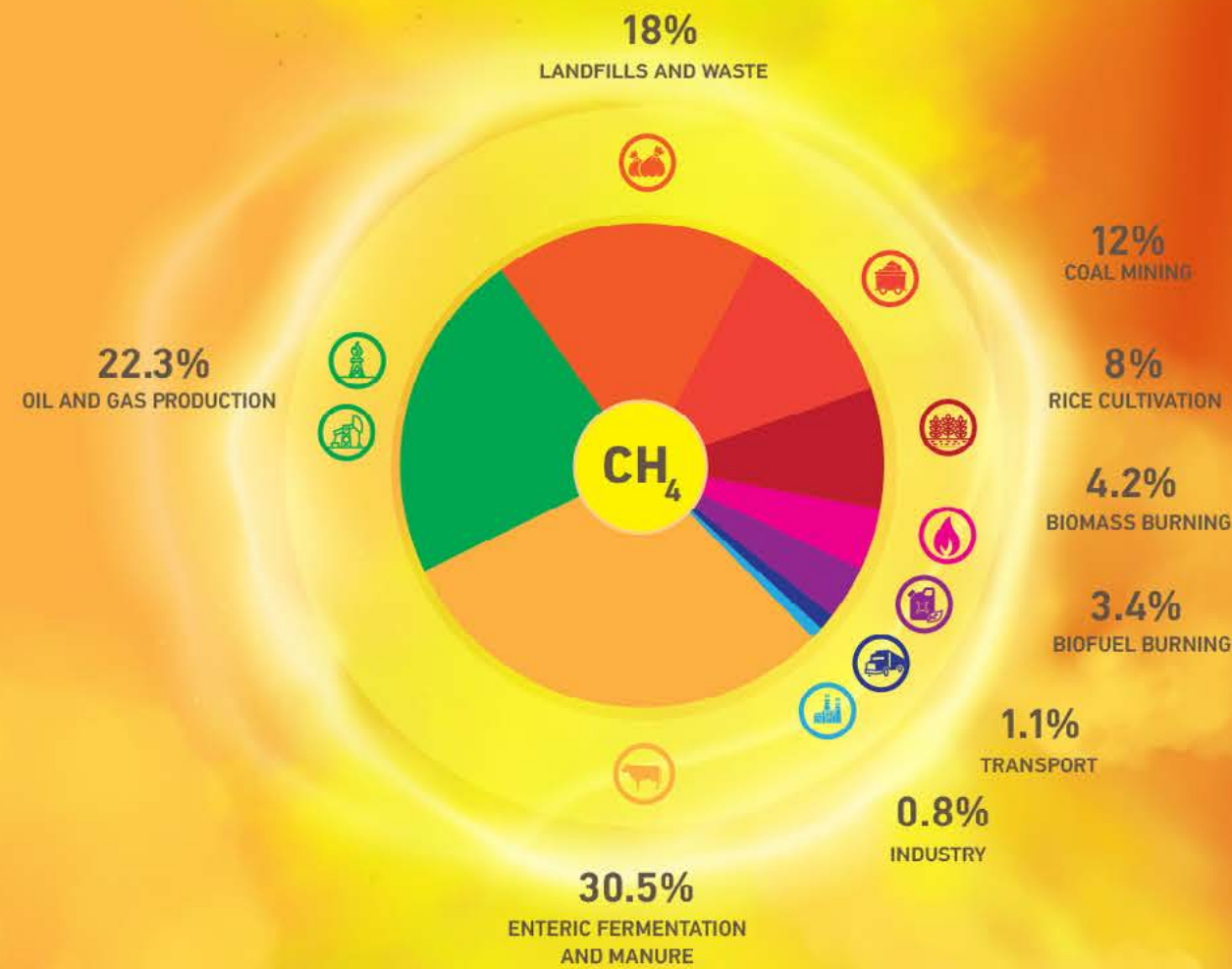
This cyclical narrative characterises methane as a ‘flow pollutant’: because it degrades after about 12 years, new emissions could be thought of as ‘replacing’ the previous methane which has degraded. In contrast, CO₂ is described as a long-term ‘stock pollutant’ because it lasts much longer in the atmosphere and new emissions accumulate on top of old ones, increasing warming as the ‘stock’ of CO₂ in the atmosphere increases.

The terms short-lived climate forcers (SLCFs) and long-lived climate forcers (LLCFs) are also used to describe flow and stock gases. However, at current atmospheric concentrations methane is acting like a stock. Methane emissions in 2021 were 262% above pre-industrial levels, largely because of the increased number of farmed ruminants. The 4 billion farmed ruminants globally disrupt the natural cycling of CO₂ through photosynthesis.^{40,41,42} As the IPCC AR6 WGIII report makes clear:

“...increasing numbers [of livestock is] directly linked with increasing CH₄ emissions... continued global livestock population growth between 1990 and 2019, including increases of 18% in cattle and buffalo numbers, and 30% in sheep and goat numbers, correspond[s] with CH₄ emission trends” (p. 771).

Massive increases in livestock numbers have led to a 332% increase in methane emissions from farmed animals from 1890 to 2014.^{43,44,45,46} From 2000-2017, cattle were one of the main causes of the observed increase in biogenic methane emissions.^{47,48} Overall increase in livestock numbers are linearly related to global CH₄ atmospheric inventories.⁴⁹ This trend is set to continue in the future, given the projected rising demand for meat and dairy in developing countries. One scenario shows farmed animal numbers are predicted to double by 2050.⁵⁰

The planet warming power of methane



METHANE 80x
WARMS THE PLANET
 MORE THAN CARBON DIOXIDE (CO₂)
OVER 20 YEARS
 AND **HAS CAUSED 0.5 °C OF WARMING**
 SINCE PRE-INDUSTRIAL TIME

Cows and other ruminants belch methane after their digestion through a process called enteric fermentation, where microbes in their stomachs break down food and release methane gas. A smaller share of methane is also emitted from animal manure.



FOSSIL VS. BIOGENIC METHANE

The only difference with fossil sources of methane is that the leftover CO₂ portion comes from ancient stored sources adding to an additional small amount of warming (~3% more over 20 years) where the leftover biogenic sources of CO₂ was from recently drawn down CO₂ (2). Biogenic & fossil methane still warm the atmosphere equally and must be reduced¹.

Troposphere

OH

(Hydroxyl Oxidation)

CH₄

METHANE (CH₄)

262%

N₂O

NITROUS OXIDE (N₂O)

124%

CO₂

CARBON DIOXIDE (C₂O)

149%

Total concentration of GHGs in the atmosphere in 2021²
ABOVE PRE-INDUSTRIAL LEVELS

OH

DETERGENT OF THE ATMOSPHERE:



