Department of Primary Industries

# Metrics for Net Zero

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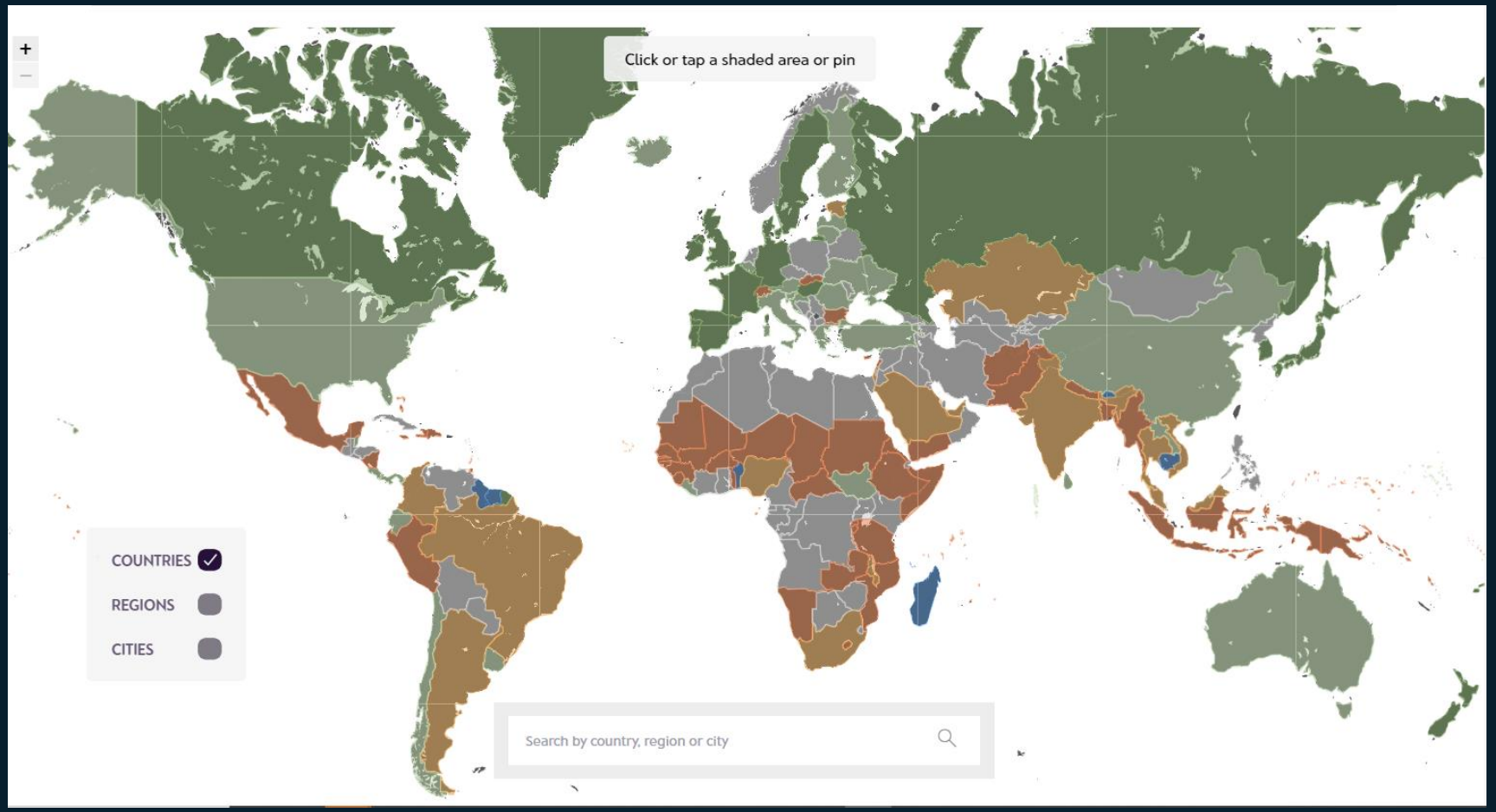
# UNFCCC: The Paris Agreement

- Aim: limit temperature rise to well below 2°C, pursue 1.5 °C target
- Emissions to be balanced by removals – net zero net emissions - in second half of century

