



AGRICULTURAL GREENHOUSE GASES AND EMISSION METRICS

GRA Communication Note

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NOTE OUTLINE

Key Messages

1. Context and issue
2. What is a GHG emission metric?
3. Frequently used metrics
4. Example application
5. Why do policy objectives matter when determining the 'right' metric?
6. Conclusions and open questions

Further reading

1. CONTEXT AND ISSUE

Objectives:

- explain the definition, scope and limits of greenhouse gas emission metrics
- why metrics differ in the weighting they assign to CH₄ emissions
- how emission metrics relate to different climate policy objectives
- does not recommend the use of any specific metric
but seeks to increase understanding of metrics and their uses

2. WHAT IS A GHG EMISSION METRIC?

- IPCC AR6 definition
 - variety of choices – different metrics give different values because they answer different questions (apples and oranges)
 - determining what CO₂ emissions have an “equivalent” impact on climate as CH₄ emissions depends on what aspect we chose to focus on
 - differences more pronounced for CH₄ than for N₂O
- Note focuses on CH₄

3. FREQUENTLY USED METRICS

GWP and GTP with different time horizons, GWP*

	GWP-20	GWP-100	GTP-20	GTP-50	GTP-100
CH ₄	79.7	27.0	51.7	10.4	4.7
N ₂ O	273	273	297	290	233

Large differences in values for CH₄; much more consistent for N₂O.

GWP and GTP are not intended to provide information on the cumulative effect of emissions that are sustained over many decades. A key metric to provide such information is GWP* (pronounced GWP-star).

KEY CHARACTERISTICS OF EACH METRIC

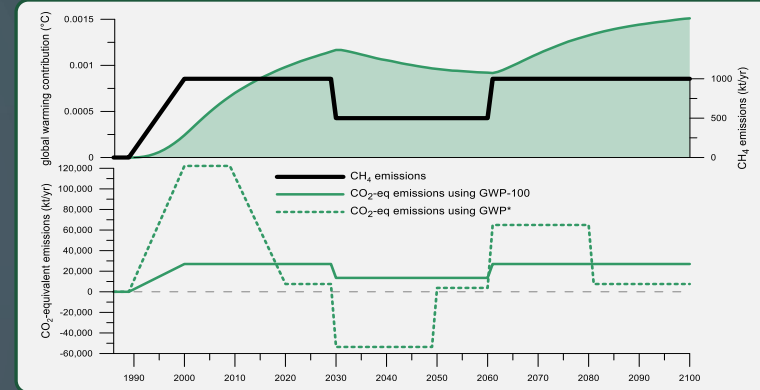
- Definition
- For what emissions (pulse or sustained; CH₄ or also N₂O)
- Calculation formula
- Graphical display
- Interpretation (making sense of what the metric tells us)
- Potential policy application (for what sort of questions could one use this)
- Limitations (avoiding misuse and misinterpretation)

4. EXAMPLE APPLICATION

GWP-100 and GWP* assign very different values to the same CH₄ emissions, because they answer different questions:

- GWP: how much warmer is the world with an emission, compared to if that emission did not occur?
- GWP*: how much warmer is the world with an emission, compared to how warm it was 20 years earlier from previous emissions?

Difference between “marginal” and “relative” warming. What approach is more appropriate is not a question of science but depends solely on the policy question or objective in which the metric is applied.



5. WHY DO POLICY OBJECTIVES MATTER ?

- Comparing the climate effect of agricultural products or farm systems
- Climate benefit of mitigations
- Comparing agriculture and agricultural products with other sectors
- Monitoring progress towards net emission targets

Most of these questions require ‘marginal’ metrics, i.e. information about the effect on climate with, compared to without, a given emission; or how much warming would be avoided if a given emission were avoided.

Illustration of using GWP-100 and GWP* to describe two farms with different historical and future emissions. Both metrics give correct answers, but they answer different questions. Can inform but not determine policy choices.

6. CONCLUSIONS AND OPEN QUESTIONS

- different metrics answer different questions
- one metric cannot simply be used to substitute another since that would imply changing the policy objective and climate outcome
- multiple metrics for multiple objectives; or ‘good enough’ metrics
- setting objectives for individual gases avoids the need for metrics for monitoring progress, but doesn’t avoid the question about what reductions to expect from different gases and why; also constrains flexibility in light of new information about costs and opportunities

KEY MESSAGES

“ Emission metrics help compare how much the emissions of different greenhouse gases (GHGs) contribute to climate change. They do not prescribe what actions to take for each GHG.

