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Leading Partners in Science Limiting warming to 2 degrees: Opportunities and challenges for agriculture and New Zealand

Andy Reisinger

New Zealand Agricultural GHG Research Centre (NZAGRC)

Contributed paper prepared for presentation at the 59th AARES Annual Conference,
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Limiting warming to 2 degrees: Opportunities and challenges for agriculture and New Zealand

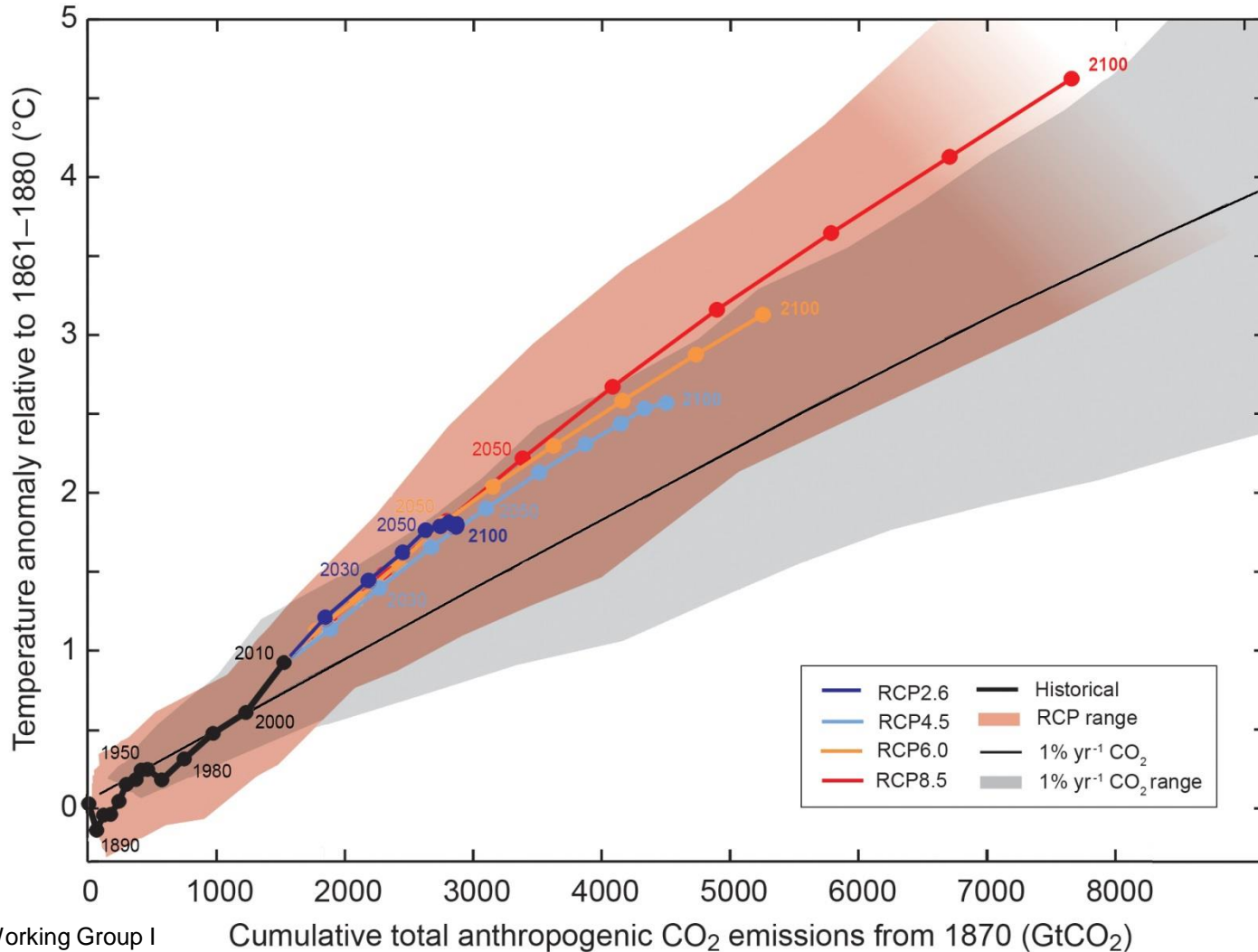
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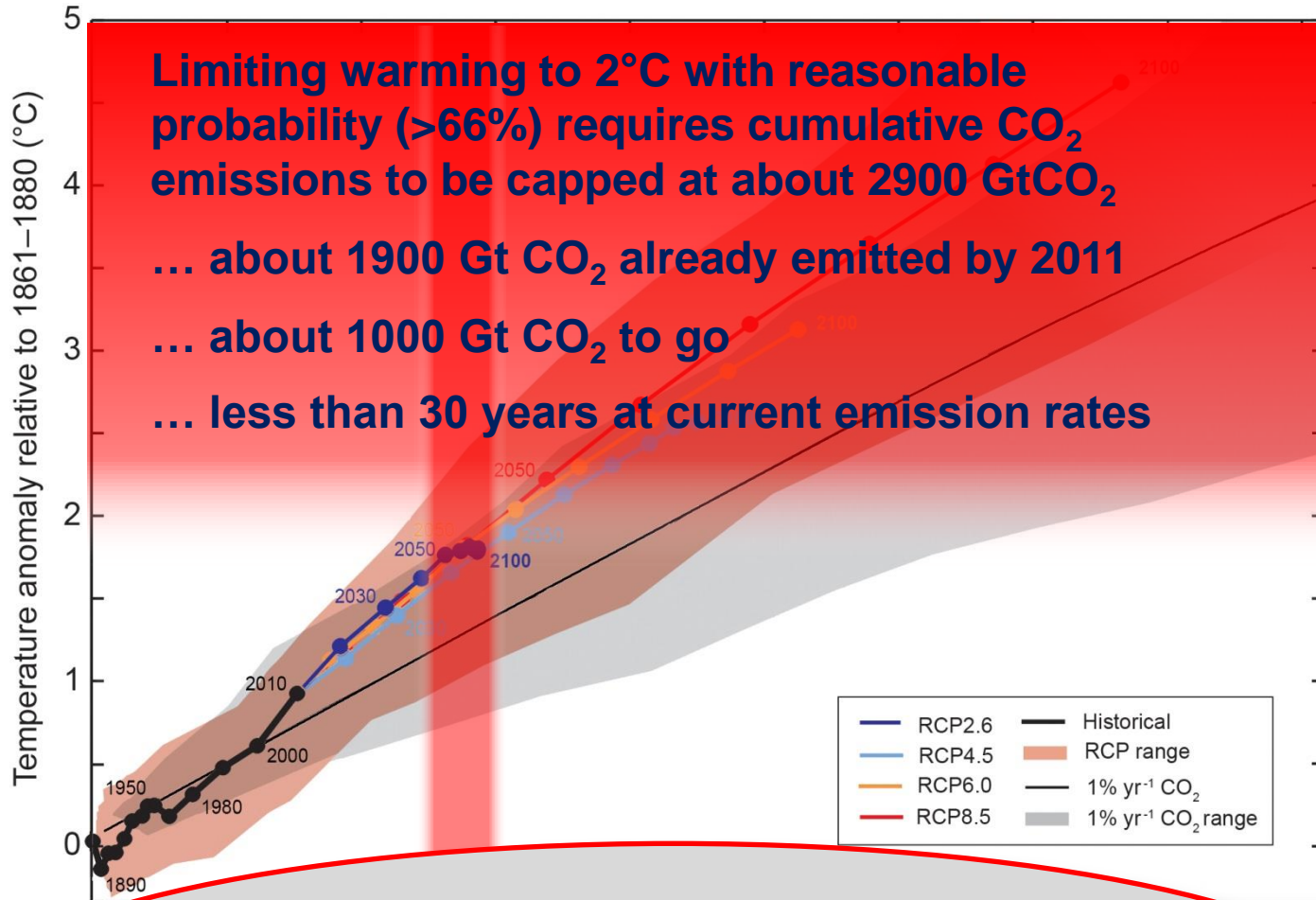
Overview