# Net Zero commitments

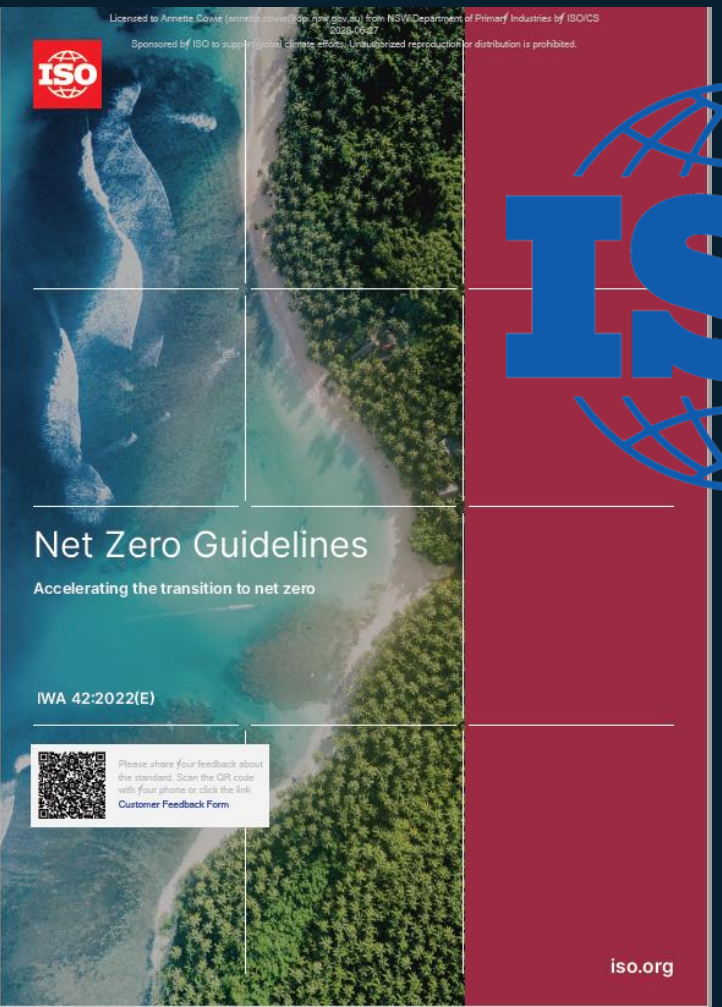



**Net Zero tracker**:

6 Achieved
26 In law
48 In policy
9 Pledged
60 Proposed


*https://zerotracker.net/*

# RACE TO ZERO




ISO

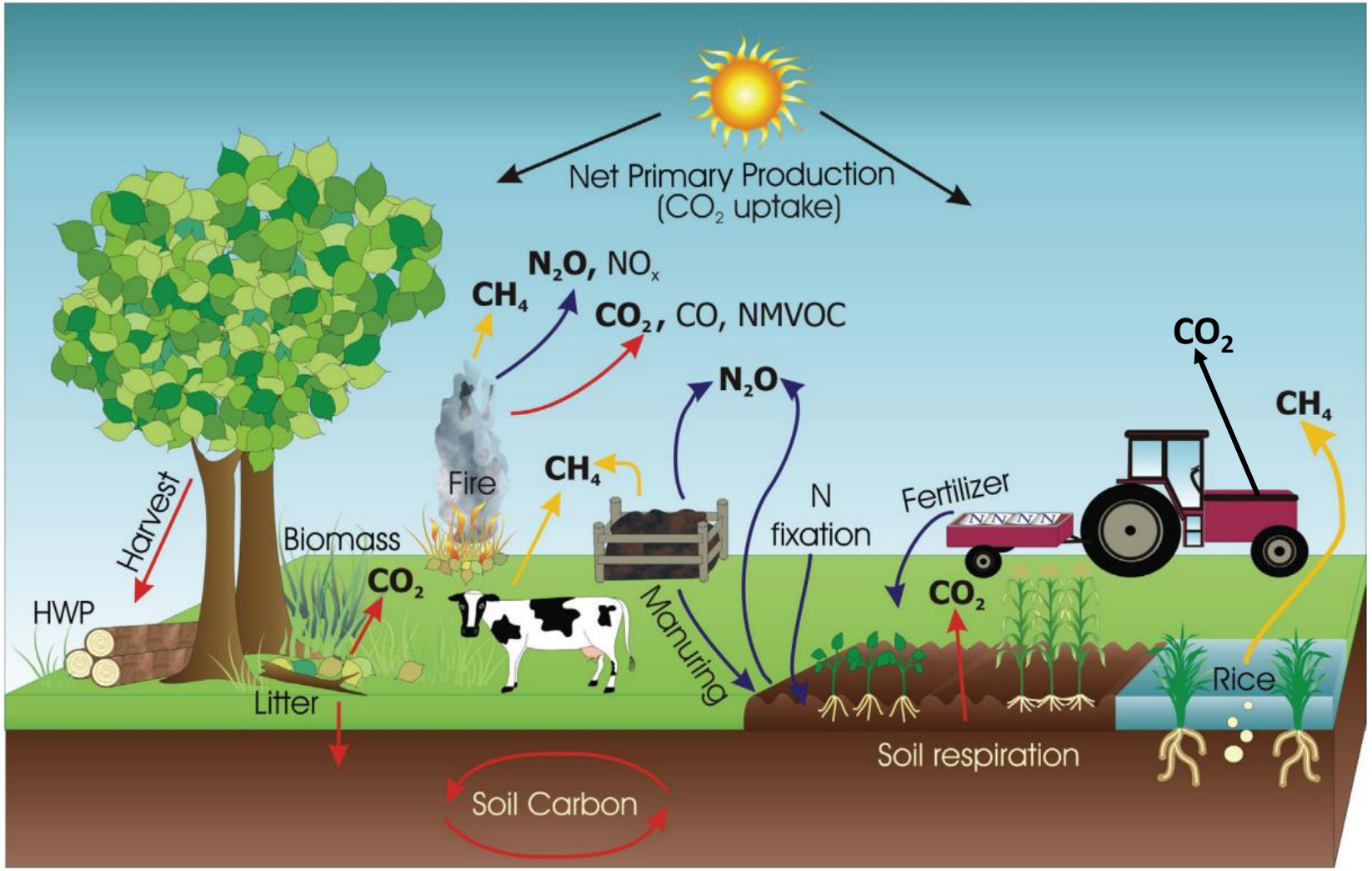

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

NET ZERO INITIATIVE

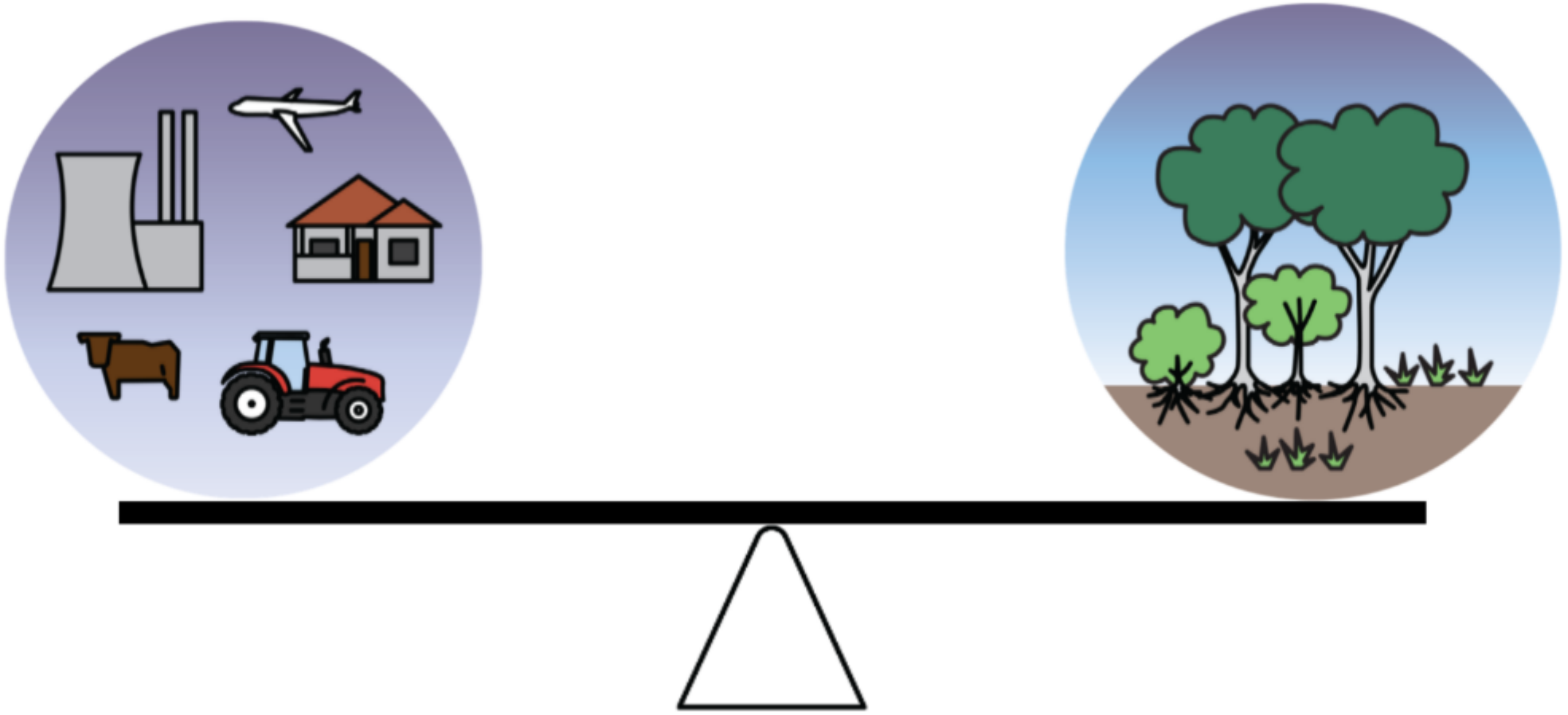
# Key terms

- Emission, removal
- Source, sink, reservoir
- Carbon dioxide removal



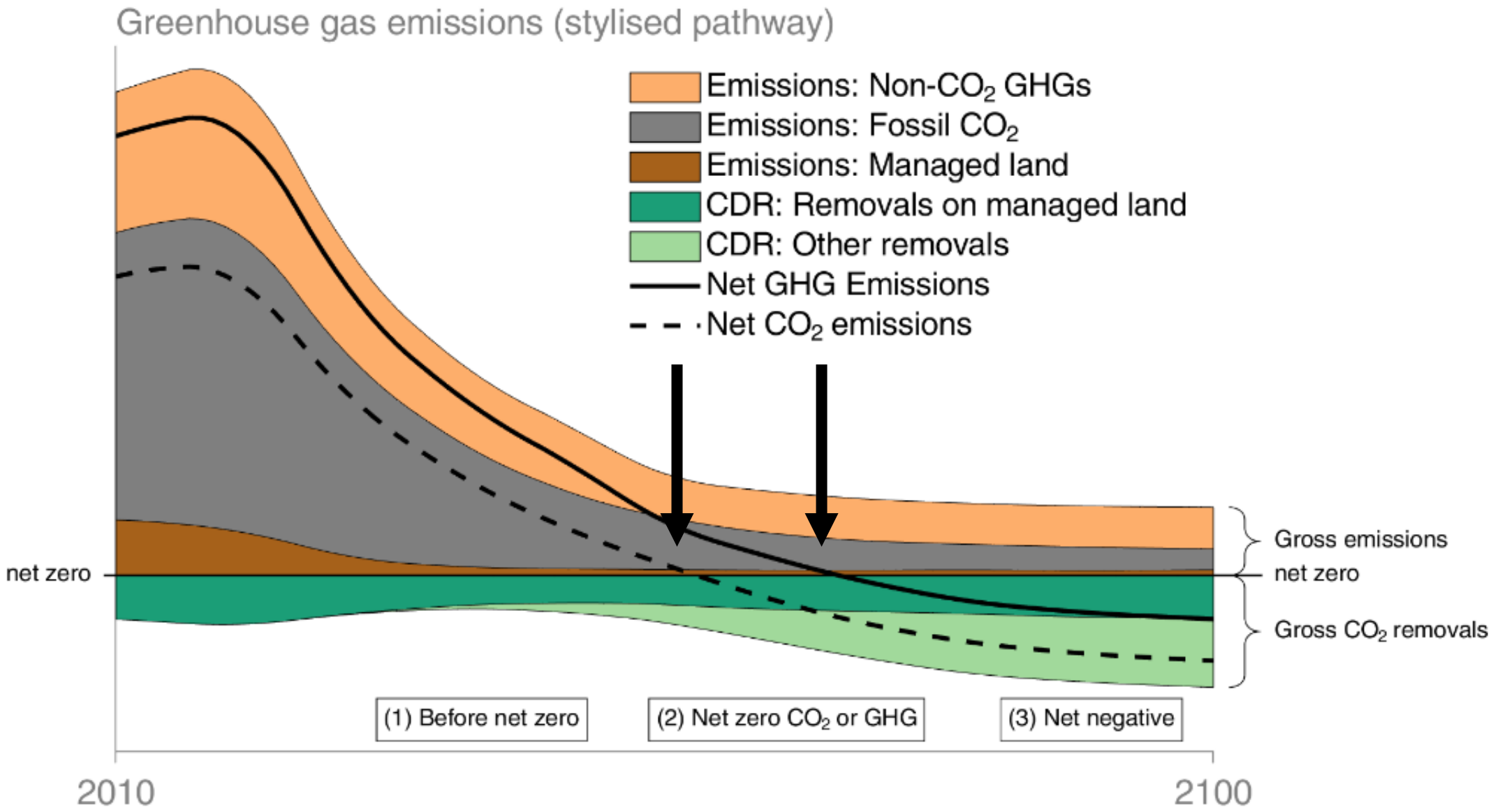
# Paris Agreement goal

# **Net Zero GHG**

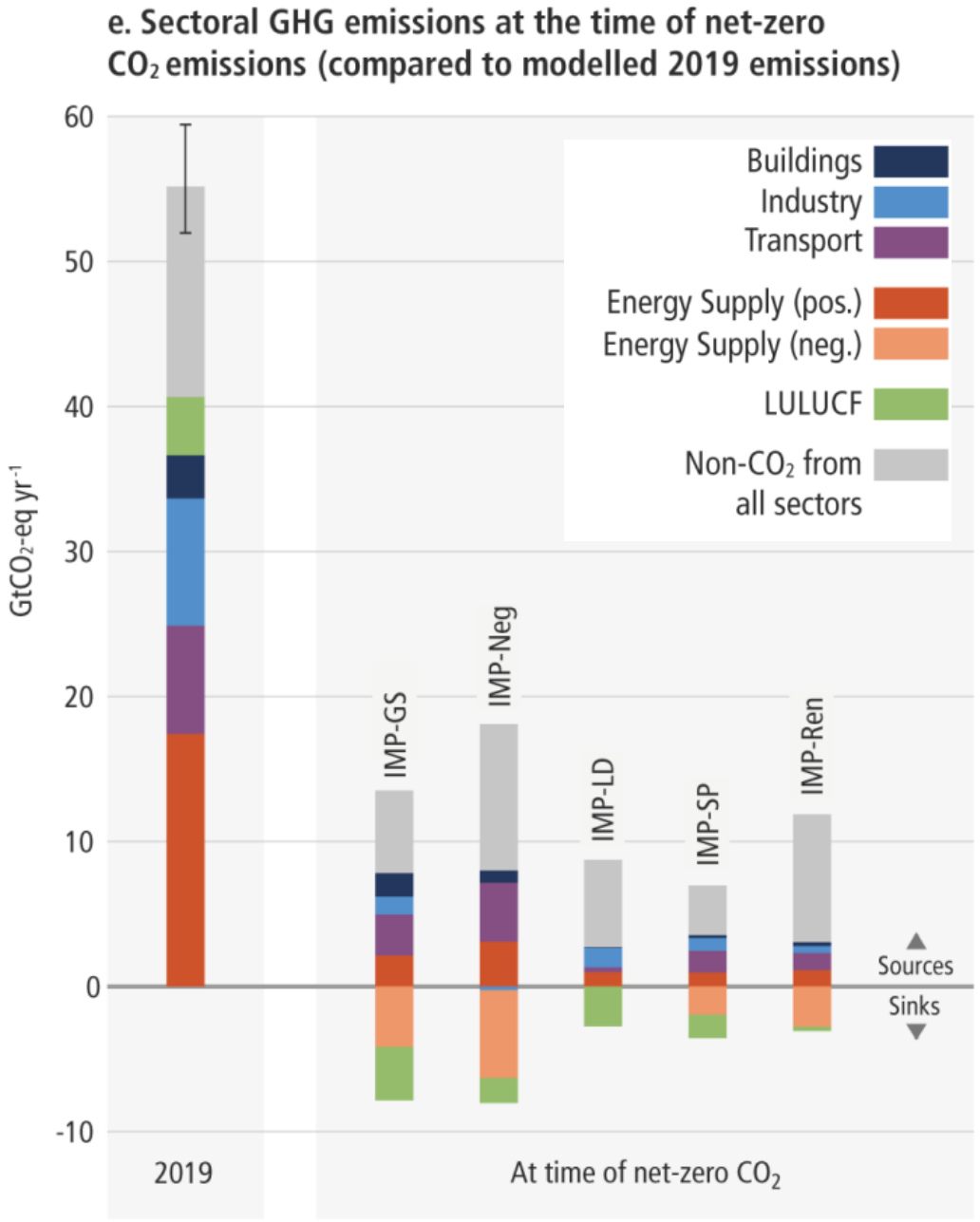


*Waters et al., NSW DPI*

# Trajectory to net zero




*AR6 WGIII Cross Chapter Box 8*

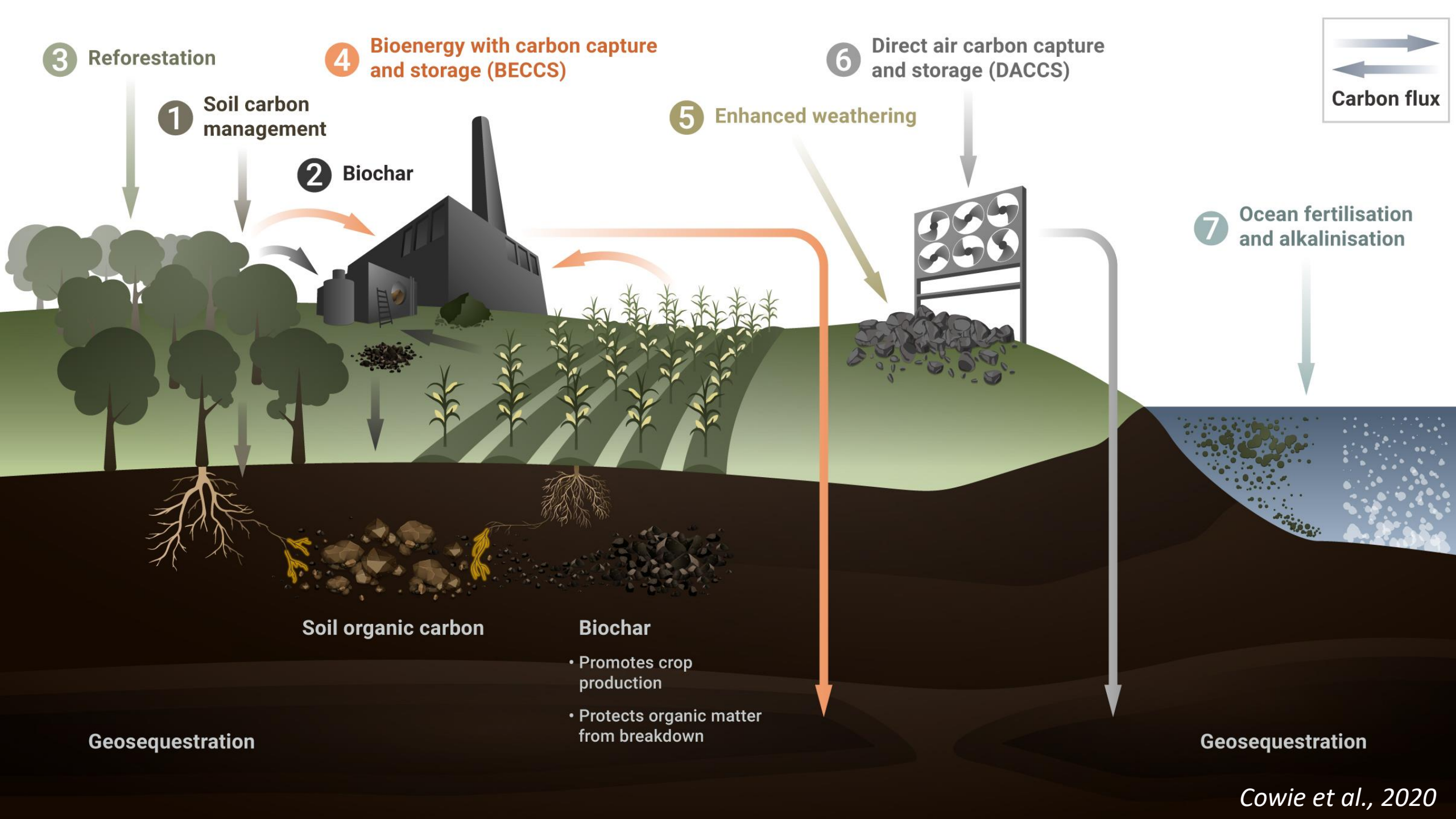



# Net-zero GHG emissions to limit warming can be achieved in different ways

- All net zero pathways involve CDR (that's what *net* in "net zero" implies!)
- Common feature: almost all electricity in 2050 is from zero or low-carbon sources
- Different balance of supply/demand measures
- Different deployment of CCS, renewables
- Different amounts of non-$CO_2$ emissions