90%

of methane is removed from the atmosphere through chemical reactions³

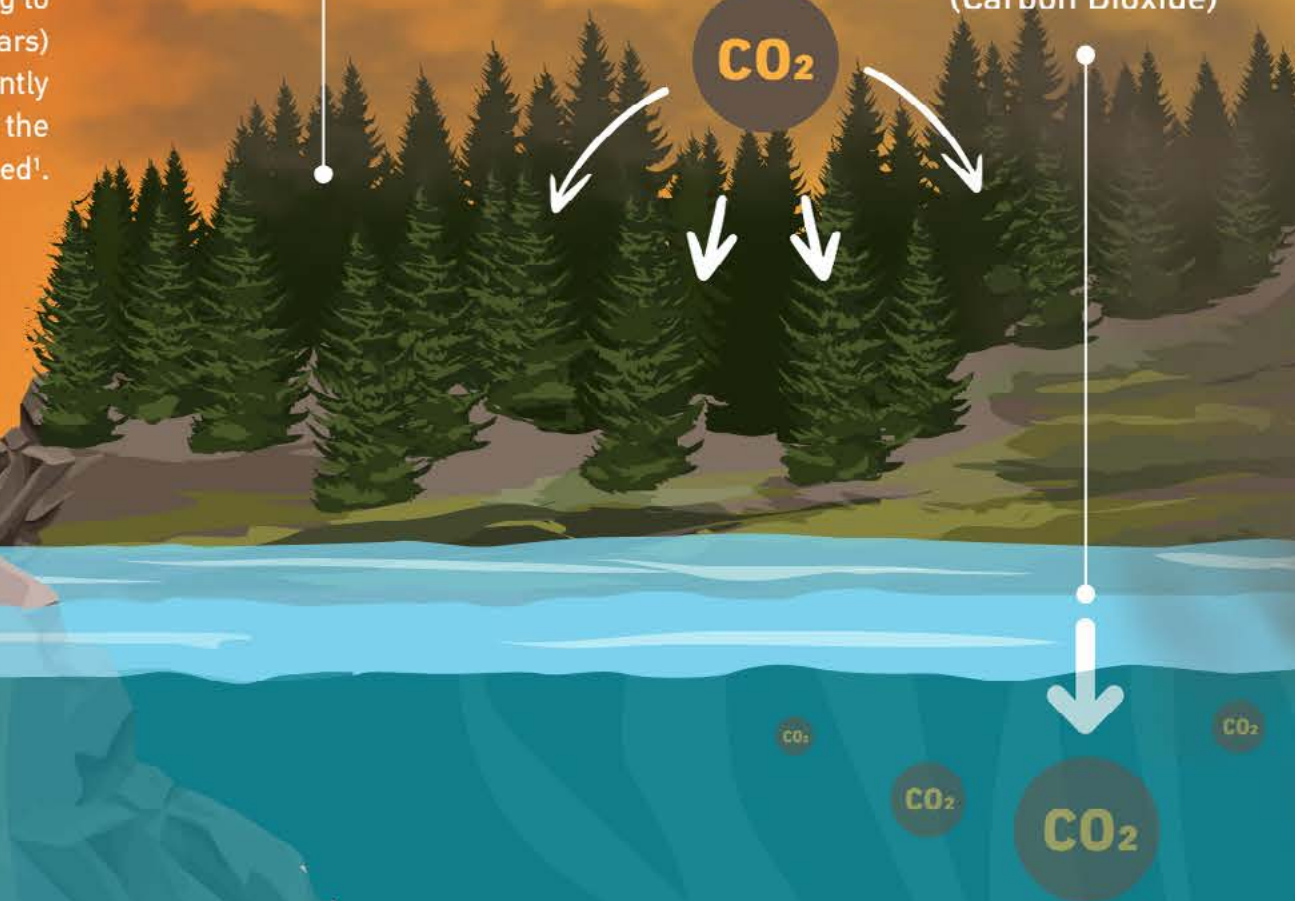


Photosynthesis

Some CO₂ is captured by sinks such as forests and oceans⁴ Protecting and enhancing native ecosystems ensures this continues.

CO₂

(Carbon Dioxide)



1. IPCC AR6 WGI Ch 7 Figure 7.15
 2. World Meteorological Organization (2022). Greenhouse Gas Bulletin: Another Year Another Record
 3. Saunio et al. 2020, ESSD (Fig. 6)
 4. Gruber et al. 2019



2. GWP* to the rescue

While GWP100 is the agreed metric used by countries to report their current and projected emissions in their annual inventories to United Nations Framework Convention on Climate Change (UNFCCC),⁵¹ proponents of GWP* like Allen and Cain have criticised GWP as “misrepresent[ing] the warming impacts of methane”.⁵² In particular, they claim that at the level of global emissions accounting, the GWP metric does not capture the fact that if methane emissions become stable then the total warming impact due to methane will also become stable.

Using GWP accounting can therefore be somewhat misleading when developing emissions trajectories consistent with a certain amount of warming (e.g. 1.5 or 2°C). This was purportedly why GWP* was developed. GWP* claims to capture the contrasting impacts of short- and long-lived climate pollutants on medium-term temperature change more accurately than other GWP metrics.⁵³ In particular, it was put forward as an answer to a concern expressed by some academics and policymakers that using GWP accounting within medium-term CO₂-equivalent emission reduction targets leads to uncertainty about the temperature outcomes associated with meeting those targets.

2.1 Shifting baselines

GWP* is designed to reflect the warming impact of ongoing emissions of a short-lived greenhouse gas in relation to the current levels of that gas in the atmosphere. The underlying theory is that, over time, ongoing emissions will not be adding warming to the atmosphere, but merely replacing old emissions that

have degraded. However, given the current high concentrations of methane in the atmosphere, the baseline to which any reductions should be measured must be much lower than current emissions levels. Ultimately, reducing methane is the quickest way to reduce atmospheric greenhouse gas effects.⁵⁴

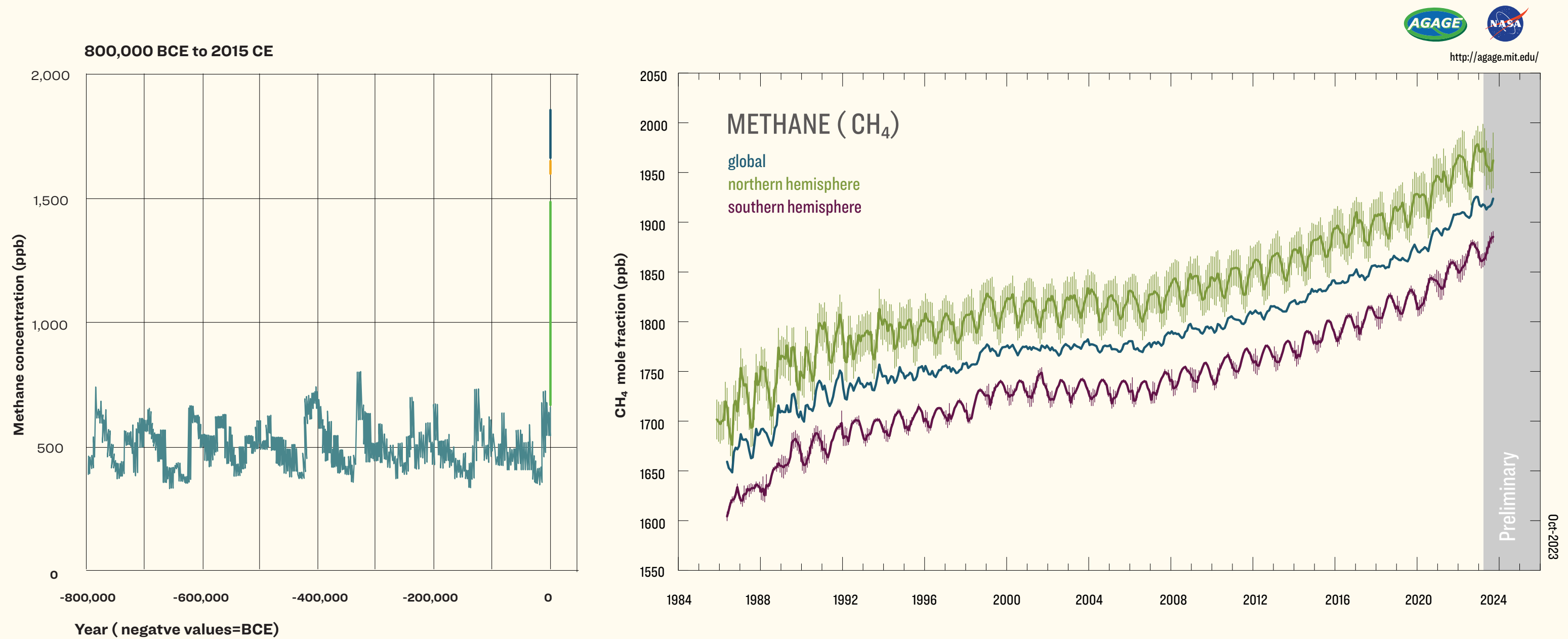


Figure 3. Global atmospheric concentrations of methane over time. The concentrations of methane in the atmosphere from hundreds of thousands of years ago through 2021, measured in parts per billion (ppb). The data comes from a variety of historical ice core studies and recent air monitoring sites around the world. Each line represents a different data source. Compilation of five underlying datasets. Source: United States Environmental Protection Agency (EPA) (2022). Climate Change Indicators: Atmospheric Concentrations of Greenhouse Gases. Figure 2. Global Atmospheric Concentrations of Methane Over Time. Retrieved from <https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases#ref6>

Figure 4. Recent growth in methane in the lower atmosphere. CH₄ in the lower atmosphere (troposphere) at stations around the world measured by the Advanced Global Atmospheric Gases Experiment (AGAGE). Abundances are given as pollution-free monthly mean mole fractions in parts per trillion. Source: Prinn et al. 2018. https://agage2.eas.gatech.edu/data_archive/data_figures/monthly/pdf/CH4_mm.pdf⁵⁵

At the heart of this is a decision about what level of a gas is acceptable in the atmosphere. The year chosen as the baseline against which emissions are measured can make a huge difference to how emissions are categorised. Early papers on GWP* include calculations of warming relative to preindustrial levels of GHGs - a time before the extractive sector and industrial-scale agriculture had contributed to much higher levels of methane in the atmosphere.⁵⁶ However, if a GWP* calculation is set up to measure warming relative to current atmospheric levels, or indeed any year after industrialisation, a certain anthropogenic level of methane in the atmosphere is baked into the calculation.