- Cumulative emissions and the 2°C limit
- Interaction of agriculture and CO₂ mitigation
- Expanding agriculture's mitigation potential
- Conclusions

Warming is proportional to cumulative CO₂ emissions



Warming is proportional to cumulative CO₂ emissions

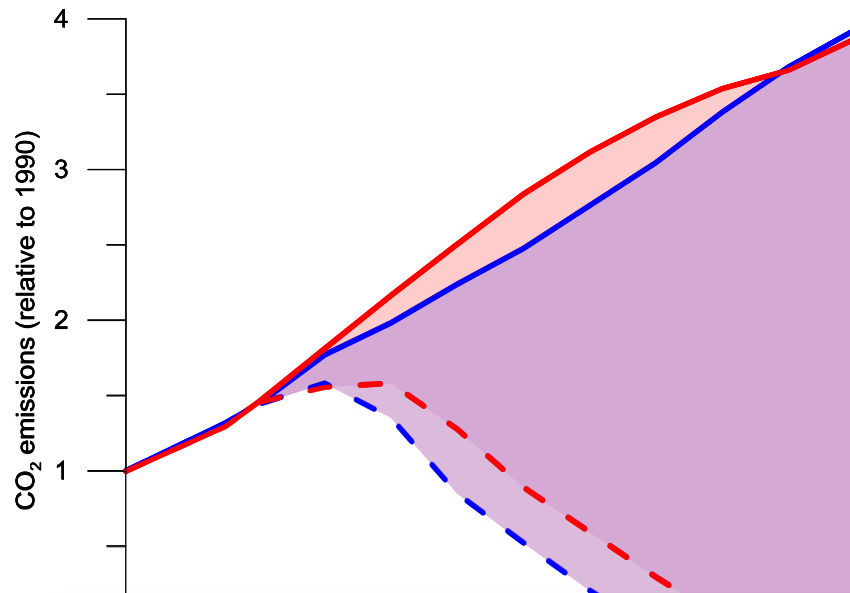


Source: IPCC

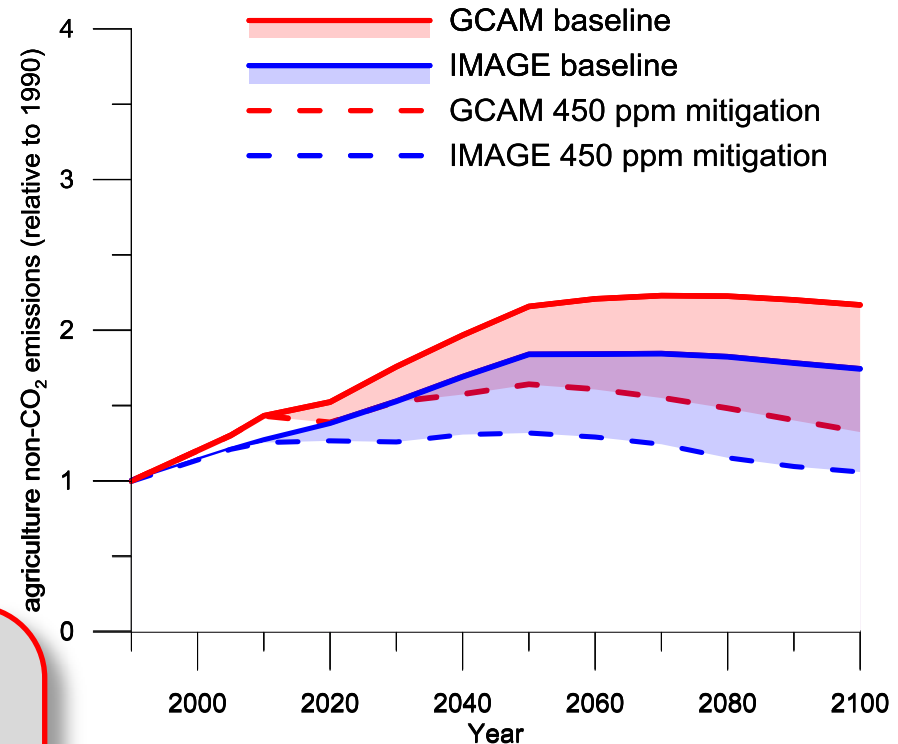
**what about non-CO₂ emissions,
particularly agriculture?**