- Different balance of CDR vs gross reductions
- Different reliance on net negative $CO_2$ emissions to recover from temperature overshoot; only half of modelled 1.5°C pathways have net zero GHG

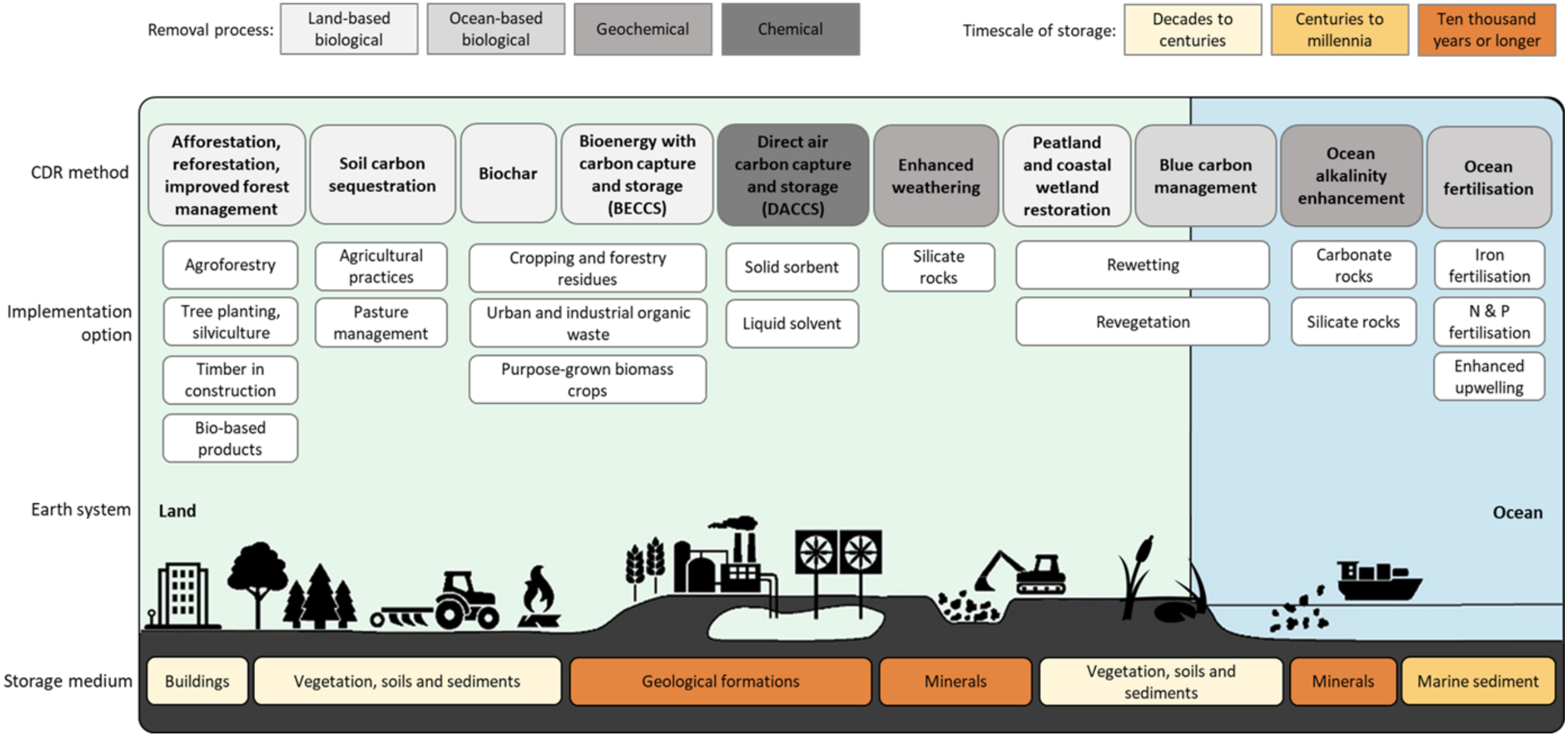
FIGURE SPM.5B

*A. Reisinger, 2022*




*Cowie et al., 2020*

# Taxonomy of CDR methods based on *removal process* & *timescale of storage*




*IPCC AR6 WGIII Chapter 12, Cross-Chapter Box 8, Figure 1*


Climate Active Carbon Neutral

TOLL


Barangaroo

Australia Post

AUSTRAL FISHERIES
SUSTAINABLE SEAFOOD

THE AgBioEn KOOYONG CLASSIC

ZERO 30

une University of New England

ARMIDALE Regional Council

Product

Service

Organisation

Event

Building

Precinct

# Net Zero = Carbon Neutral?

# Defining net zero (IPCC AR6)

Condition in which metric-weighted anthropogenic **GHG emissions are balanced by** metric-weighted anthropogenic **GHG removals** over a specified period.

The quantification of net zero GHG emissions depends on the GHG emission metric chosen to compare emissions and removals of different gases, as well as the time horizon chosen for that metric.

Note 1: GHG neutrality and net zero GHG emissions are overlapping concepts.

**At global scale, GHG neutrality and net zero GHG emissions are equivalent.**

At sub-global scales, net zero GHG emissions is generally applied to emissions and removals under direct control or territorial responsibility of the reporting entity, while GHG neutrality generally includes anthropogenic emissions and anthropogenic removals within and beyond the direct control or territorial responsibility of the reporting entity.

**Net zero GHG: GHG emissions balanced by $CO_2$ removals**

Key:

- $CO_2$ emissions
- $CO_2$ removals
- Non-$CO_2$ emissions (methane, nitrous oxide)
- Offsets (emissions reduction, removals)

# Net Zero:

Emissions = Removals

Usually calculated on *territorial* basis, using annual inventory

Sometimes includes offsets – restricted to removal credits

**GHG neutrality: GHG emissions balanced by $CO_2$ removals plus offsets**

Key:

- $CO_2$ emissions
- $CO_2$ removals
- Non-$CO_2$ emissions (methane, nitrous oxide)
- Offsets (emissions reduction, removals)