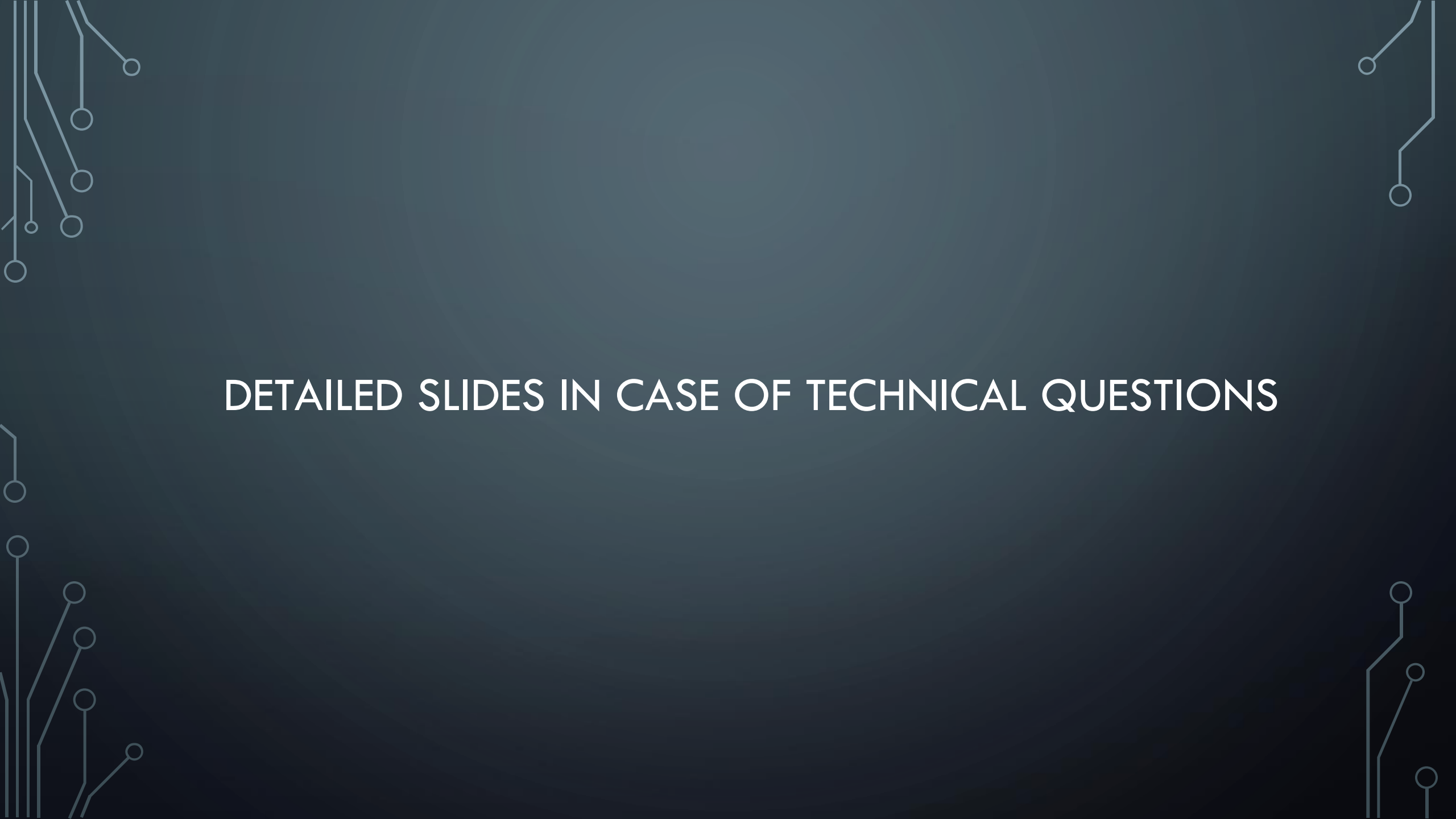
“ Parties to the Paris Agreement have agreed to use the 100-year Global Warming Potential (GWP-100) for national emissions reporting and accounting, but they can supplement this information by using other metrics assessed by the IPCC.