For example, a country with a large established livestock sector could use the methane produced by its current livestock herd as the baseline against which the warming impact of new emissions is calculated with GWP*. Using this method, keeping emissions stable could be described as contributing no additional warming - or, much more misleadingly, contributing no warming at all. A further issue is that, even against a very high baseline, decreases in emissions can be described as cooling, whereas in reality the decreases are just less warming from an already high level. We have calculated a scenario like this for New Zealand below.

GWP* proponents argue that the 'exchange rate' of conventional GWP does not fairly reflect the changing impact of emissions, and the interplay of new and degrading GHG emissions over time. This is why GWP* focuses on changes in emissions rather than absolute emissions.

While GWP accounting focuses on the amount of CO₂ emissions that would produce the same heat-trapping effect over a certain time horizon as a tonne of methane emissions, GWP* accounting focuses on the amount of CO₂ emissions that would produce the same change in temperature as a sustained increase by a tonne per year in the *rate* of methane emissions.

By building current heightened levels of anthropogenic methane into the baseline, GWP* can be used to imply that a constant level of methane emissions from a particular activity does not contribute to climate change. This is not true and the GWP metric is still accurate in saying that emitting a tonne of methane today would have 80 times more temperature impact over the next 20 years than emitting a tonne of CO₂. Even though methane pollution previously emitted by that source may simultaneously be breaking down in the atmosphere, this does not change the fact that reducing methane emissions is necessary to stay below 1.5°C.⁵⁷ Nor does it change the polluter-pays principle, which suggests that companies should be held accountable for their pollution today, irrespective of whether they released the same amount of pollution yesterday.

The IPCC has discussed the different approaches in its successive reports. It notes that “all GHG emission metrics have limitations and uncertainties, given that they simplify the complexity of the physical climate system and its response to past and future GHG emissions.”⁵⁸ Myles Allen, the lead researcher behind GWP*, is also an IPCC contributing scientist and he (among others) co-authored a box on “measuring progress to Net-Zero emissions combining long-lived and short-lived climate forcers” in the IPCC Special Report on Global Warming of 1.5°C (SR15). The box includes a graph comparing the CO₂ equivalent emissions values under various metrics (including GWP20, GWP100 and GWP*) of two methane emissions trajectories and the global mean air surface temperature (GSAT) impact associated with those methane emissions in the IPCC climate modelling.⁵⁹ The graph covers the period from 1750 through to 2100, and the two methane emission trajectories (dotted black lines) both show peaks of global methane emissions before 2100 - on the left they peak in about 2060, on the right (far less likely) they peak just after 2020.

Warming equivalence of cumulative emissions

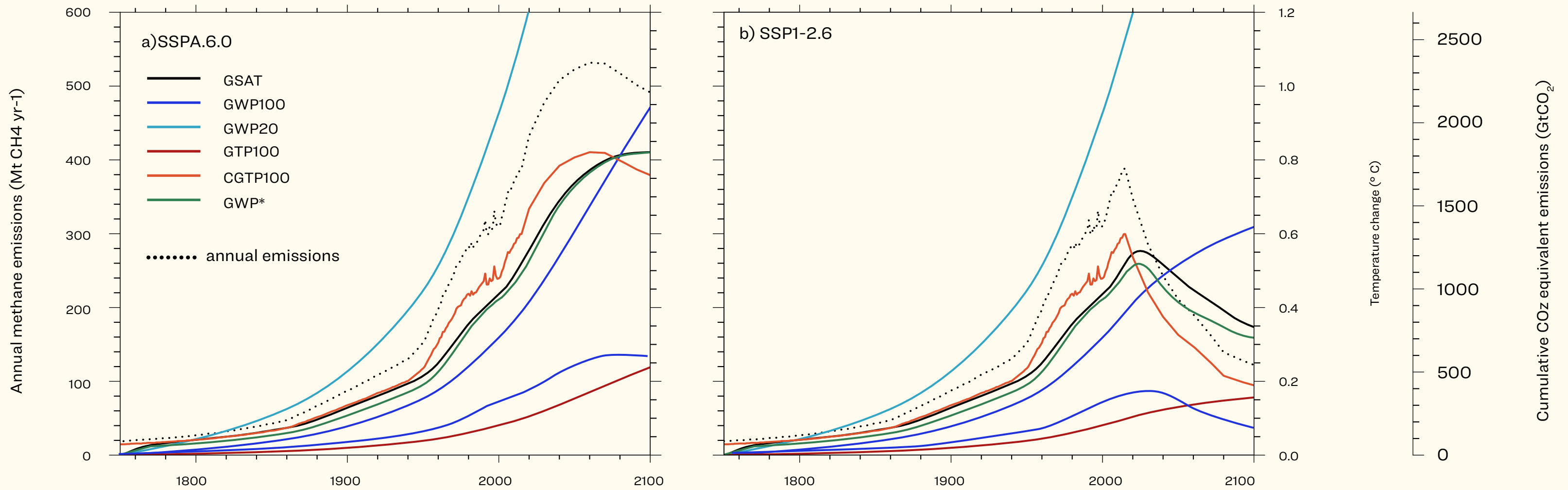


Figure 6. Comparing metrics with preindustrial time as a baseline. How cumulative carbon dioxide equivalent emissions estimated for methane vary under different emissions metric choices and how estimates of the global surface air temperature (GSAT) change deduced from these cumulative emissions compare to the actual temperature response computed with the two-layer emulator (solid black lines). In the SSP4-6.0 scenario on the left, we begin seeing annual emissions decrease by 2050, a plausible scenario.⁶⁰ In the SSP1-2.6 scenario on the right, society and economic systems are immediately transformed, which currently appears highly unlikely.⁶¹ Source: Figure 7.22 in IPCC (2021) Climate change 2021: The physical science basis.

The thick black line (GSAT) on the graph represents modelling of the temperature impact from methane emissions over the chosen 350 year period. Comparing the thick black line to the teal line for CO₂ equivalent emissions on a GWP20 basis shows that using the GWP20 metric to characterise the impact of these 350 years of methane emissions would deliver an overestimate of cumulative impact. This is not surprising, as we know that GWP20 captures the short term

power of methane as a climate forcer but will overstate the impact on longer timescales. A slight overestimation would also be welcome as it allows for a range of uncertainty; however, as shown in Box 1 below, if GWP20 is used properly, it tracks well with warming.

Box 1. GWP20 can track with warming when used appropriately

When GWP20 is calculated over a 20-year timeline it closely matches the actual warming effect of a pulse emission of methane (i.e. the methane emission for an industry or country in a given year or other time period). Since a pulse emission of methane lasts approximately 12 years before most is degraded, the major warming impact is closer to 20 years than 100 years, and has three times the warming potential during this shorter time. An analysis in Australia argued the relevance and importance of GWP20 and showed the country's emissions from agriculture would be double using GWP20.⁶² As such, GWP20 more clearly highlights the dire need for immediate and decisive methane reductions, within the comprehensive approach to addressing climate change under the Paris Agreement and other global commitments. Instead of accumulating methane

from 1750 to calculate the temperature as in Figure 6 (IPCC figure 7.22, regularly cited to advocate for GWP*), we calculated this for the past 40 years. In this more relevant calculation, GWP20 estimates GSAT very well in both the scenarios presented by the IPCC report. GWP100 tracks better if the analysis is done over 100 years.

The IPCC report's supplementary documents show that the GWP* calculations use preindustrial times (1750) as a starting point, where initial emissions are close to zero. It turns out that GWP20 and GWP100 were calculated using a quantity of historical methane starting from the year 1750 for each point on the graph, resulting in irrelevant numbers. When recalculated using pulse emissions for the previous 40 years for each point on the graph, GWP20 tracks extremely well with GSAT. This is a more relevant measure since a pulse of methane is more than 95% degraded within 40 years, reflecting the physical basis from which GWP20 numbers are derived.⁶³