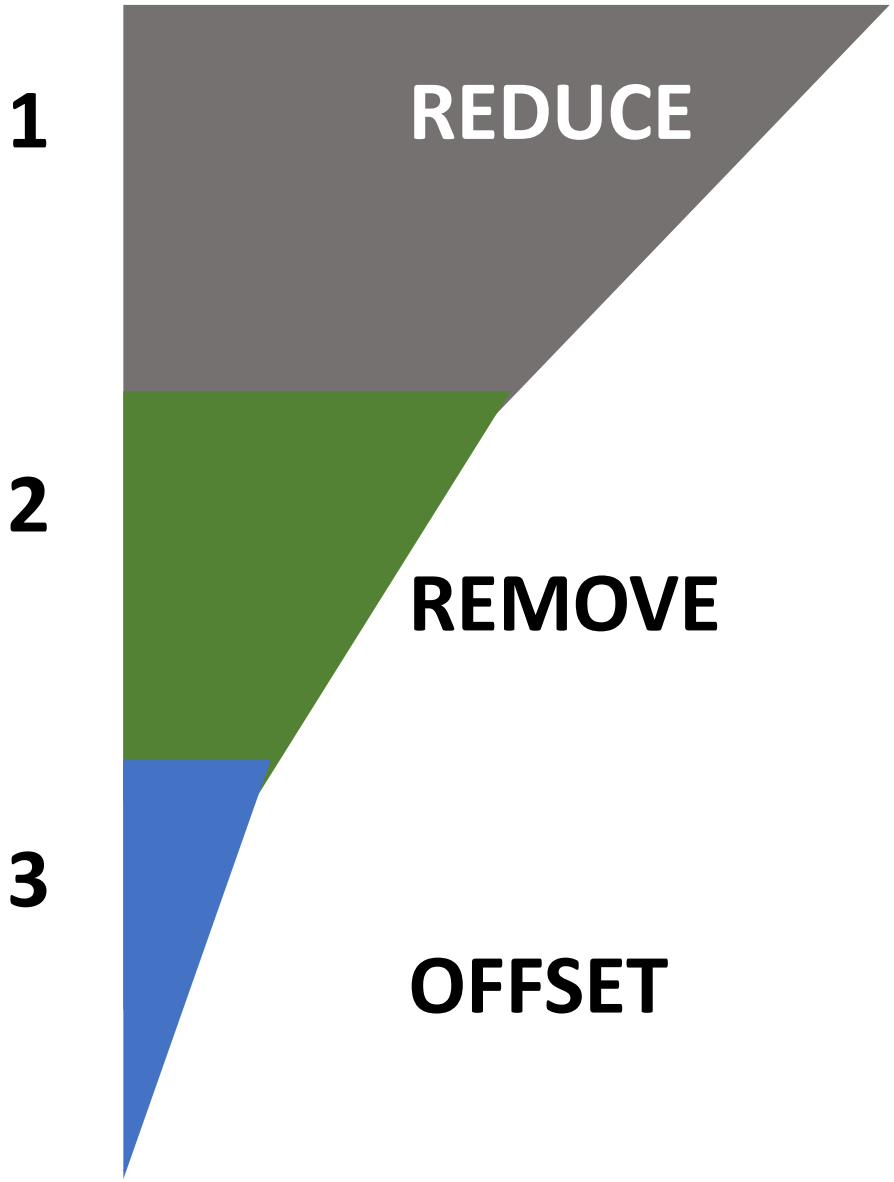
# Carbon (GHG) Neutral:

Emissions = Removals

Calculated on *life cycle* basis including direct and indirect emissions and removals
Often requires **offsets** to counterbalance the footprint

Emissions = Removals – Offsets

# Carbon neutrality hierarchy




Emissions reduction

Carbon dioxide removal (sequestration)

Offsets: Counterbalance residual footprint through emission reduction or sequestration

**ISO/FDIS 14068:2023(E)**

Date: 2023-07-06

ISO/TC 207/SC 7/WG 15

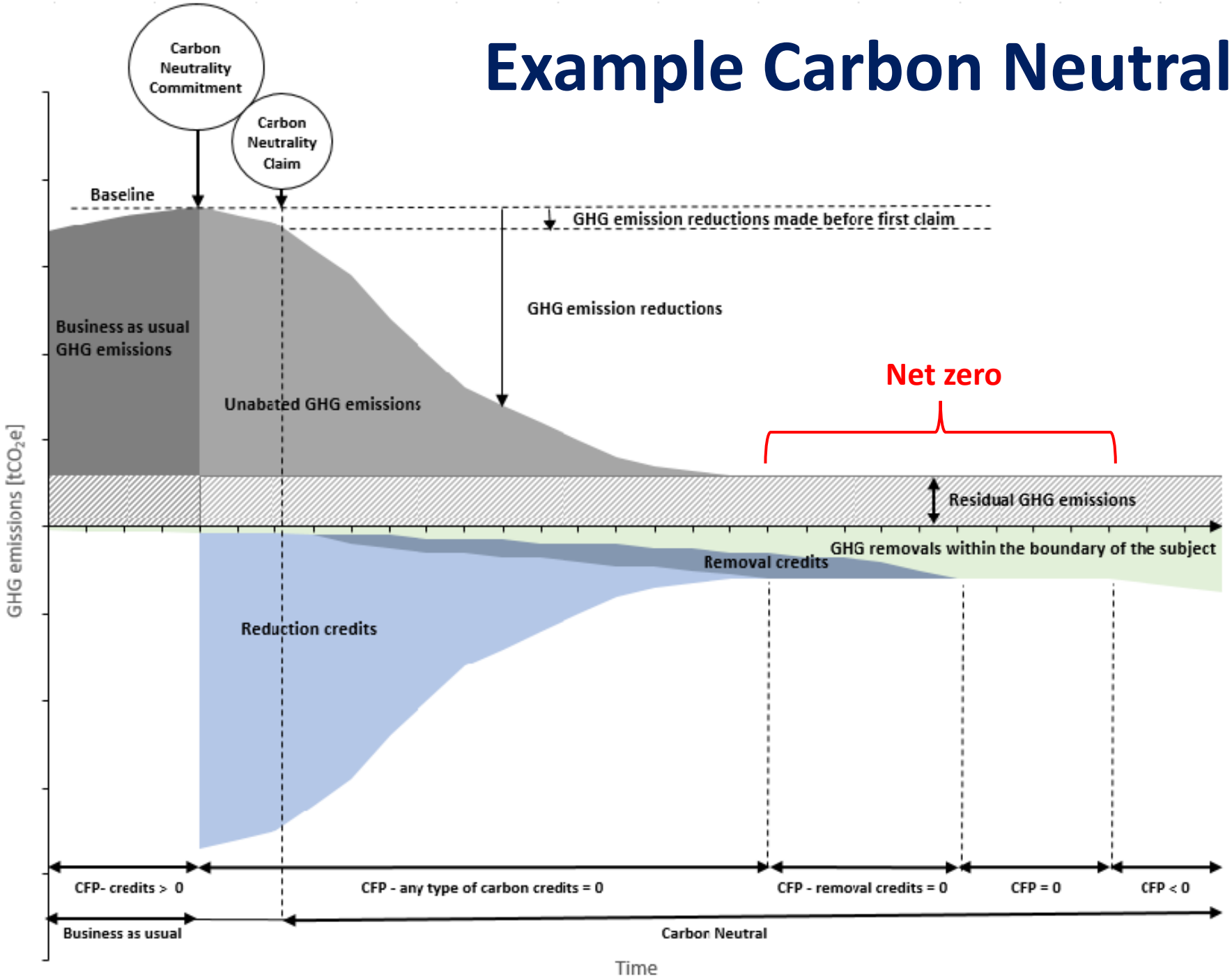
Secretariat: SCC

# Greenhouse gas and climate change management and related activities — Carbon neutrality



## Contents

# Example Carbon Neutrality Pathway




ISO FDIS 14068

# Greenhouse gas emission metric (IPCC AR6)

A simplified relationship used to quantify the effect of emitting a unit mass of a given greenhouse gas (GHG) on a specified key measure of climate change.

A relative GHG emission metric expresses the effect from one gas relative to the effect of emitting a unit mass of a reference GHG on the same measure of climate change.