Limiting warming to 2°C requires zero CO₂ by 2100 ... but a different level of ambition for agriculture?

CO₂ emissions



non-CO₂ from agriculture

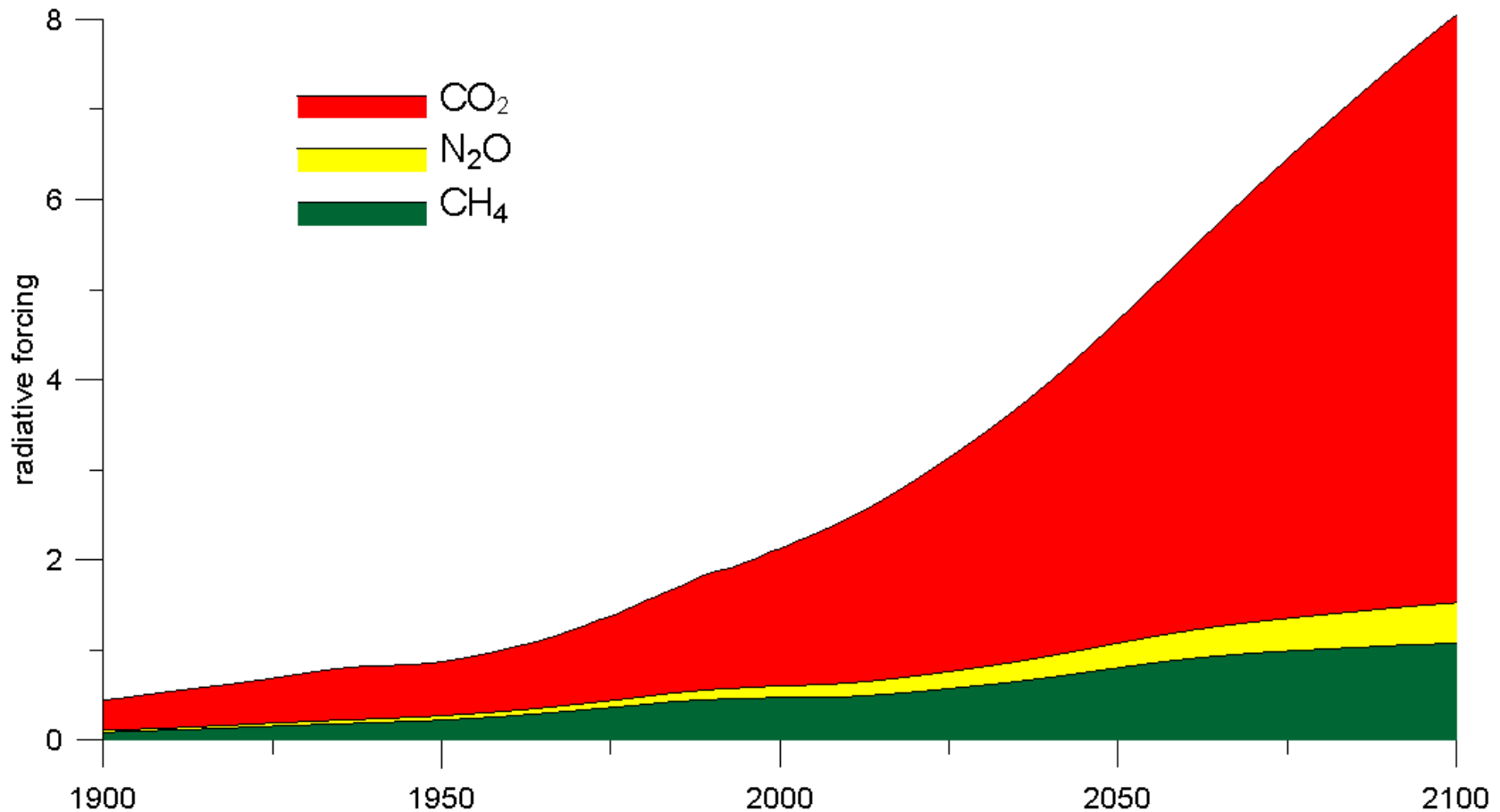


Agriculture mitigation: assumptions

- global mitigation at effective carbon price
- low elasticity of food demand
- no special considerations for food security
- steeply rising marginal abatement costs
- relatively short lifetime of CH₄

also Clarke et al. (2014) (IPCC WGIII)