Warming equivalence of cumulative emissions

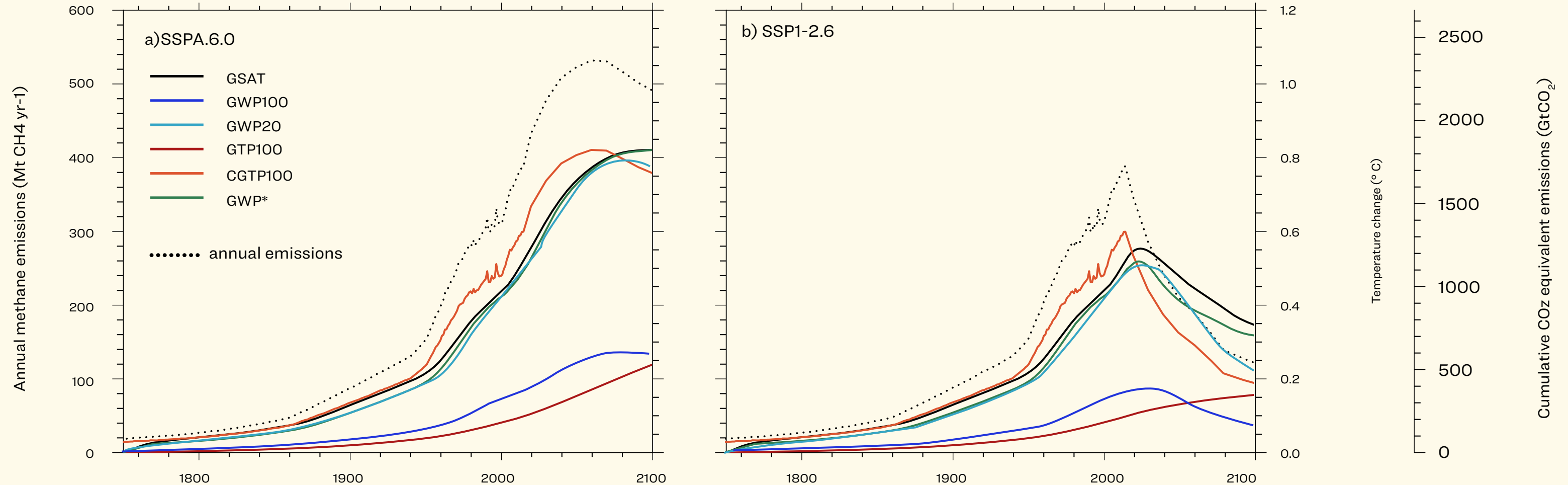


Figure 7. Our calculation comparing metrics with a modified 40 year time period. Calculation of GWP20 where E(y) – the dotted black line – represents the calculated CH4 annual emissions as a function of the year “y”. Since CH4 decays with a mean lifetime of 12 years, there is no point in accumulating from 1750. So we could modify the calculation of temperature for GWP20 and choose 40 years by which the CH4 emitted is more than 95% degraded. Note, the difference here is we are accumulating the CH4 emissions from only the past 40 years instead

Finally, comparing the green line for the GWP* metric to the thick black line (GSAT) shows that assessing cumulative CO₂ equivalent emissions using GWP* would give a good fit to the modelled temperature impact. This is also not surprising, because this is exactly the application that the GWP* metric was designed for, and indeed the parameters used in the calculation of GWP* have been calibrated to give a good fit to this sort of modelled temperature response. The issue is in claiming this provides the overall picture on current methane impacts or holds emitters accountable.

Figure 6. shows that if GWP* accounting had been introduced in 1750, it would have provided a good indication of the temperature impact from methane emissions up to the present day. However, this says nothing about whether GWP* accounting could be useful as a policy and regulatory tool to apply to individual countries or industries from today forwards. One obvious problem with GWP* as an accountability tool is that recent historical emissions (the proponents of GWP* usually suggest looking at emission changes over 20 years) are baked into the calculation. This would be equally true for emissions from livestock production or from the oil and gas industry.

Any country or company reducing its emissions at even a moderate rate (about 0.3% a year) could report a negative climate impact. For example, oil and gas production in Turkmenistan is associated with nearly 5 million tonnes of annual methane emissions⁶⁴ due to poor well management, with a methane intensity 11 times higher than Saudi Arabia. Under GWP100 or GWP20 accounting the high year after year emissions would be evident, and Turkmenistan would be encouraged to reduce its reportable national climate impact by bringing those emissions in line with international norms. With GWP* accounting, making even small reductions would instead be reported as a negative emissions, possibly equivalent to hundreds of millions of tonnes of avoided CO₂. Or, just keeping emissions at a steady state would be reported as a very small emission value, and close to “climate neutral”.

Since the baseline of absolute methane emissions will not be revealed by the metric, the incentive of reducing emissions may be reduced or even nullified.

What is key is that delivering a rapid reduction in methane emissions could keep global temperatures 0.75°C lower in 2100 than delivering a gradual peaking of methane emissions. That would be 0.75°C of breathing space for the world to bring CO₂ emissions under control. Those rapid reductions are more likely to be delivered if companies are held to account using a metric like GWP20 that acknowledges the climate impact of total yearly methane emissions than if they are allowed to use a metric that allows the worst methane polluters to label themselves ‘climate neutral’.

Box 2. New York chooses GWP20

Scientific analysis needs to serve wider climate policy (e.g., to inform equitable and ambitious emission targets or to support sector-specific mitigation policies). To reflect the severity of methane in the short term, and atmospheric benefits of reducing it quickly, New York City recently switched to reporting non-CO₂ emissions with GWP20,⁶⁵ since the next couple of decades are of crucial importance for the mitigation of the climate crisis.⁶⁶

Recent publications reinforce this point. Abernethy and Jackson (2022) support the use of a 20-year time horizon for emissions metrics, since this is better aligned with the temperature goals and timeline of the Paris Agreement.⁶⁷ Similarly, the Institute for Governance & Sustainable Development, in A Primer on Cutting Methane: The Best Strategy for Slowing Warming in the Decade to 2030, argues that:

“when comparing climate impacts for short-lived climate pollutants like methane, using the 20-year global warming potential (GWP20) better captures near-term warming impact than the 100-year GWP, in addition to being more aligned with meeting the 1.5 °C target.”⁶⁸

2.2 Hiding historical impacts

With CO₂ the “historical” emissions matter a lot. Since methane is shorter lived in the atmosphere, historical emissions matter less but are not insignificant, especially as methane has consistently been rising and adding warming concentrations. Full emissions are important because the ideal rate of human-caused unnecessary emissions is zero: even if this is not achievable, it shows the direction to point towards. The absolute emissions are hidden if GWP* is used, as if none of these emissions contributed to warming. The bottom left graph below (showing current emissions) for every emitter and source needs to be transparent. GWP* simply shows the difference between marginal warming and additional warming, as shown in the bottom right graph.

For any high historical methane emitter with slightly lower current methane emissions, the waning temperature effect of the past will dominate the additional warming from current emissions.⁶⁹ As a result, they are considered net negative in the GWP* framework. Yet current emissions still warm the planet compared to what would have happened without those emissions. Metrics should reflect this marginal/additional warming.

2.3 Inequity

GWP* has been criticised on a global policy level because it has the potential to reward the highest historically polluting countries or companies for their past GHG emissions by giving them credit for slight decreases from a high base-