There are multiple emission metrics, and **the most appropriate metric depends on the application**. GHG emission metrics may differ with respect to:

(i) the key measure of climate change they consider;

**(ii) whether they consider climate outcomes for a specified point in time or integrated over a specified time horizon**;

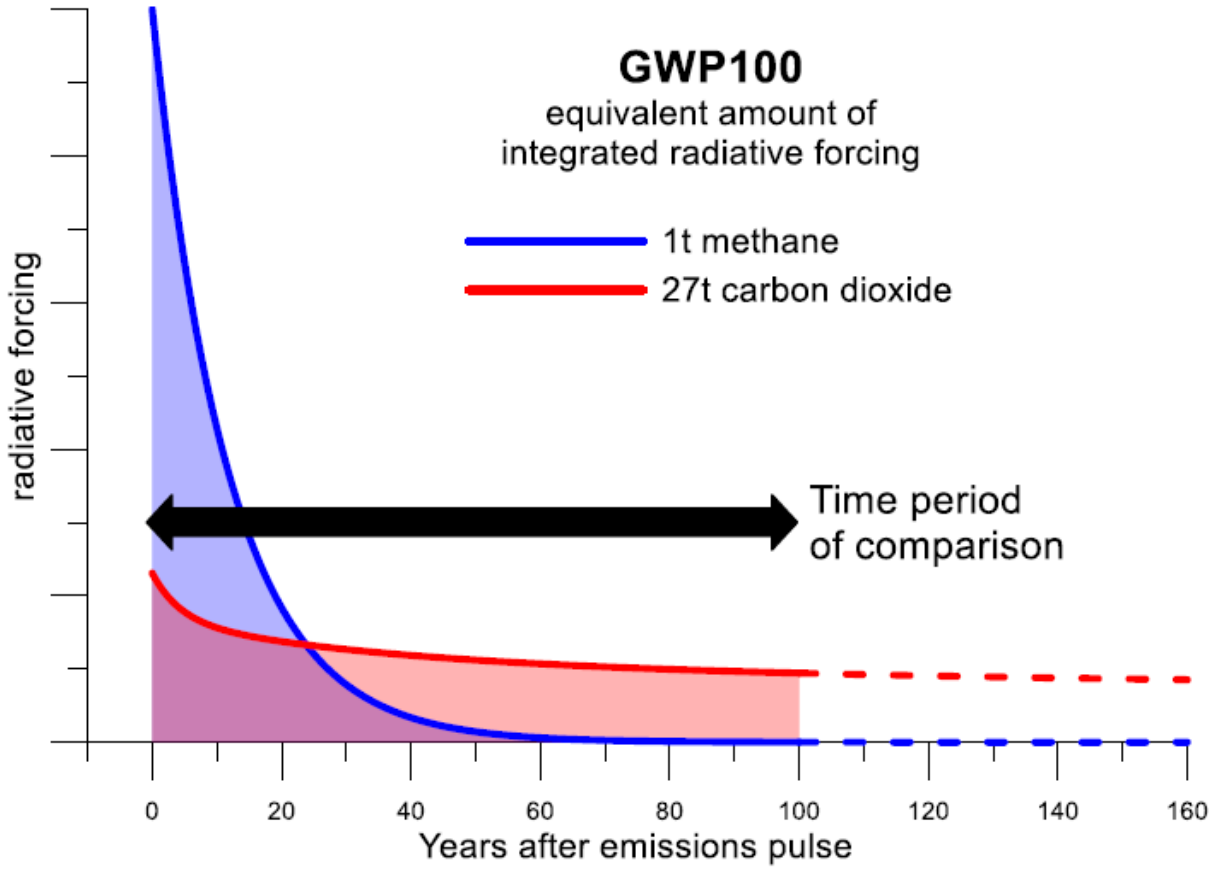
(iii) the time horizon over which the metric is applied;

**(iv) whether they apply to a single emission pulse, emissions sustained over a period of time**, or a combination of both; and

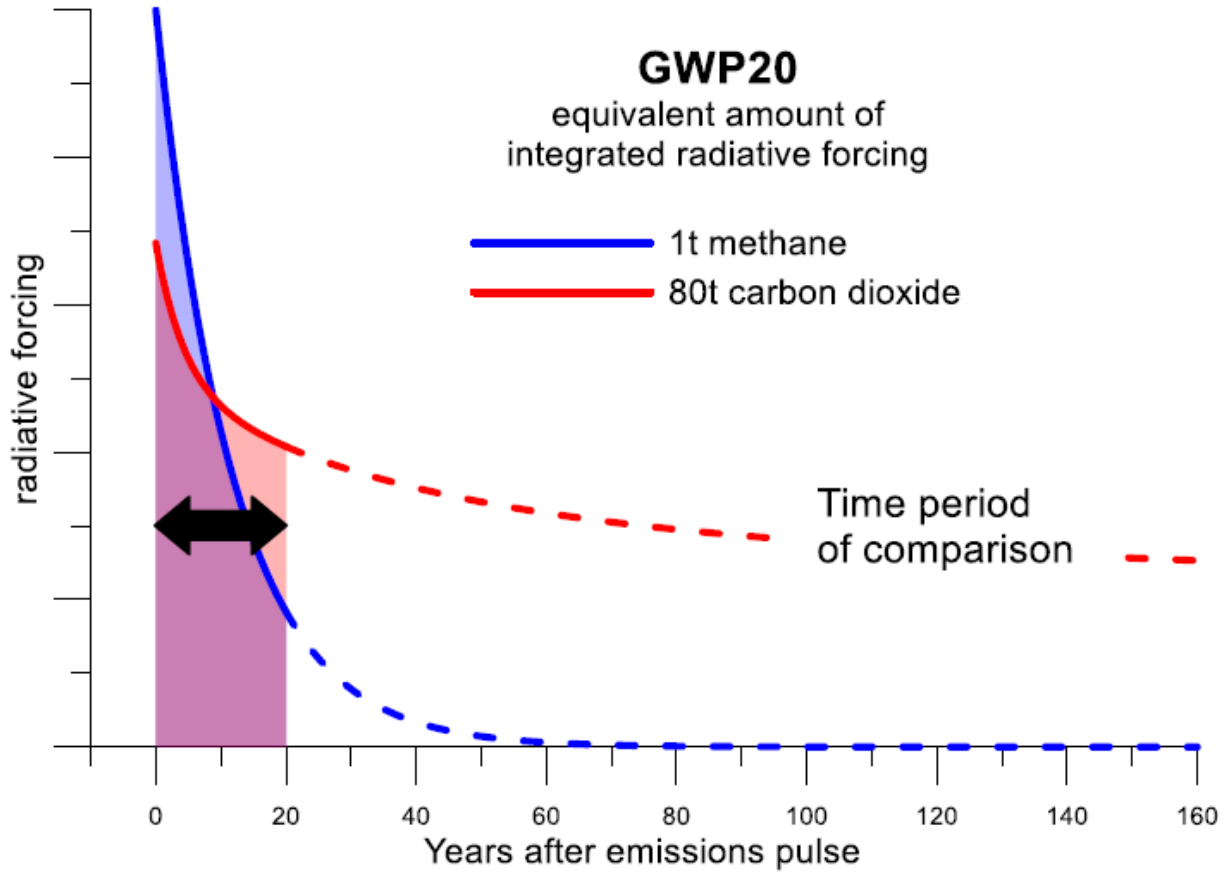
**(v) whether they consider the climate effect from an emission compared to the absence of that emission or compared to a reference emissions level or climate state**.