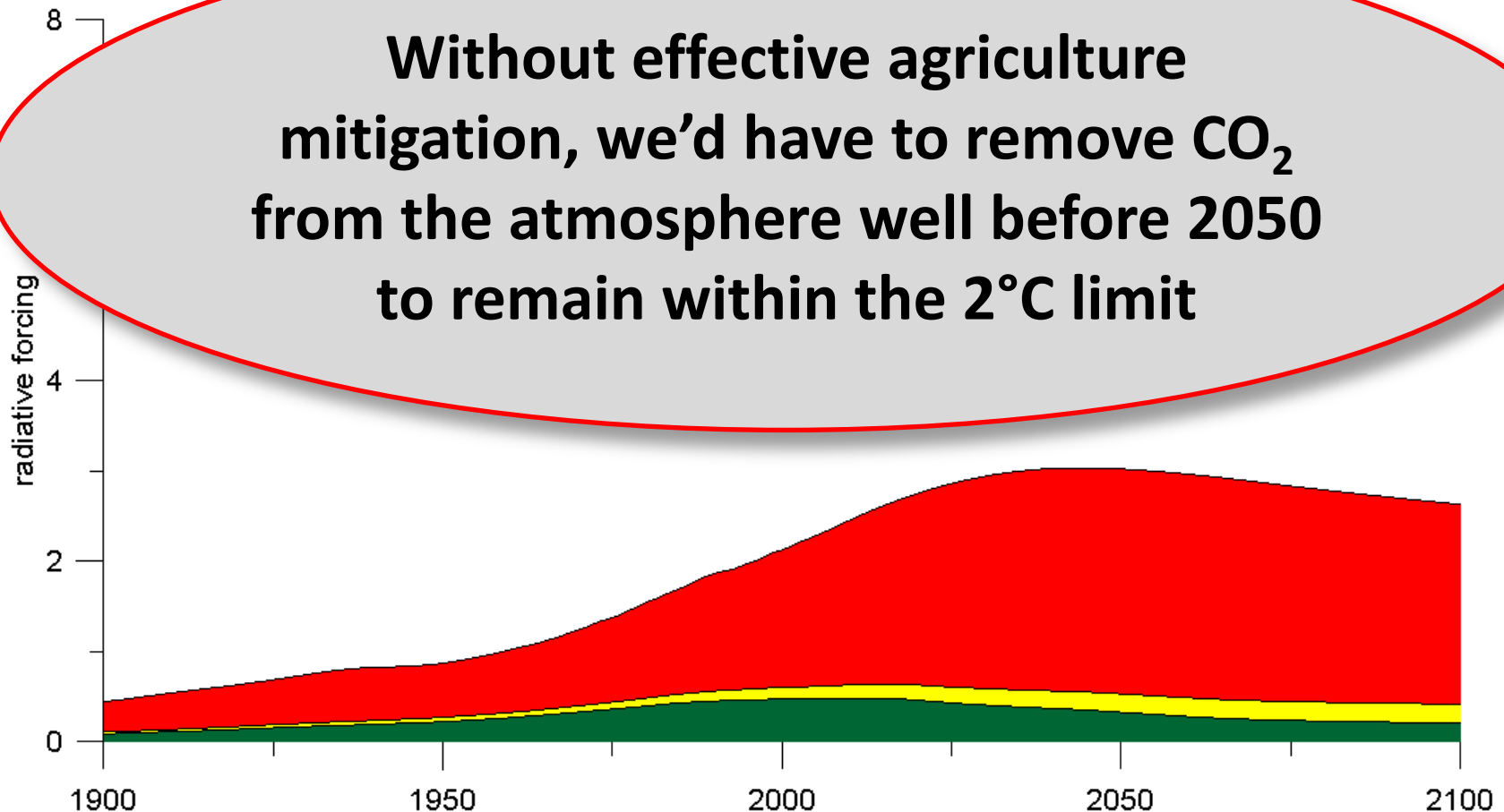
Abatement of non-CO₂ gases keeps the 2°C window feasible (even if only just)