“ Metrics differ in the weighting for non-CO₂ emissions compared to carbon dioxide (CO₂). These differences reflect different choices of what aspect of climate change the metric focuses on, or what question the metric is trying to answer. Differences tend to be more material for short-lived gases like methane than for long-lived gases like nitrous oxide.

“ Every metric represents only one specific scientific aspect of climate change. The most appropriate metric depends on whether this scientific aspect is relevant to a given policy goal. The policy goal determines what metrics are appropriate and useful.

“ In practice, users often have a range of policy goals or questions. Users need to decide if a given metric provides sufficiently useful and relevant insights for their needs rather than matching their needs perfectly. All metrics have limitations.

“ Using multiple metrics to report emissions or evaluate mitigation options can provide nuances and reflect multiple policy goals but may make it harder for end-users to interpret the information provided. A given CO₂-equivalent emission reduction target can imply different climate outcomes and ambitions depending on the metric used to monitor that target.

The background is a dark blue gradient. In the corners, there are white line art illustrations of circuit boards or neural networks, with lines connecting to small circles.

DETAILED SLIDES IN CASE OF TECHNICAL QUESTIONS

GWP

- compares effect of emissions compared to those emissions not occurring
- approximates the damages caused by emissions
- supports cost-benefit analysis of abatement options