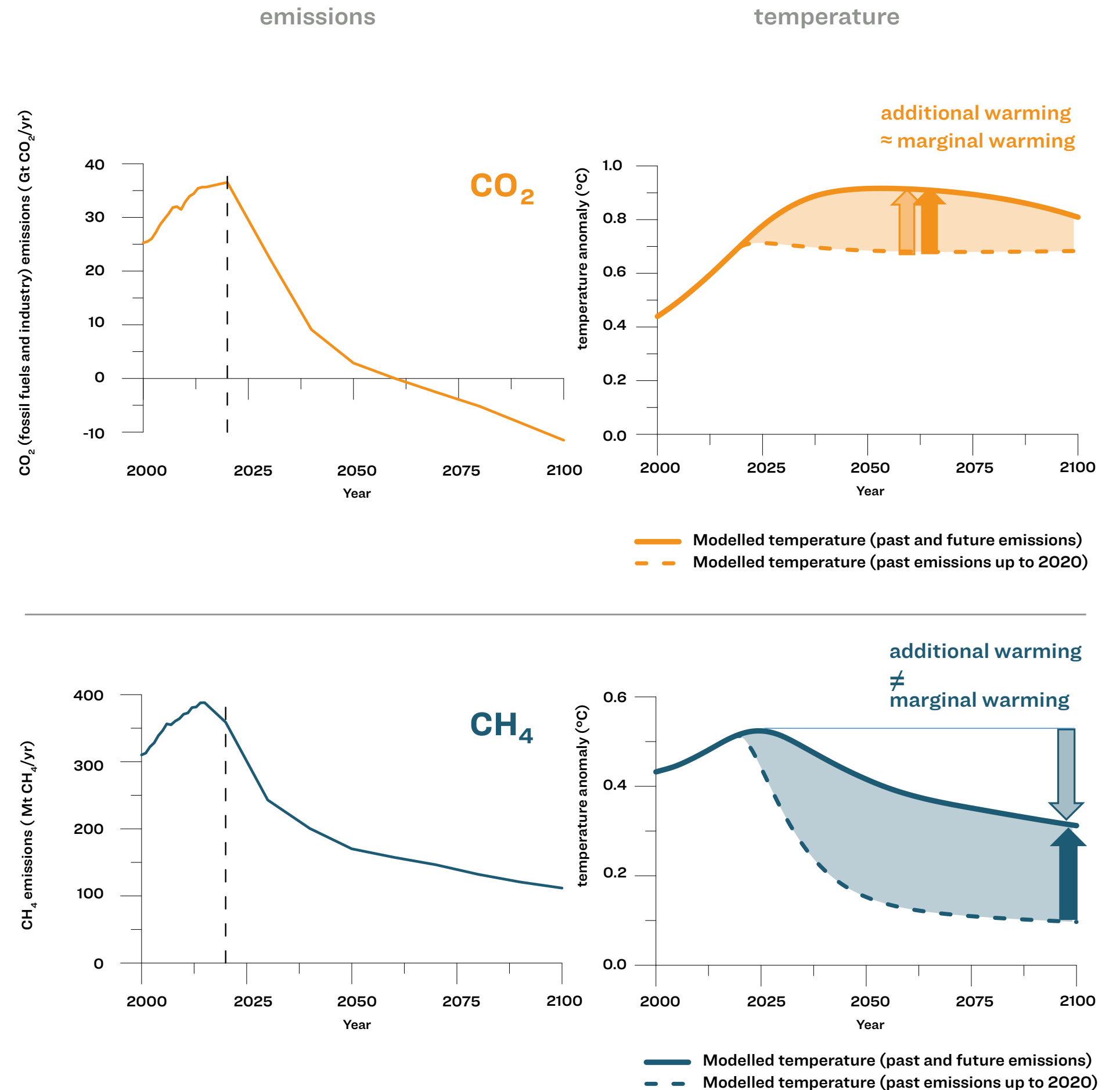


Figure 8. Additional vs. marginal warming. Source: IPCC (2023) GHG emission metrics: Findings from WGIII. IPCC workshop on common GHG emission metrics, Bonn, 7 June. https://unfccc.int/sites/default/files/resource/WGIII_metrics.pdf

line. This would simultaneously penalise countries with historically low levels of methane emissions for small increases.⁷⁰

Those arguing for the use of GWP* with a baseline set today or in the past few years are in effect saying the current levels of atmospheric methane are acceptable, as ongoing stable emissions won't cause *additional* warming. Using this logic, a global methane "budget" might cover the amount of methane that could be released into the atmosphere each year to maintain existing atmospheric methane levels. Weaponised this way, GWP* would undermine the Global Methane Assessment, which shows that human-caused methane emissions should be reduced by up to 45% this decade to avoid nearly 0.3°C of global warming by 2045. It could also derail the Global Methane Pledge, signed by over 150 countries, to reduce global anthropogenic methane emissions by 30% in 2030 compared to 2020 levels.⁷¹ Under the Global Methane Pledge, the amount of methane that each country needs to reduce varies, but generally, the richer ones with long-term developments in fossil fuels and animal agriculture need to reduce the most. GWP* would reward them for only minor reductions, potentially allowing the offset of emissions from other damaging sectors like fossil fuels, all while penalising low-resourced countries.⁷²

It is well established that the impacts of climate change have disproportionately affected marginalised and vulnerable regions of the world. Equity is essential to our ability to understand the dynamics of political action and trade-offs in climate action.^{73,74,75} Reinterpreting the Paris Agreement target from GWP100 to GWP* undermines the ambition and environmental integrity of the Paris Agreement.⁷⁶ If GWP* were adopted, it would necessitate a complete re-evaluation and revision of the future nationally determined contributions (NDCs) made by 191 countries. GWP* would require countries to begin the process of setting

their political climate targets anew - an ambitious request for policymakers, and a distraction from urgent cuts this decade.⁷⁷

2.4 Latest on the GWP* debate

Recently, academics with opposing views on GWP* published an update in *Nature* where they were able to agree that the:

“valuation of emission targets at the national or corporate level cannot be undertaken from a physical science perspective alone, but also depends on economic, social, equity and political considerations, including responsibility for past warming, capacity for and costs of abatement, and non-climate impacts.”⁷⁸

Based on equity-related feedback, the GWP* equation was attempted to be fixed with an update decreasing the weight of methane's impact from changing emission rates to 75% (flow) and to reflect past methane level increases, arbitrarily assigning 25% as accumulating (stock).⁷⁹ The modified GWP* framing still helps the high polluters because it allows them to claim the impact is a quarter of what the GWP100 rating suggests. Professor Frank Mitloehner, in a presentation to Lincoln University entitled “How Managing Methane from Livestock can be a Climate Solution”, claimed that:

“A constant livestock herd produces a constant amount of methane, but almost an equal amount of methane that's produced by a constant herd is also naturally destroyed and that means when you have a slight reduction of methane per year and that reduction is 0.3% ... then you are not causing additional warming.”⁸⁰

The same pitch is happening in the UK where industry is apparently working closely with IPCC researchers from the University of Oxford to advise the UK Government and the Climate Change Committee on using GWP*. A government adviser on ruminant methane, stated that “...net zero warming from enteric methane can be achieved through a 0.3 per cent emissions reduction, year-on-year, in existing flocks and herds.”⁸¹

This 0.3% reduction in methane tracks with our calculations below for the new GWP* equation to claim climate neutrality.

Proponents of GWP* disregard the issues of historical methane contributions claiming that “...burden-sharing discussions is a matter for policy-makers to decide.”⁸² They make the argument that there is nothing inherently unfair or inconsistent in the use of a metric that technically more accurately reflects the global mean surface air temperature,⁸³ while also stating that using GWP100 would be more unfair.⁸⁴ But unfair to whom?

Equity and fairness are crucial issues in the application of GWP*.⁸⁵ The same proponents of GWP* who state these are issues for policymakers are happy to advocate for policy in high-emitting countries by showing they can become climate neutral with only minor reductions in methane emissions.^{86,87} Academic proponents of GWP* have failed to call out the co-opting of it as a tool for greenwashing, and instead have presented it to industry representatives like those at the Belgian Association of Meat Science and Technology sustainable beef forum.⁸⁸

Box 3. Calculating methane emissions with GWP*

To demonstrate the implications of adopting GWP*, we have estimated GHG emissions for 2030 under different metrics for one meat company (Tyson) and one dairy company (Fonterra). We have also modelled the potential implications for New Zealand – a major meat and dairy producing country. Three versions of GWP* calculations exist as authors modified calculation techniques in response to criticisms. Using the latest version of GWP*, our calculations show how meat and dairy companies like Tyson Foods and Fonterra could escape virtually all climate responsibility if GWP* is given the green light.

Tyson and Fonterra: A licence to pollute

As most meat and dairy companies do not report their full supply chain emissions and do not disclose their methane emissions separately, we had to rely on estimates from Changing Markets Foundation and the Institute for Agriculture and Trade Policy (IATP) in the *Emissions impossible: Methane edition* report.⁸⁹ Fonterra was estimated to have

30.9 million tonnes of CO₂ equivalent emissions in 2020, while Tyson was responsible for an estimated 83.8 million tonnes in 2021. Through our methodology we were able to break down these emissions into methane, CO₂ and nitrous oxide (N₂O). Tyson’s methane emissions were roughly comparable to the total livestock methane emissions of the Russian Federation, while Fonterra’s were comparable to those of Ireland. (For a full description of the methodology, our findings and detailed calculations, please see Annex 1 of the Emissions impossible report.) Baseline emissions are presented in Table 1. We calculated how a 30% and 15% emissions reduction by 2030 would compare in GWP100 and GWP* accounting. The level of reduction was chosen on the basis that Danone, the first major dairy company to adopt a methane target, aims to reduce methane emissions for its fresh milk supply by 30% by 2030.^c The results highlight that under a nine-year GWP* methane accounting methodology, Tyson could claim no net warming with a mere 1.4% annual emissions reductions (Table 2).



Company	GHG emissions (GWP100 basis)	GHG emissions (GWP20 basis)	CH ₄ emissions (GWP100 basis)	CH ₄ emissions (GWP20 basis)	Fraction of GHG emissions as methane (GWP100)	Fraction of GHG emissions as methane (GWP20)	Methane/CH ₄ emissions
	kg CO ₂ e	kg CO ₂ e	kg CO ₂ e	kg CO ₂ e	%	%	kg CH ₄
	83,784,741,795	166,667,351,111	42,463,575,930	125,346,185,246	51%	75%	1,572,725,034
	30,922,750,517	56,990,438,174	13,355,361,798	39,423,049,456	43%	69%	494,643,030

Table 1. Baseline emissions estimates for Tyson and Fonterra. Source: IATP and Changing Markets Foundation (2022) Emissions impossible: Methane edition.

^c As the baseline for Tyson and Fonterra was one year apart, for 2030 reductions we had to calculate a nine-year timeframe for Tyson and a 10-year timeframe for Fonterra.