Source: MAGICC simulations using RCP database at IIASA; van Vuuren et al, 2011

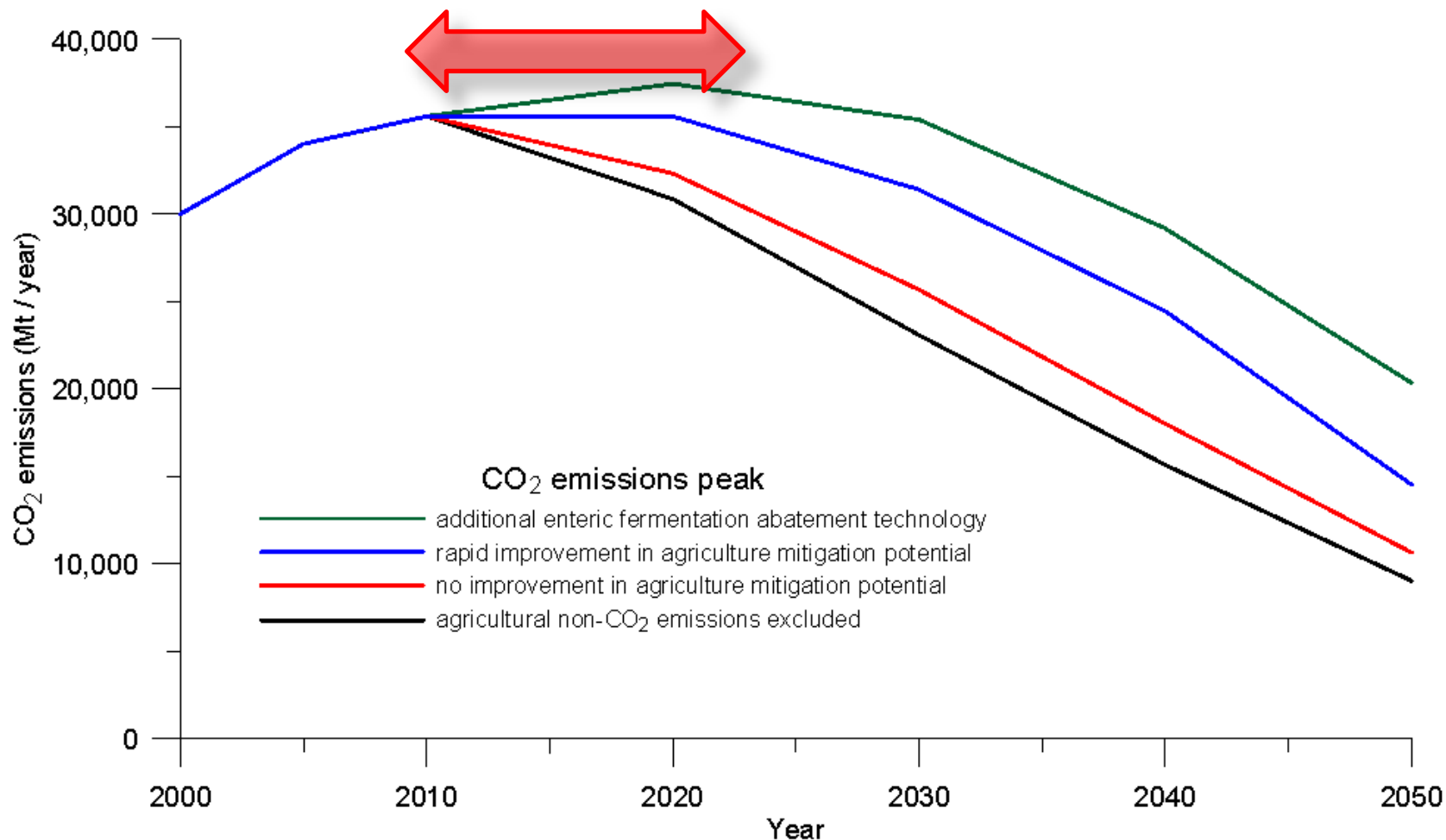
Abatement of non-CO₂ gases keeps the 2°C window for agriculture (if only just)

Without effective agriculture mitigation, we'd have to remove CO₂ from the atmosphere well before 2050 to remain within the 2°C limit



Source: MAGICC simulations using RCP database at IIASA; van Vuuren et al, 2011

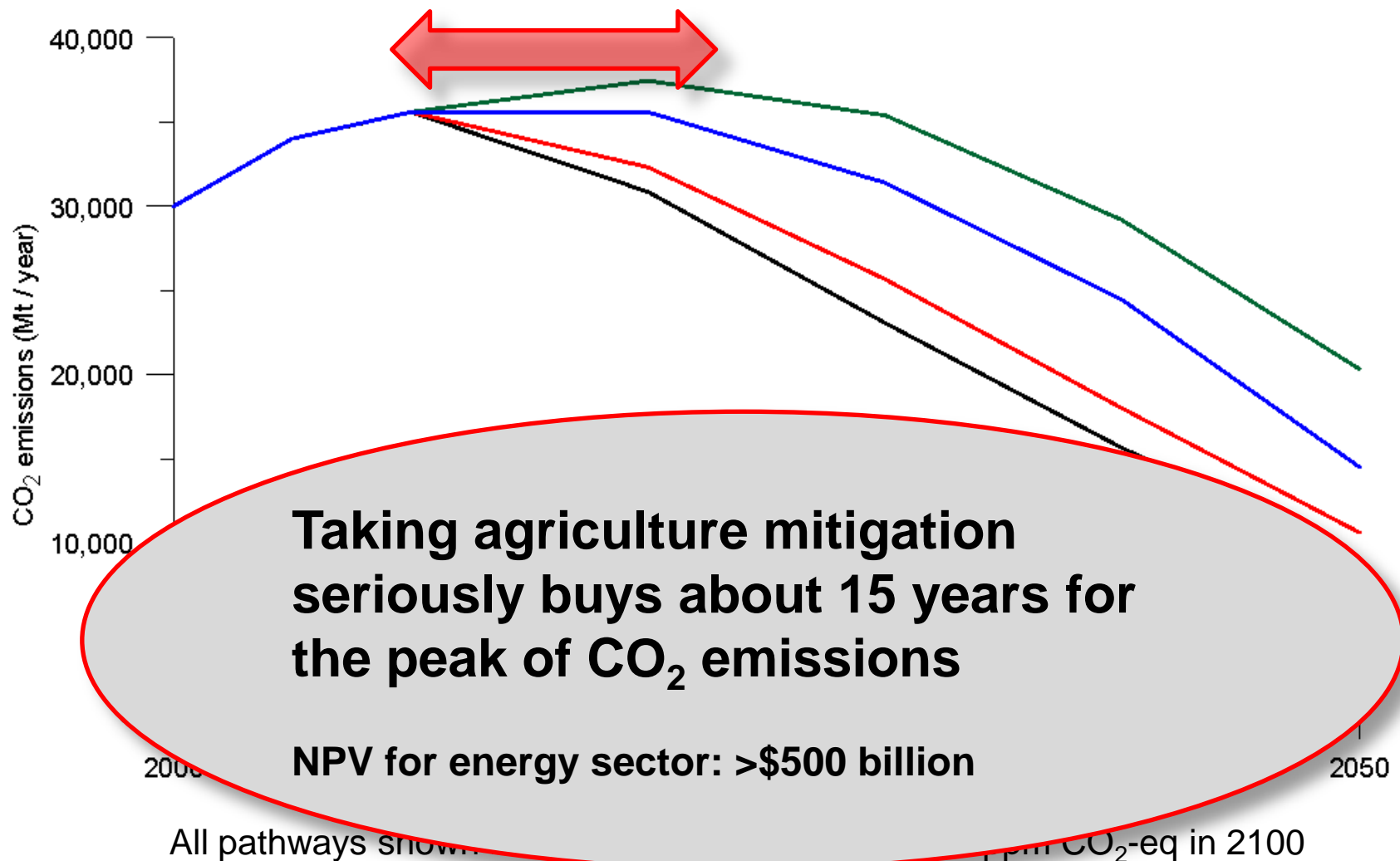
Interactions between agriculture and CO₂ mitigation