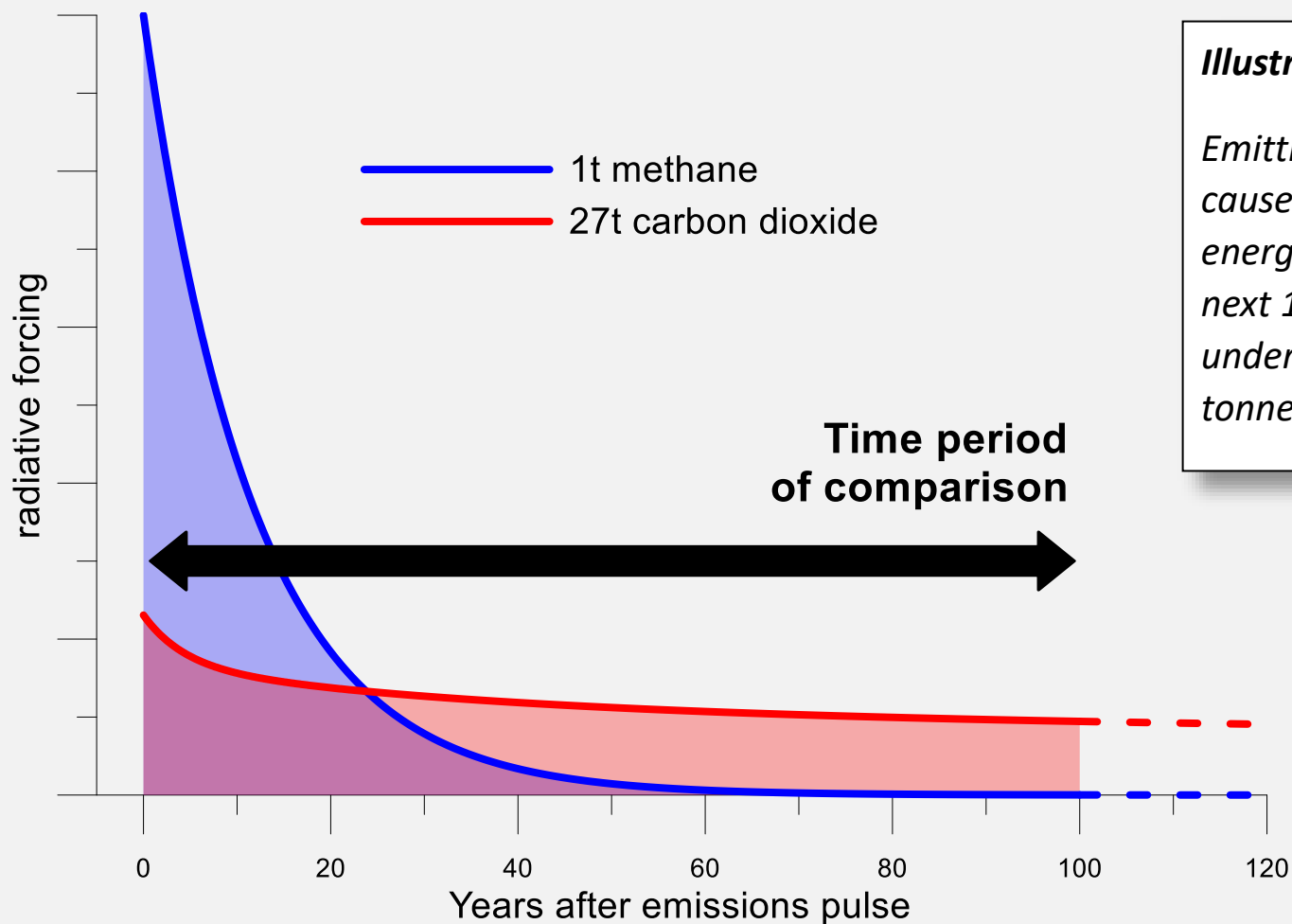


Illustration of GWP-100:

Emitting 1 tonne of CH_4 today will cause the same change in Earth's energy balance in total over the next 100 years (the shaded area under the curve), as emitting 27 tonnes of CO_2 today.

Limitations:

- should not be applied to cumulative emissions over many decades
- cannot tell us temperature change in any specific year, only the average warming effect over the time horizon

GTP

- compares effect of emissions compared to those emissions not occurring
- tells us about actual temperature change, but only in a specific future year
- can support cost-effective abatement to limit warming in a specific future year