In the 2030 framing, the calculations are based on the 2030 emissions rate and the change from 2020 to 2030.





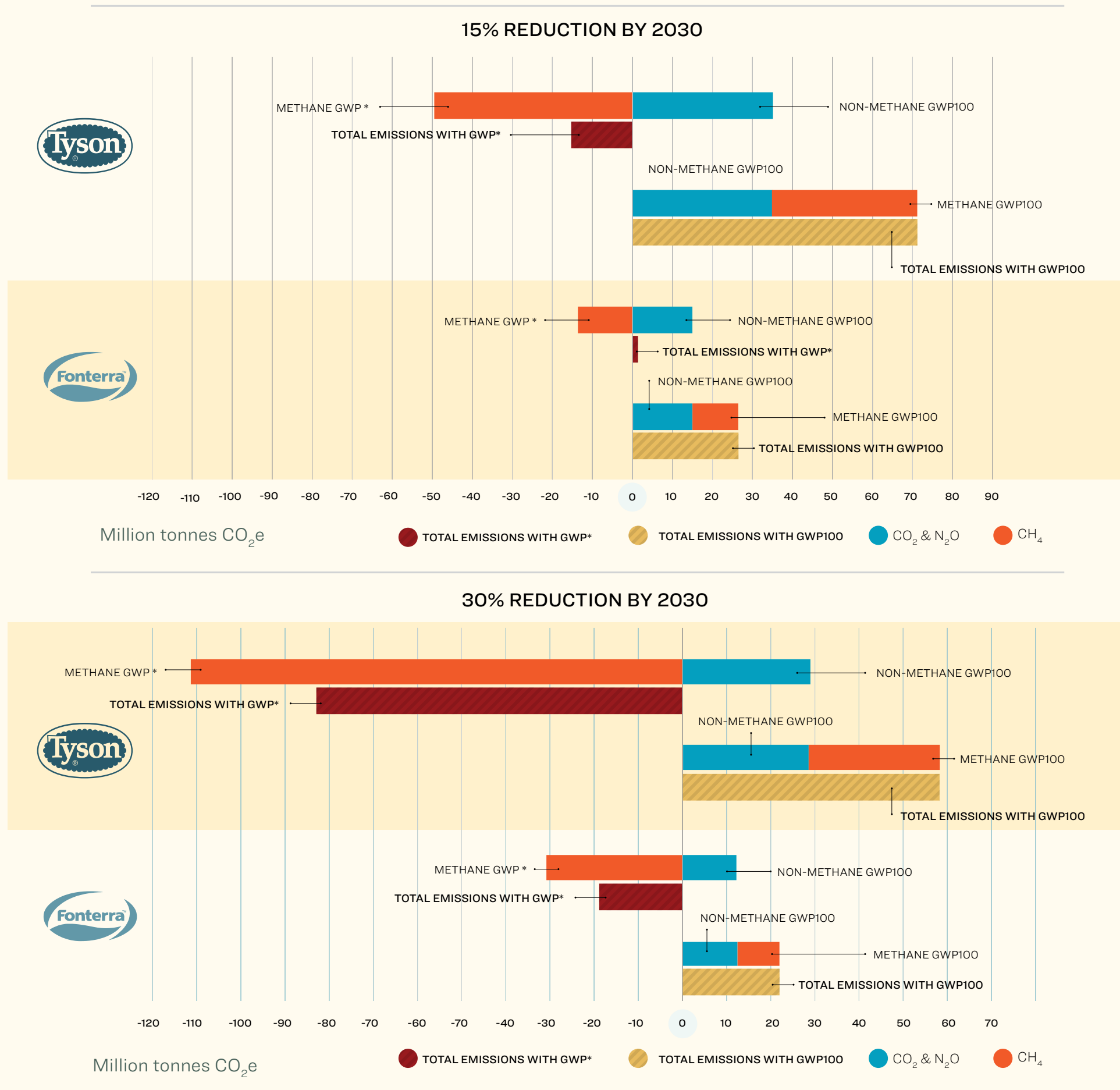
All in kg:								2030 methane emissions (kg CO2e)			2030 total emissions (kg CO2e)			Annual equivalent
Company	Year for 'current' data	'Current' emissions (CH ₄)	Emission reduction to 2030	Implied CH ₄ emission in 2030	Non-CH ₄ (2020), CO ₂ e, GWP100	Non-CH ₄ (2030), CO ₂ e, GWP100	GWP100	GWP20	GWP*	GWP100	GWP20	GWP*		
	2021	1,572,725,034	30%	1,100,907,524	41,321,165,865	28,924,816,106	29,724,503,143	87,742,329,647	-111,562,429,831	58,649,319,248	116,667,145,752	-82,637,613,725	3,89%	
	2020	494,643,030	30%	346,250,121	17,567,388,719	12,297,172,103	9,348,753,267	27,596,134,644	-31,314,984,604	21,645,925,370	39,893,306,747	-19,017,812,501	3,50%	
	2021	1,572,725,034	15%	1,336,816,279	41,321,165,865	35,122,990,985	36,094,039,530	106,544,257,428	-49,783,234,817	71,217,030,516	141,667,248,414	-14,660,243,832	1,79%	
	2020	494,643,030	15%	420,446,576	17,567,388,719	14,932,280,411	11,352,057,539	33,509,592,067	-13,771,047,446	26,284,337,950	48,441,872,479	1,161,232,965	1,61%	

Table 2. 2030 emissions estimates for Tyson and Fonterra, calculated using GWP100, GWP20 and GWP* methodologies

This translates into a reduction of around 12% from 2021 to 2030 to achieve so-called climate neutrality under the GWP* methodology.

Using GWP*, with a 30% reduction in emissions – a figure more in line with what’s recommended from high methane emitters to meet basic climate targets – Tyson could claim to be removing 82.6 million tonnes from the atmosphere. This would reframe the GWP100 calculations of 58.5 million tonnes of CO₂ equivalent emissions which roughly compare to the current annual emissions of Peru (or 116.7 million tonnes using GWP20) instead as a climate win.

For Fonterra, with a 30% reduction by 2030 from a 2020 baseline, it would still be responsible for 21.6 million tonnes of CO₂ equivalent emissions under the GWP100 methodology, which roughly compares to the current annual emissions of Sri Lanka. Using GWP* to measure the same reduction, Fonterra could claim to be taking around 19 million tonnes of CO₂ equivalent from the atmosphere. Fonterra could claim no net warming with an annual emissions decrease of approximately 1.7% over the 10-year period, or around 16% in total from 2020 to 2030.



Creative greenhouse accounting practices like this enable major methane polluters to greenwash their minimal reductions and present themselves as part of the solution, while hiding emissions equivalent to those of entire countries.