All pathways shown result in radiative forcing of 450ppm CO₂-eq in 2100

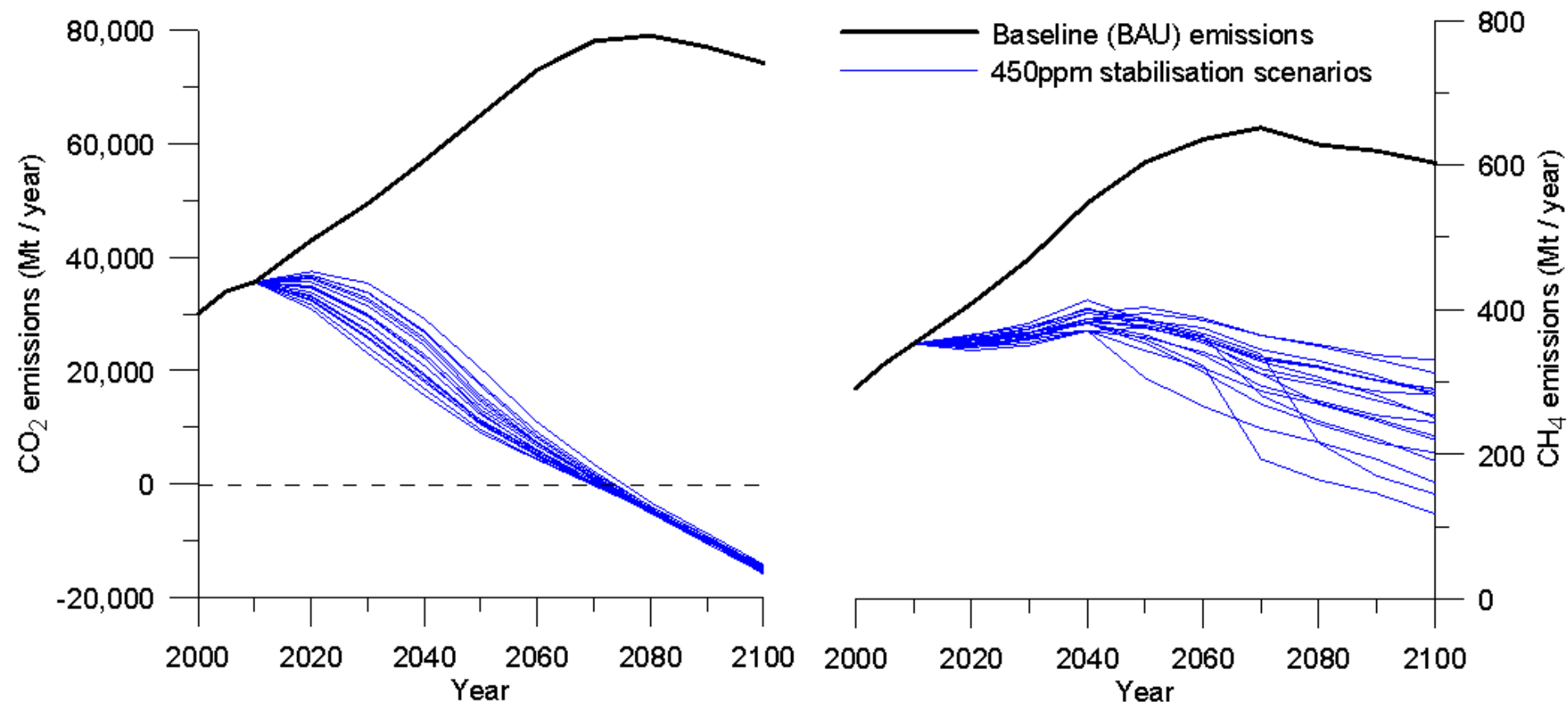
Global agricultural marginal abatement costs from Beach et al. (2008); model results from Reisinger et al, 2012