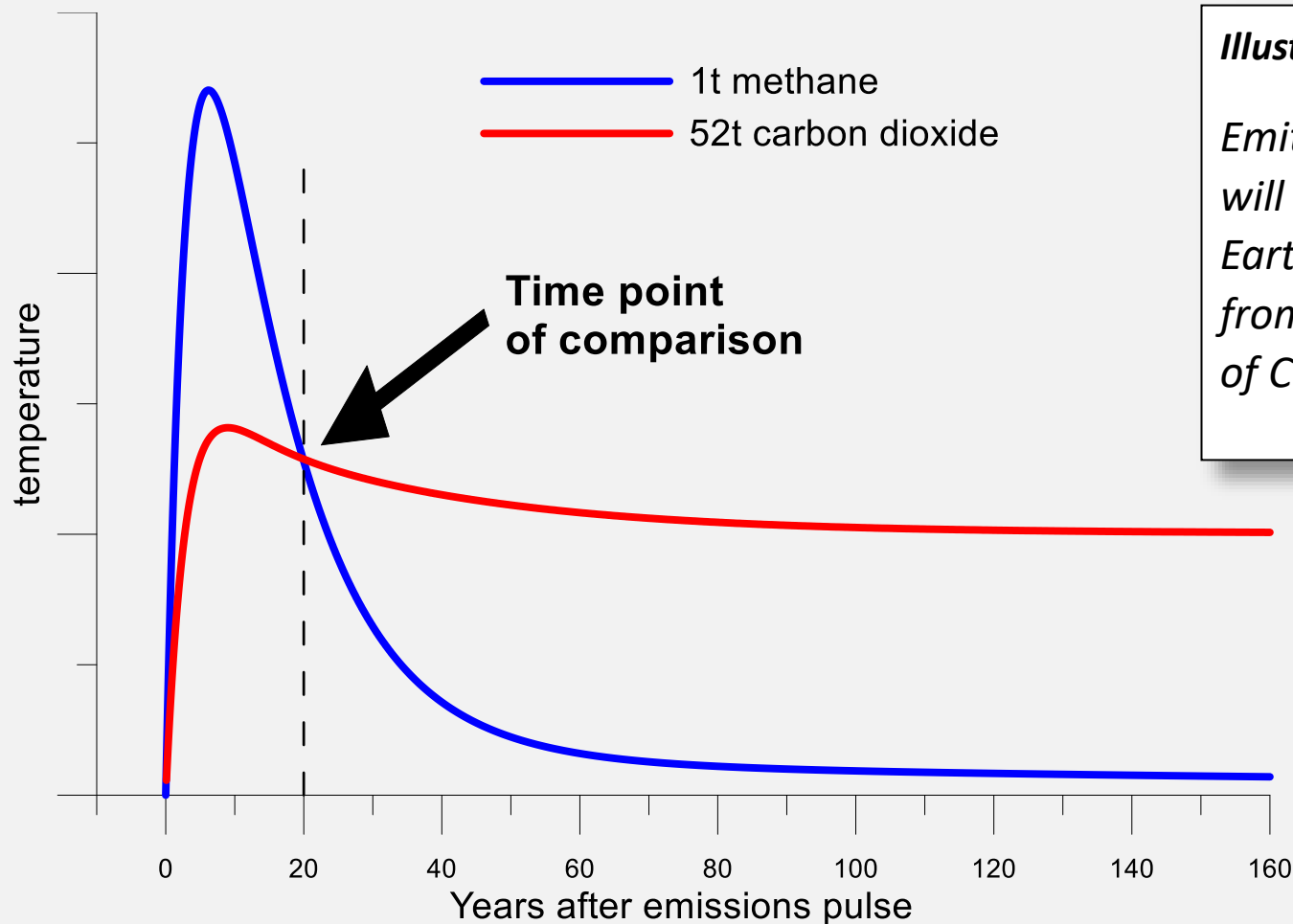


Illustration of GTP-20:

Emitting 1 tonne of CH_4 today will cause the same increase in Earth's temperature 20 years from now as emitting 42 tonnes of CO_2 today.

Limitations:

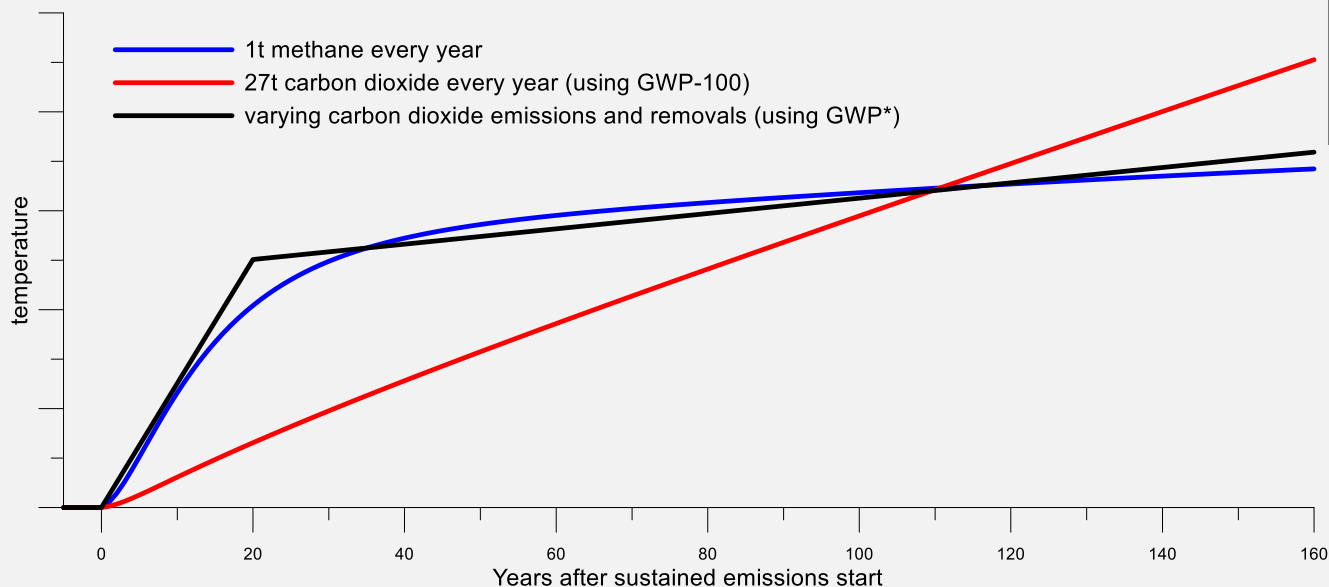
- should not be applied to cumulative emissions over many decades
- to support cost-effective abatement, the time horizon and metric value should change every year; and needs target year