New Zealand: Net zero with minor emission reductions

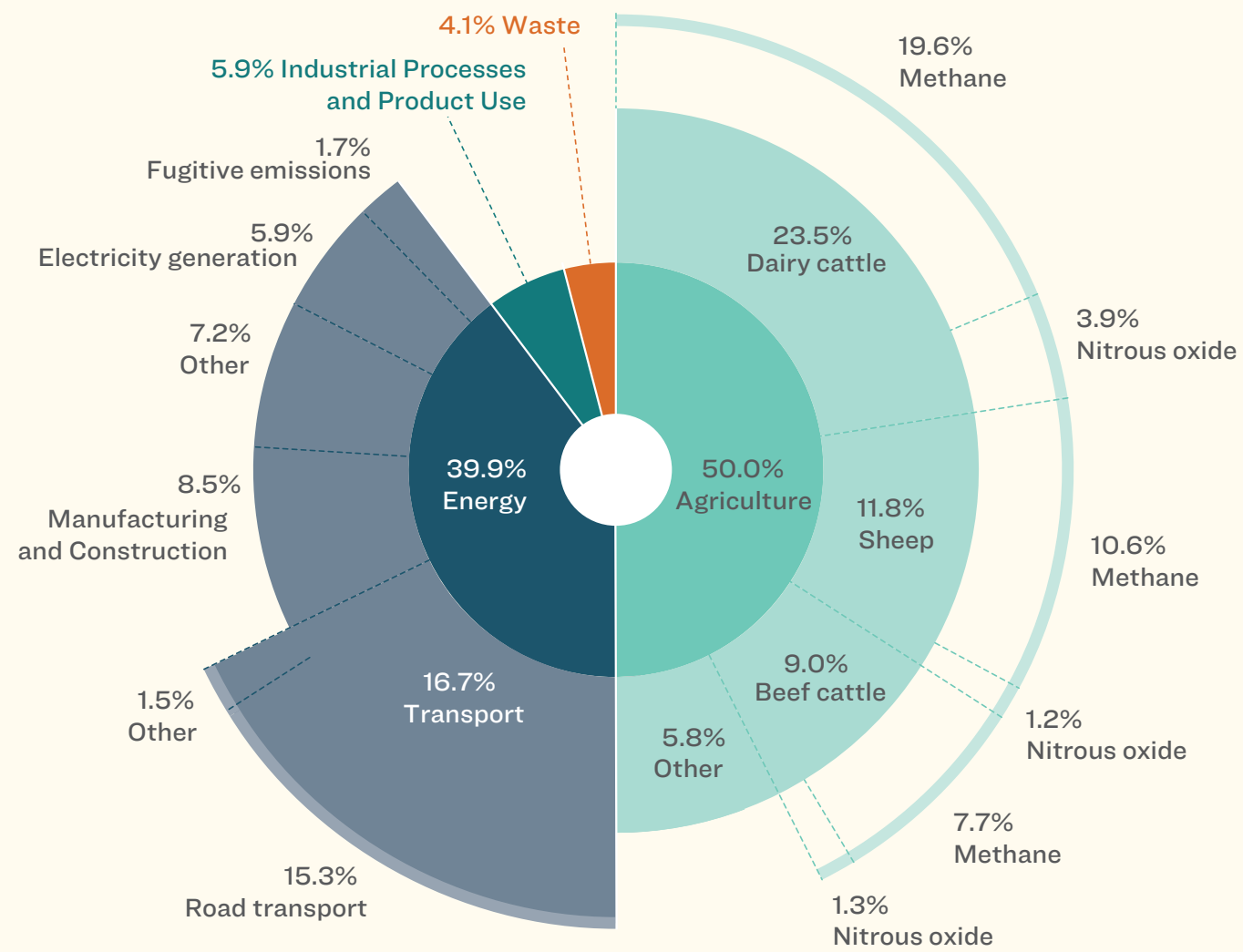
New Zealand farms 6 million dairy cows and is the world's biggest exporter of dairy products. About 44% of all New Zealand's emissions come from animal agriculture; dairy alone represents 23.5% of total national emissions.⁹⁰ It's no surprise that GWP* advocates have a receptive audience in the country: Frank Mitloehner visited New Zealand on a trip supported by Beef + Lamb New Zealand to promote GWP* and "how managing methane from livestock can be a climate solution"^{91,92} while Cain and Allen have also advocated for GWP* to industry.^{93,94}

To illustrate how GWP* could translate into (lack of) government action, we calculated two scenarios for New Zealand's livestock methane emissions. Using past data as reported by New Zealand until the year 2021, we modelled 10% and 19% reduction scenarios for the 30-year period until 2050; these are the reductions Myles Allen has suggested for New Zealand to achieve net zero.⁹⁵

Calculating methane with the latest GWP* methodology and assuming 10% reductions, New Zealand could start reporting negative methane emissions (in CO₂ equivalent) around the year 2038, while with 19% reductions this would happen in 2031. With 10% reductions, under GWP100 methodology, the country would still be responsible for

Figure 9. Companies 30% and 15% reductions compared in GWP100 and GWP*

Gross greenhouse gas emissions in 2020 by sector, sub-category and gas type



Breakdown of emissions by sector (Agriculture, Energy, Industrial Processes and Product Use (IPPU), and Waste), and sub-category, and greenhouse gas by type. The emissions contribution from Tokelau is too small to be shown in the figure.

around 30 million tonnes of CO₂ equivalent methane emissions in 2050 and under the 19% reduction scenario it would be responsible for 25.7 million tonnes of methane in CO₂ equivalent. However, if translated into GWP* figures, the emissions would be negative 1 million tonnes and negative 10 million tonnes respectively.

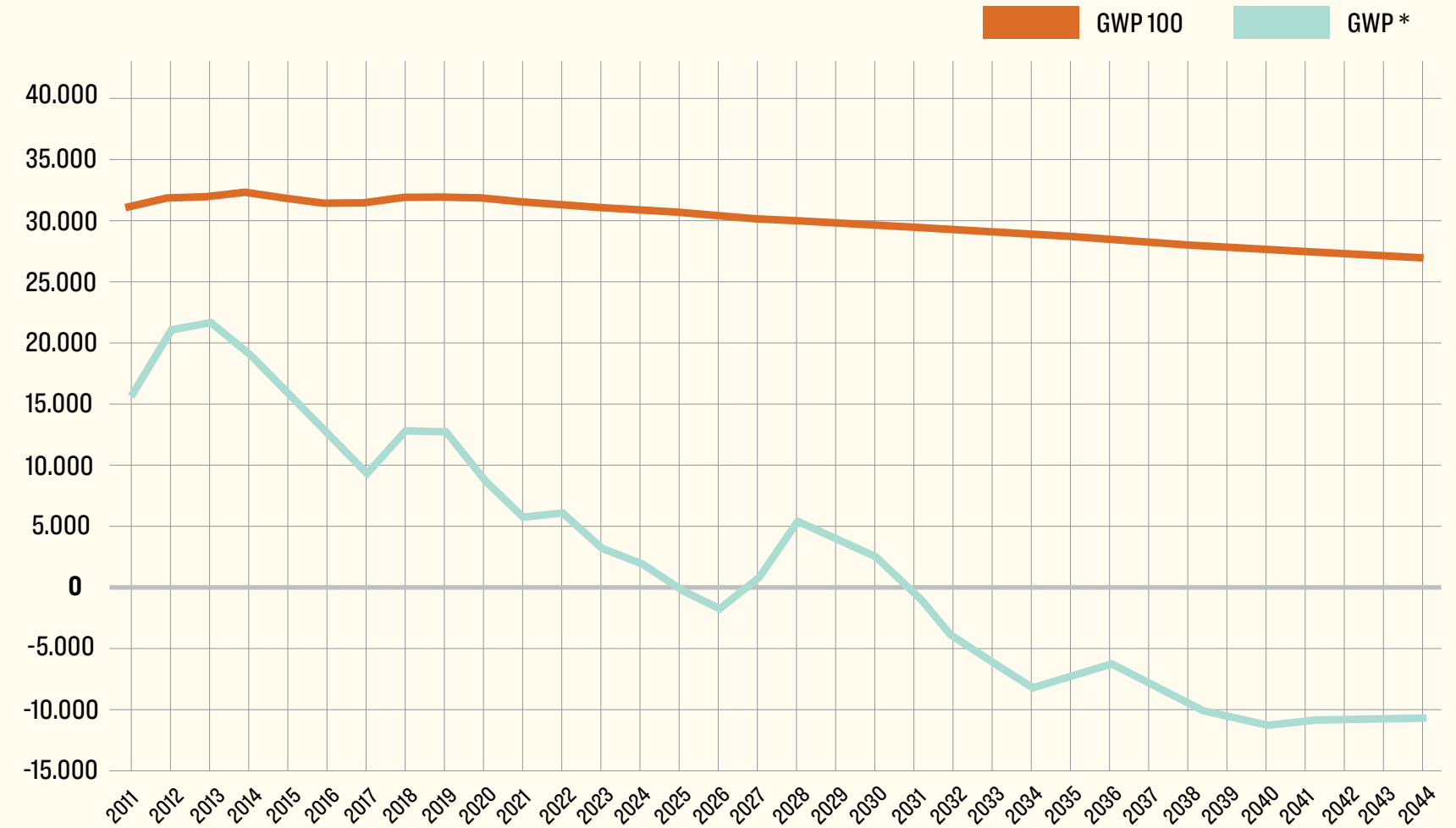


Figure 11. New Zealand's 19% methane emissions comparison in GWP100 and GWP*

Figure 10. New Zealand emissions by sector. Breakdown of total anthropogenic emission shares in New Zealand. Source: <https://environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2020-snapshot>

Emissions for New Zealand (19%)

kt CO2e[*] on basis of...	2011	2012	2013	2014	2015	2016	2025	2026	2027	2028
GWP 100	31.589	32.208	32.448	32.748	32.257	31.828	30.875	30.651	30.429	30.209
GWP 20	93.246	95.074	95.780	96.667	95.217	93.950	91.138	90.478	89.823	89.173
GWP*	15.470	20.467	20.983	18.510	15.066	11.845	-141	-1.643	926	5.342

Table 3. Emission estimates for New Zealand, calculated using GWP100, GWP20 and GWP* methodologies



3. Industry ploy to escape accountability

The scientific debate about the accuracy of either GWP metric has been academically inaccessible and complex.⁹⁶ To suggest that a company or industry that pumps out millions of tonnes of methane every year should be treated as climate neutral if it starts to reduce its emissions by a few percent per decade is simply misleading.