Interactions between agriculture and CO₂ mitigation



Global agricultural marginal abatement costs from Beach et al. (2008); model results from Reisinger et al, 2012

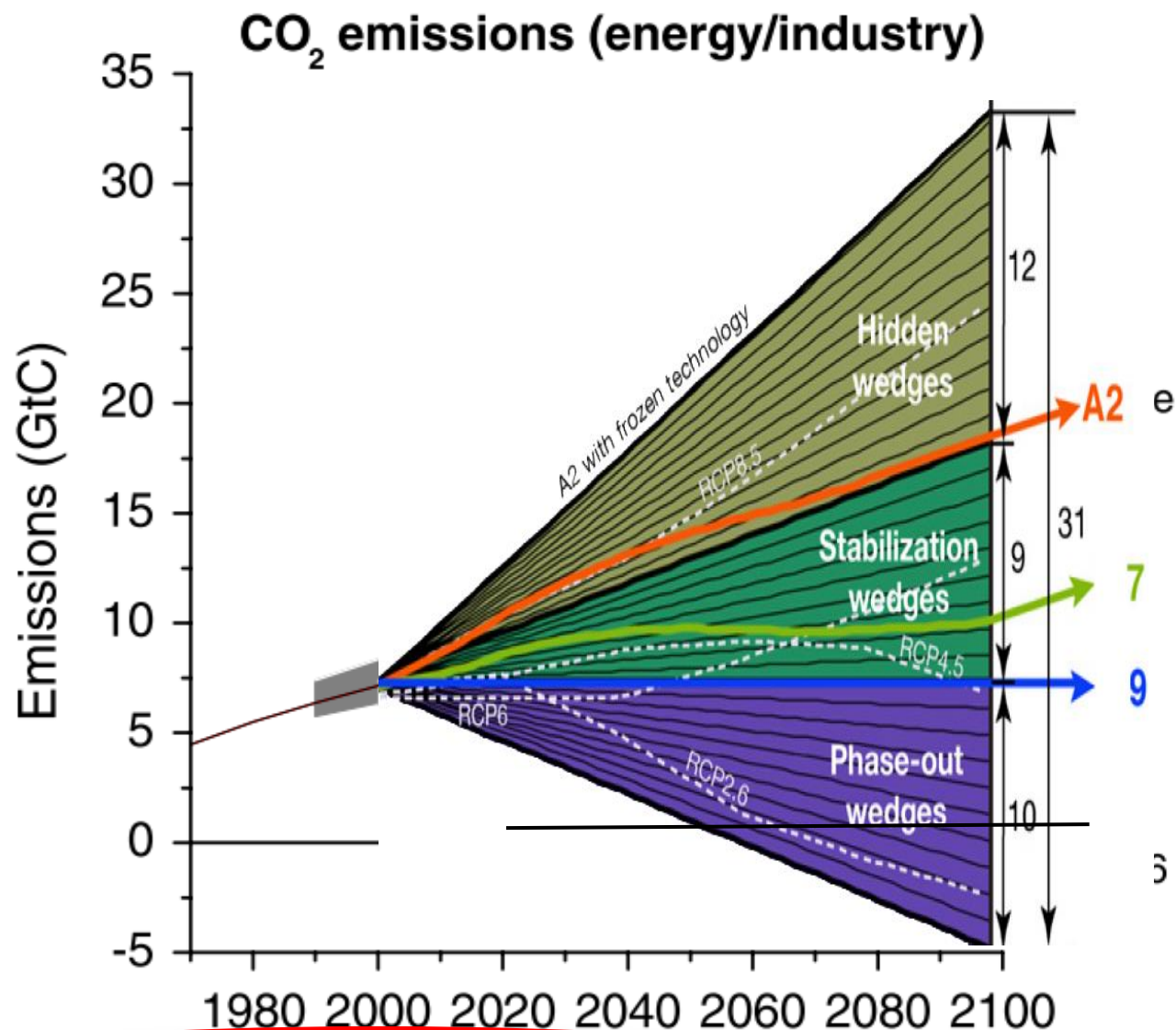
Interactions between agriculture and CO₂ mitigation



... but this doesn't change the long-term picture:

**CO₂ mitigation to zero by 2100
is non-negotiable**

How can we get there?