Note: …

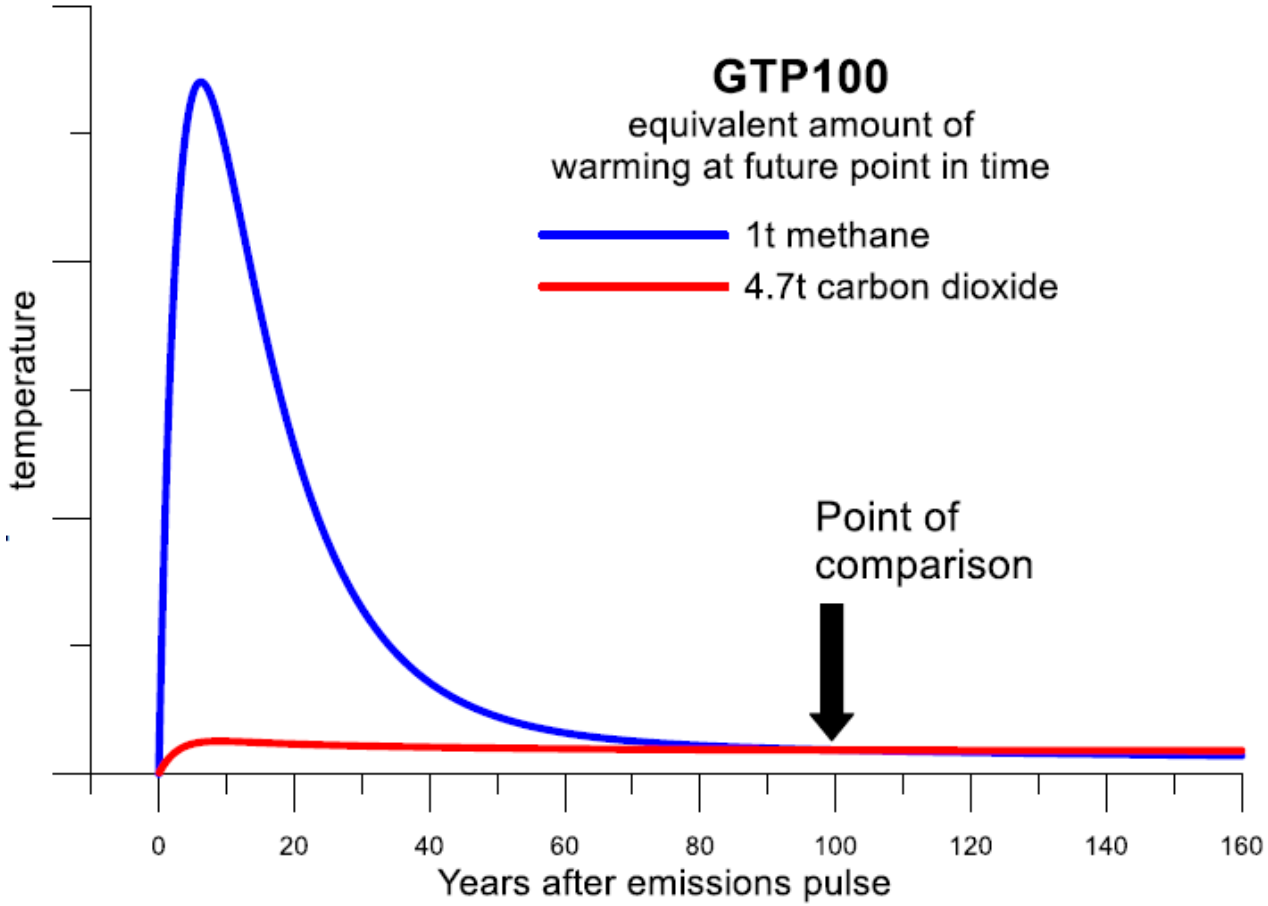
A metric that establishes equivalence regarding one key measure of the climate system response to emissions does not imply equivalence regarding other key measures. The choice of a metric, including its time horizon, should reflect the policy objectives for which the metric is applied.

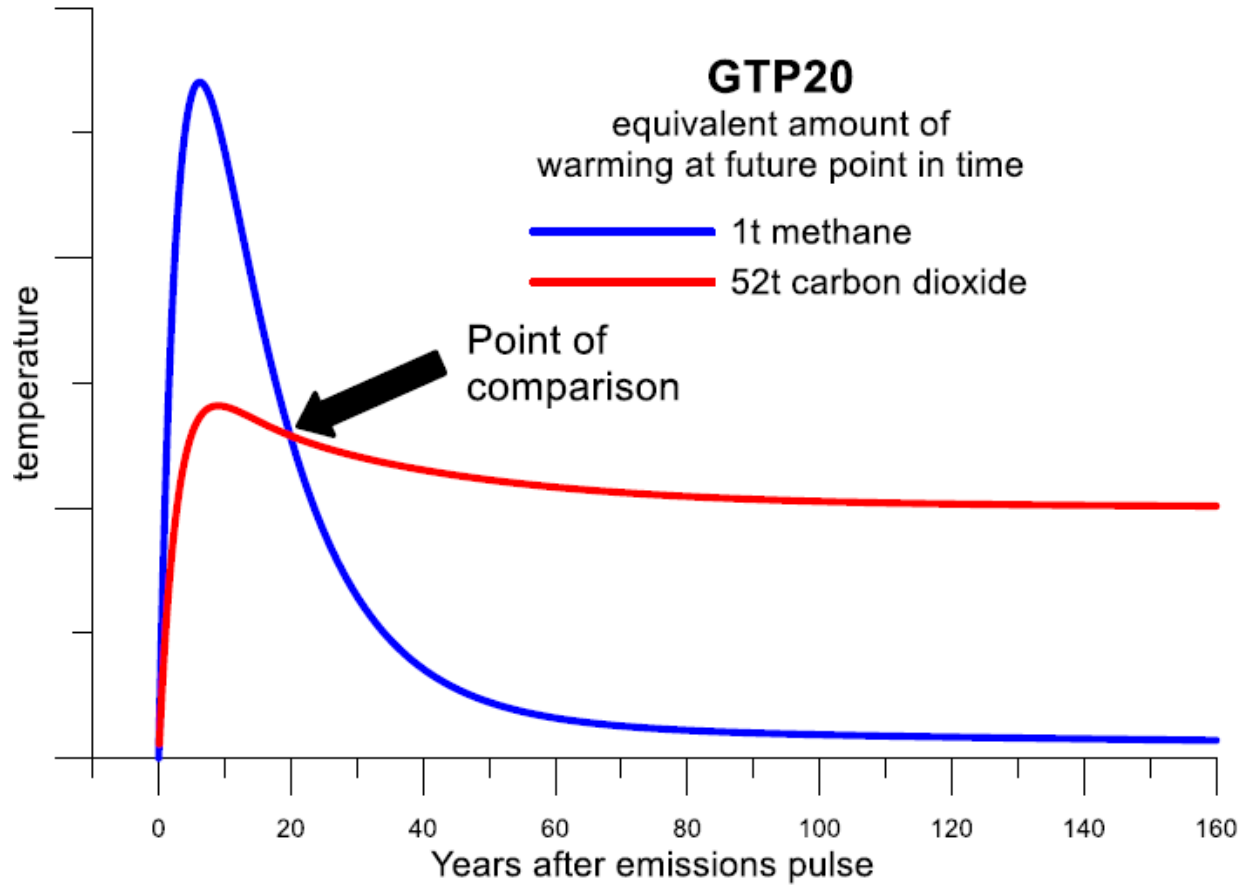



Based on AR6 WGI Chapter 7 supplementary material




*A. Reisinger, 2023*




Based on Figure 2.SM.8 (extract), and AR6 WGI chapter 7 supplementary material

*A. Reisinger, 2023*

# GWP*
# - for short-lived climate pollutants

- relates warming impact of a short-term change in SLCP emissions to cumulative warming impact of $CO_2$ - the $CO_2$-warming-equivalent ($CO_2$-we)
- sensitive to rate of change of SLCPs:
- small absolute increases in emissions lead to large warming impact relative to $CO_2$
- small decline in SLCP emissions leading to **negative $CO_2$-we emissions**