GWP*

- compares effect of each emission relative to warming from 20 years before
- is designed to be used for continued emissions over many decades
- tells us about actual temperature change over time based on cumulative emissions
- captures both near-term and longer-term warming effects of CH₄

Illustration of GWP*:

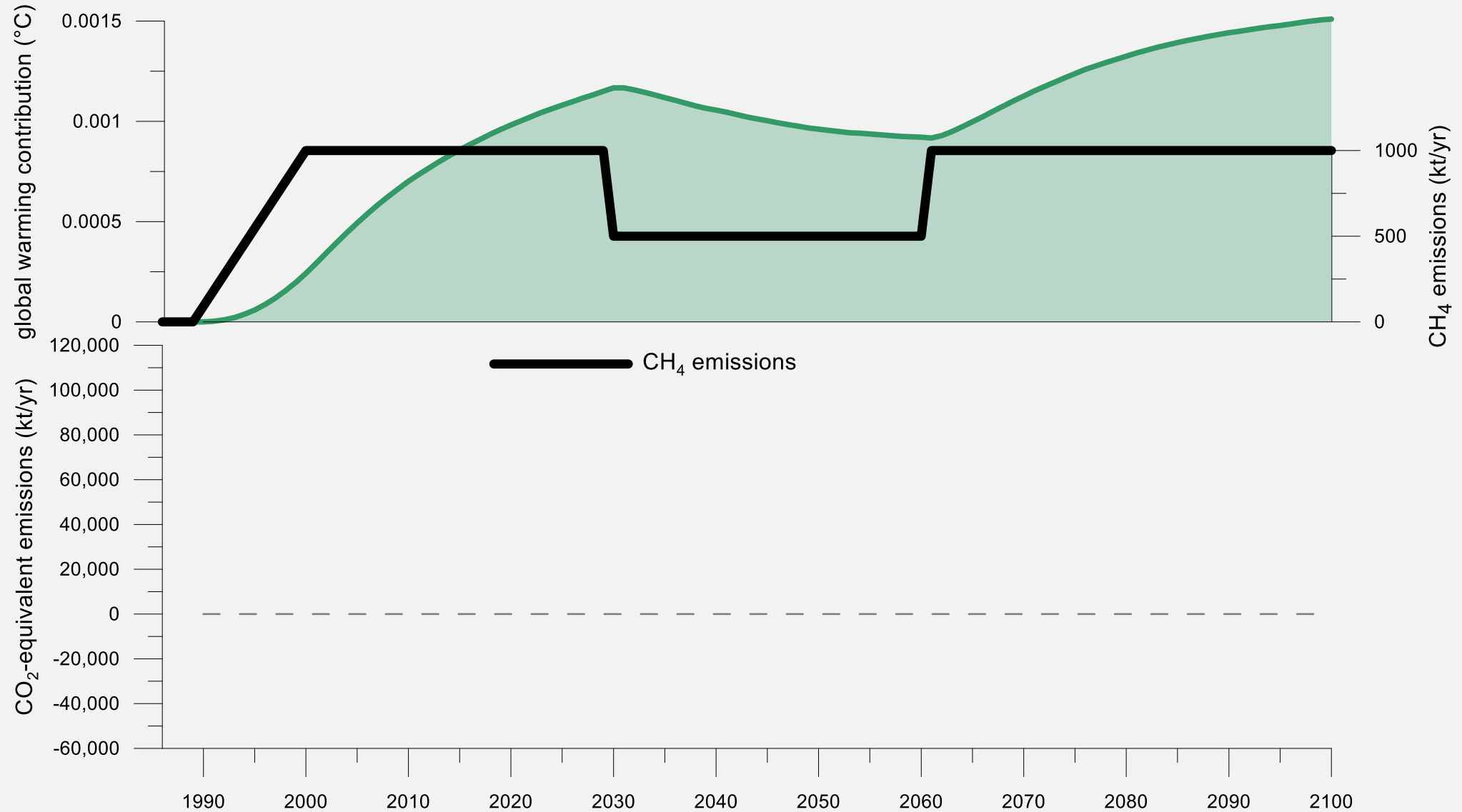
Emitting 1 tonne of CH₄ every year does not cause a constant increase in Earth's temperature. The warming is better captured if it is represented by emitting 122 tonnes of CO₂ every year for 20 years followed by 7.6 tonnes every year thereafter.