Some proponents of GWP* have even used it to describe reductions in levels of methane emissions as cooling of the planet.⁹⁷ The UC Davis CLEAR Center (2022) suggests that GWP* “shows that with aggressive reductions in enteric emissions and manure methane, cattle can make up for past warming, going beyond mere net-zero warming to have a cooling effect on the atmosphere.”⁹⁸

The Global Dairy Platform, representing the dairy and beef sector, produced a report in 2020 describing the ramifications of GWP* as “profound”, stating that under GWP* slight decreases in emissions “may have already

caused a relative cooling effect in the regions where ruminant populations have declined and/or productive efficiency is increased”.⁹⁹ This would be welcome news to the funding partners of this study, including Arla, McDonald’s, Global Roundtable for Sustainable Beef, Meat and Livestock Australia, and others. Despite this, the study concluded that GWP* is not appropriate at less than a global level.

Efforts to sway the emissions measurement system to greenwash the animal agriculture industry have taken multiple routes. 16 industry groups across the UK and New Zealand, including Beef + Lamb New Zealand, and UK farming unions, have jointly urged the IPCC in 2020 to adopt GWP* for assessing warming impacts.^{100 101}

Similarly, the European Commission’s call for input on a new methane strategy saw various agriculture sector responses debating GWP100 versus GWP*.¹⁰² Submissions came from several groups, such as Dairy Industry Ireland, the Irish Farmers Association and the CLEAR research institute at UC Davis, the latter having published a report for the Californian dairy industry, put together by industry-funded professor Frank Mitloehner.¹⁰³

After GWP* was introduced at COP24 in 2018, it attracted support beyond its creators, almost exclusively from those affiliated with beef and dairy industries or countries where agriculture comprised the highest share of emissions.¹⁰⁴ Supporters state that GWP* could counter mainstream critique of animal agriculture’s lack of sustainability. Industry publications¹⁰⁵ and events¹⁰⁶ have amplified these sentiments, asserting that the sector has been unjustly portrayed by GWP100 and GWP* can help paint a more positive picture.¹⁰⁷

While state-level interest in this metric is obvious from those regions that have a significant emissions share from agriculture, the animal agriculture sector is leading this campaign with coordinated pressure:

- In 2022, the chief executive of leading lobby group the National Cattlemen’s Beef Association (NCBA) said that GWP* “is the methodology we need to make sure everybody is utilizing in order to tell the true story of methane” and that “we’re working with our partners around the globe to ensure that everybody is working towards adoption of GWP*.”¹⁰⁸ This association represents over 175,000 beef producers, and major food companies such as Cargill and Tyson Foods and fast food chains like McDonalds and Five Guys sit on its product board.¹⁰⁹ This work seeps into the global level through the International Beef Alliance, a group of which the NCBA is a member, composed primarily of meat trade associations from North America, Latin America and Australasia - all high meat-producing regions that would benefit from this metric.¹¹⁰
- In 2023, the UK’s National Farmers Union (NFU), together with the Centre for Innovation Excellence in Livestock (CIEL), brought together experts and stakeholders to hear insights on alternative ways of accounting for methane’s impact on global temperature.¹¹¹ Following the private consultation with many industry groups, NFU concluded “GWP* provides a more accurate representation of the current contribution of UK ruminant agriculture to climate change.”¹¹² It has proposed showing GWP* alongside GWP100, backtracking from its initial approach for GWP* to fully replace GWP100.^{113,114}
- The California dairy sector, the largest in the US, claims it can become climate neutral by 2027 by using minor changes in feed and biogas schemes, based on UC Davis professor Frank Mitloehner’s research applying the GWP*



| Grist / Kate Yoder | Sourced from: <https://grist.org/food/carbon-neutral-milk-whole-foods-climate-change>

metric.^{115,116,117} This is despite emissions reductions from feed additives being uncertain and not yet proven at scale,¹¹⁸ while methane digesters risk a host of ammonia, health, clogging, corrosion and leaking issues, and further delays shifts in energy to renewables.¹¹⁹

Underlying these calls to use GWP* is the assumption that the existing animal agriculture industry is entitled to a larger share of the anthropogenic methane budget than any other sector. It is also assumed that this industry must maintain its size and that there are not far better environmentally performing alternatives (cultivated, precision fermentation, plant-based protein).¹²⁰ The industry likes having a metric that makes its impact seem small by building existing operations into the baseline.

How this metric is formalised matters far beyond agriculture. It could lead to a free pass to expand carbon-intensive energy.¹²¹ Countries with per capita methane emissions well above the global average (e.g. USA, Ireland, New Zealand, Australia) could use the GWP* model to express minor reductions from current methane emission levels as significant contributions to their climate goals. These could in principle be used to offset other GHG emissions including long-lived gases such as CO₂ or to generate offsets for a market mechanism.¹²² For example, if New Zealand decreased its methane emissions by 50% in 2035 relative to 2015, this would equate to a perceived ‘additional’ CO₂ budget of about 2.5 times New Zealand’s annual CO₂ emissions in the year 2015.¹²³

This is one of the many reasons why GWP* should not be taken out of context and applied nationally or at a product or farm level, as it is not equivalent to a globally applied metric like GWP100.¹²⁴

Box 4. Internal documents reveal Ireland pushing for GWP* metric

In 2021 Ireland passed climate legislation that required a 51% reduction in the country's GHG emissions by 2030.¹²⁵ Different sectors of the economy have been asked to make different levels of cuts to achieve the overall goal. Despite being the largest emitter (with 38.4% of total GHG emissions in 2022),¹²⁶ the agricultural sector is only required to cut emissions by 25% by 2030 compared to 2018 levels.¹²⁷ The 25% target was agreed after a period of heated debate and intense lobbying from industry bodies and farmers unions,¹²⁸ including, the Irish Farmers' Association, who have been advocating for the adoption of GWP* to count methane emissions in the livestock sector.¹²⁹

Internal documents suggest that the Department of Agriculture, Food and the Marine (DAFM) is keen to adopt GWP*, in the context of serious concerns that Ireland may “[fail] to achieve an ambitious 51% reduction target” due the agrifood sector’s volume of biogenic methane.¹³⁰ DAFM proposes relying on a mixed approach, with technological fixes such as feed additives to reduce individual cows’ methane emissions, and the use of GWP* instead of GWP100 to count methane from agriculture.^{131 132} DAFM's documents show some awareness that currently available technology cannot deliver the 2030 GHG reduction target.¹³³ Internal briefing notes prepared for DAFM Ministers, suggest they were advocating for GWP* at the international level,¹³⁴ including at COP26, as part of discussions on the adoption of the Global Methane Pledge.^{135 136}



4. Conclusions

Methane needs to be reduced to as low a level as possible to have any chance of keeping global warming below 1.5°C.^{137,138} There is a scientific consensus that methane emissions need to be reduced across all sectors, and political leaders and policymakers should not succumb to industry attempts to delay action through creative accounting. The animal agriculture industry is now proposing this alternative metric in a coordinated way, in order to escape accountability and to continue to receive the special treatment to which it is accustomed.

A useful metric for methane will demonstrate *both* the warming impact of absolute emissions from an industry or other emitter, *and* the impact of changes in emissions over time. GWP100 is currently the most accepted metric used for methane that meets these criteria, though it underestimates the impact of methane over a critical 20 year time frame. GWP20 also meets both criteria, and is helpful for measuring the warming impact of methane over a time scale that correlates with the atmospheric life of a pulse of methane emissions. GWP*, on the contrary, mostly measures

the warming effect of a change in methane emissions, but mostly obscures or hides the impact of baseline absolute emissions.

GWP* allows vested interests who seek to maintain political privilege to look like they're doing their part, while escaping responsibility for their climate and air pollution. This is agricultural exceptionalism, which grants a unique set of exemptions and privileges to the agricultural sector, allowing it to operate with less environmental and labour regulation and oversight than any other industry. This exceptionalism, rooted in romanticised myths about farming, has resulted in a significant lack of oversight on how food is produced, while the production of meat and dairy has benefited through greater subsidies, tax exemptions and even over-representation in government.¹³⁹

To achieve fairness when creating GHG reduction targets, each tonne of GHGs of any kind, in any country, needs to be accounted for in the same way. Rigour and clarity need to be applied, otherwise organisations or countries can use manipulative approaches, false starting measurements and narrow parameters to claim net zero or negative emissions. This will only benefit the status quo and hinder essential climate action.^{140,141}

There's a scientific consensus that we need to transform our food system by reducing the number of farmed animals and shifting to healthier and more plant-based diets. This will be a win-win-win strategy for climate, biodiversity and health. Corporate and government attempts to avoid this fact by delaying, distracting and derailing urgent climate action should not be accepted.

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