$$E^*(t) = 4.53 \times E_{100}(t) - 4.25 \times E_{100}(t-20)$$

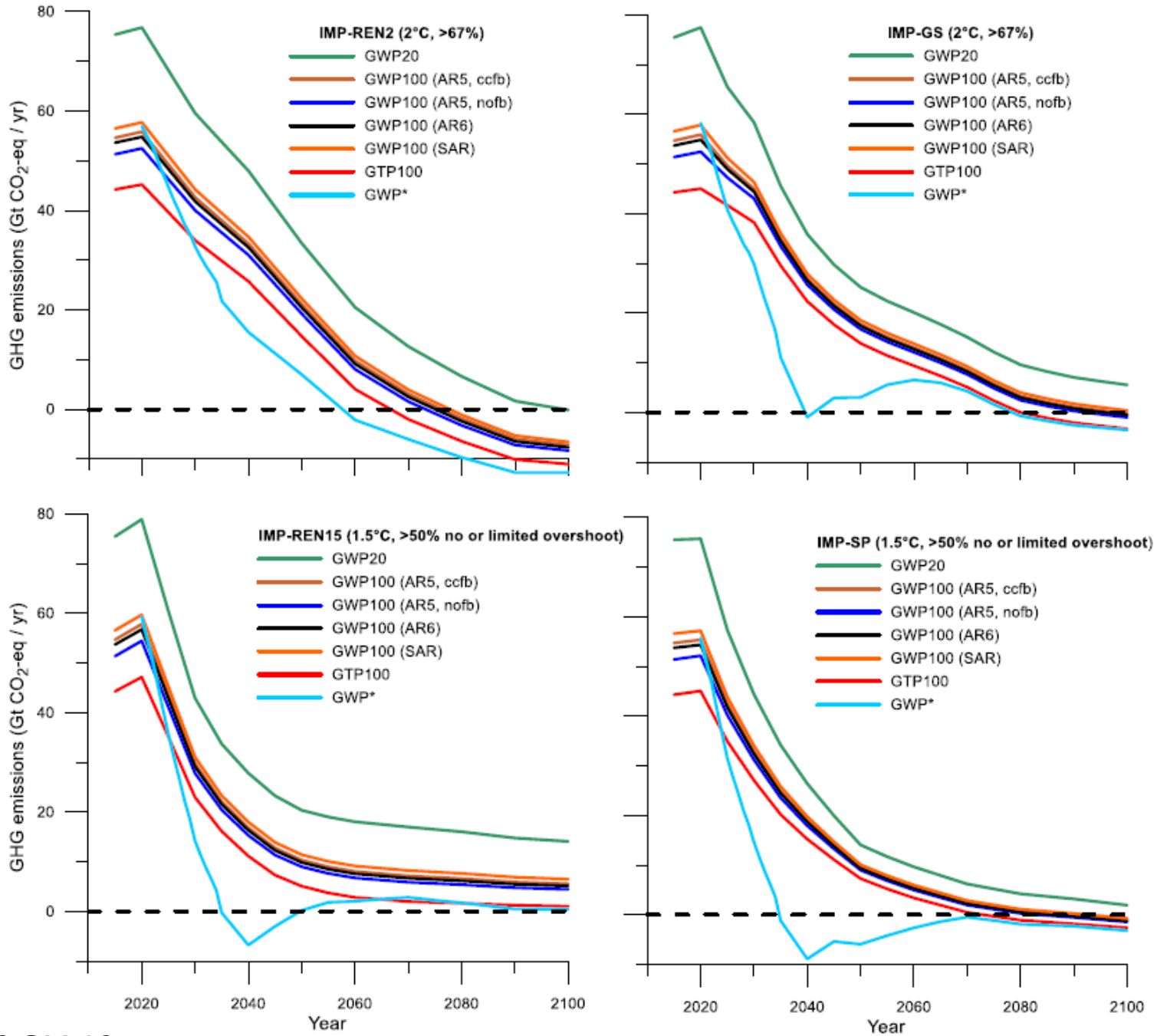
where $E^*$ (t) is the $CO_2$-we emissions at time *t*; $E_{100}$ (t) is the SLCP emission rate at *t*, calculated as $CO_2$e using $GWP_{100}$; and $E_{100}$ (t-20) is the rate of SLCP emissions 20 years before t, calculated as $CO_2$e using $GWP_{100}$

Sixth Assessment Report
WORKING GROUP III — MITIGATION OF CLIMATE CHANGE

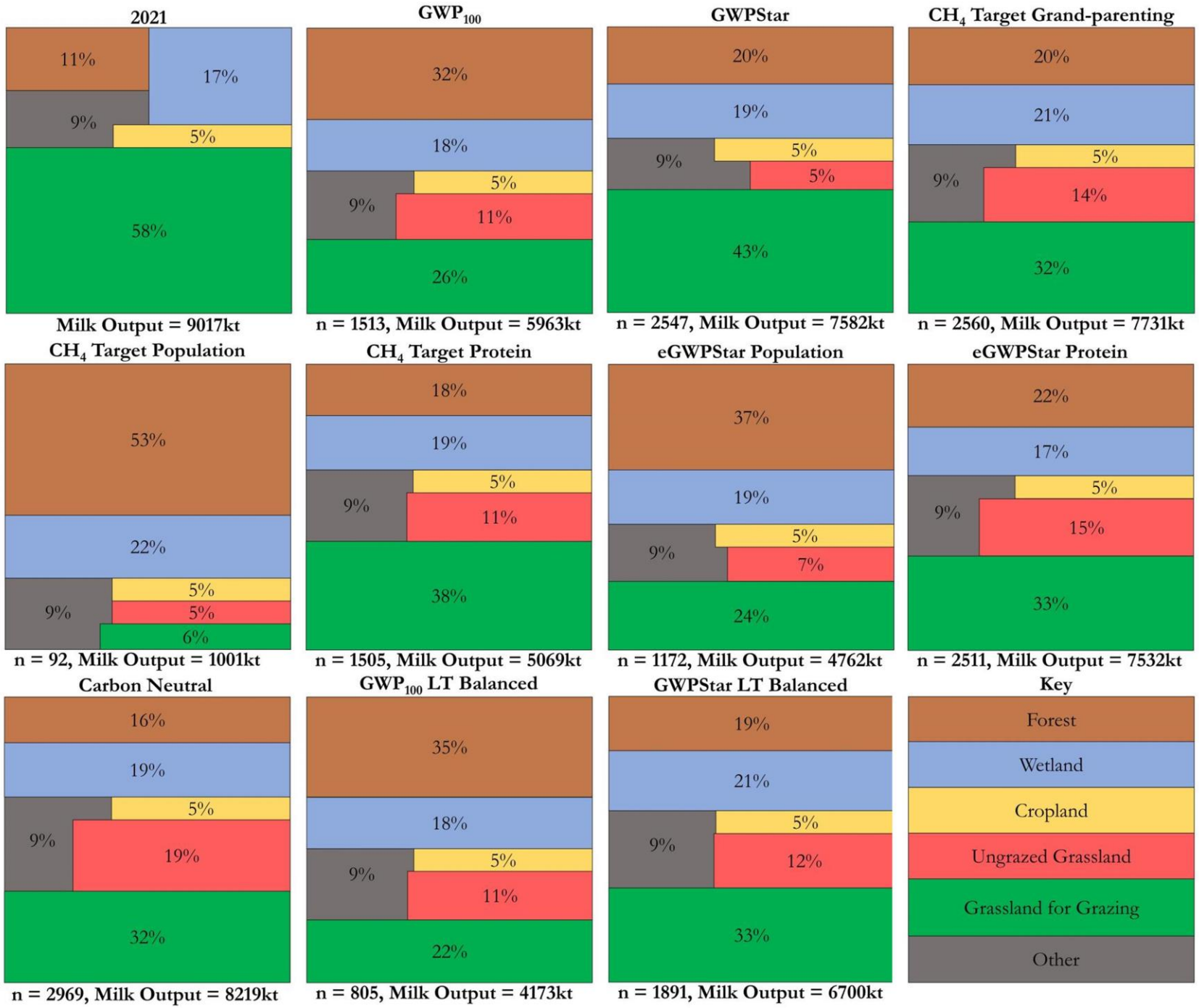
# Timing of net zero GHG

"For a given GHG emissions pathway, the pathways of individual GHGs determine the resulting climate response, whereas the choice of emissions metric used to calculate aggregated emissions and removals of different GHGs affects what point in time the aggregated GHGs are calculated to be net zero." WGI SPM D.1.8

→ **net GHG emissions for four illustrative mitigation pathways**




*A. Reisinger, 2023 Based on Figure 2.SM.10*




# **Achieving net zero:** Impact of metric on land use and agricultural production in Ireland **milk yield reduced by 16-89%**

*Bishop et al., in review*

# Messages on GHG emission metrics (AR6 WGIII)

- GWP100 is consistent with global least cost mitigation
- Best metric depends on the context, objective and intended application
- Preferable to report GHGs separately

Re Metrics for LCA:

- Use of different metrics and time horizons can lead to divergent conclusions in LCAs
- Sensitivity tests to identify impact of metric choice (GWP100, GTP100, GWP20)
- Costs/benefits and preferences for metrics depend on position of actor in value chain
- Step-change metrics not well-suited for product/event LCA, but relevant for long-term effects such as dietary shift

Info on GHG metrics:

- WGIII Chapter 2 and Supplementary Information
- WGI Chapter 7 and Supplementary Information – values for metrics

# Metrics for net zero - key questions

- Which GHGs?
- Which emissions metric(s)?
- Boundary of assessment – spatial and temporal
- Net zero by when?
- What then?
- Allow offsets? If so, which type?
- Trajectory – interim milestones?
- Fairness and equity
- Global net zero is the ultimate goal

SUSTAINABLE DEVELOPMENT GOALS

Climate Active Carbon Neutral

SCIENCE BASED TARGETS