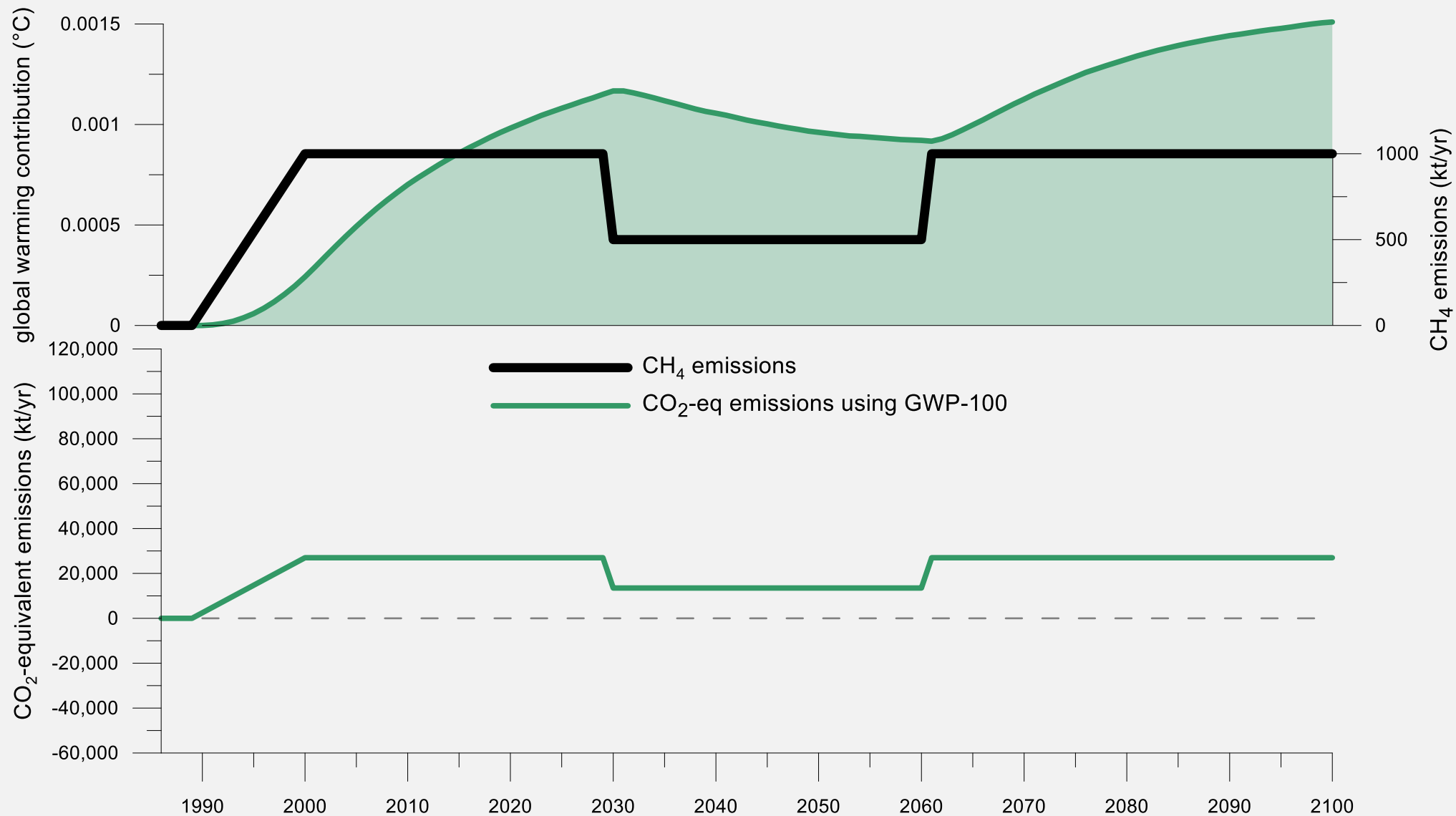
Limitations:

- the metric value depends on the reference level (emissions 20 years before)
- two emitters with different actual emissions could have the same GWP*-based emissions
- two emitters with the same actual emissions could have different GWP*-based emissions

EXAMPLE APPLICATION



EXAMPLE APPLICATION



EXAMPLE APPLICATION