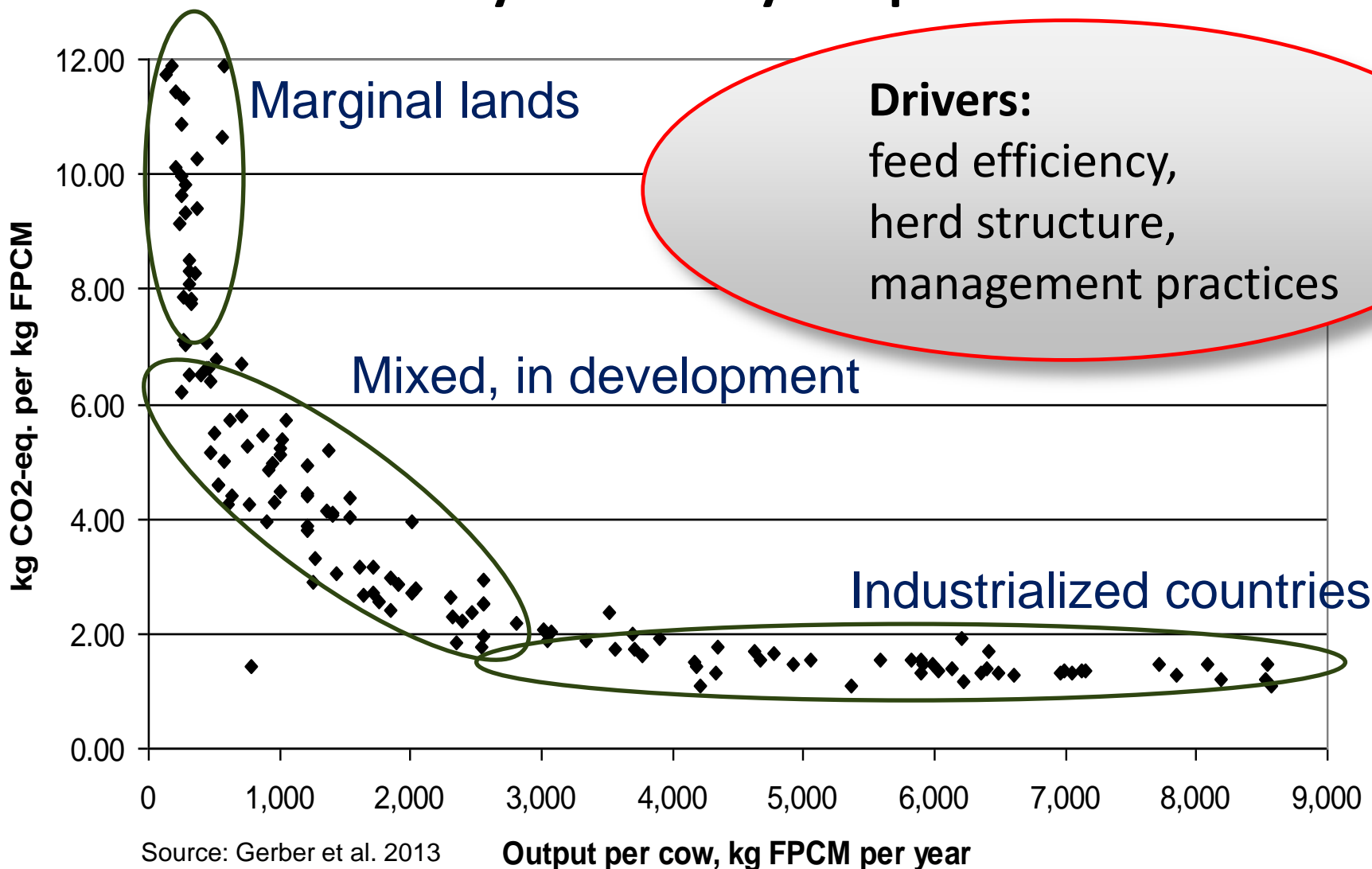
Sources: van Vuuren et al. 2011

What are agriculture's wedges, and can we make them bigger?

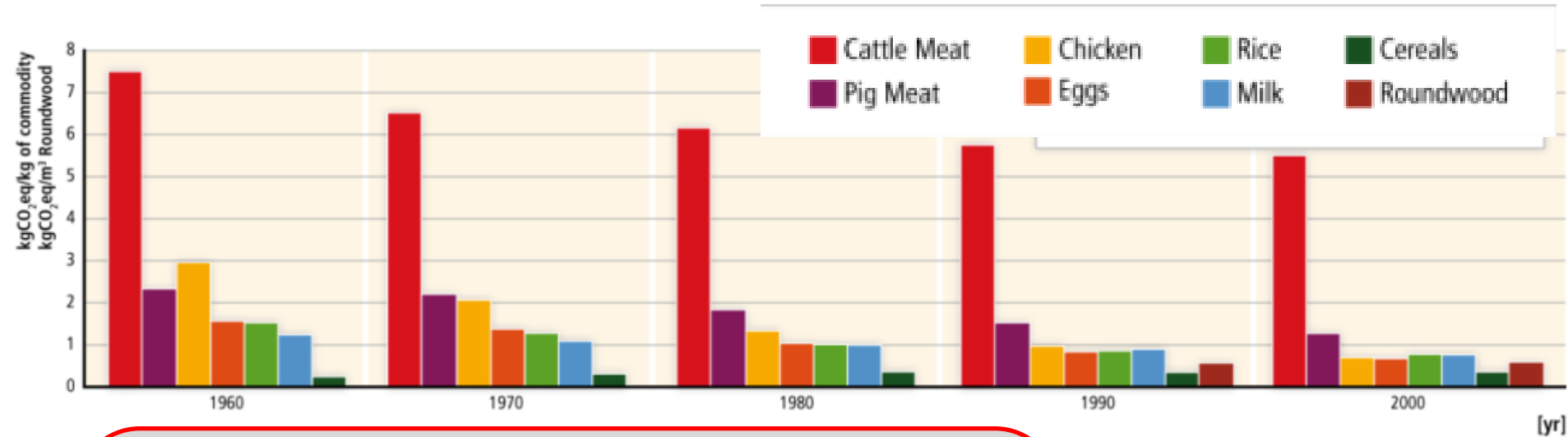
Agriculture's wedges

- Efficiency gains
- Demand management
- New/improved technologies

Emissions intensity and milk yield per cow

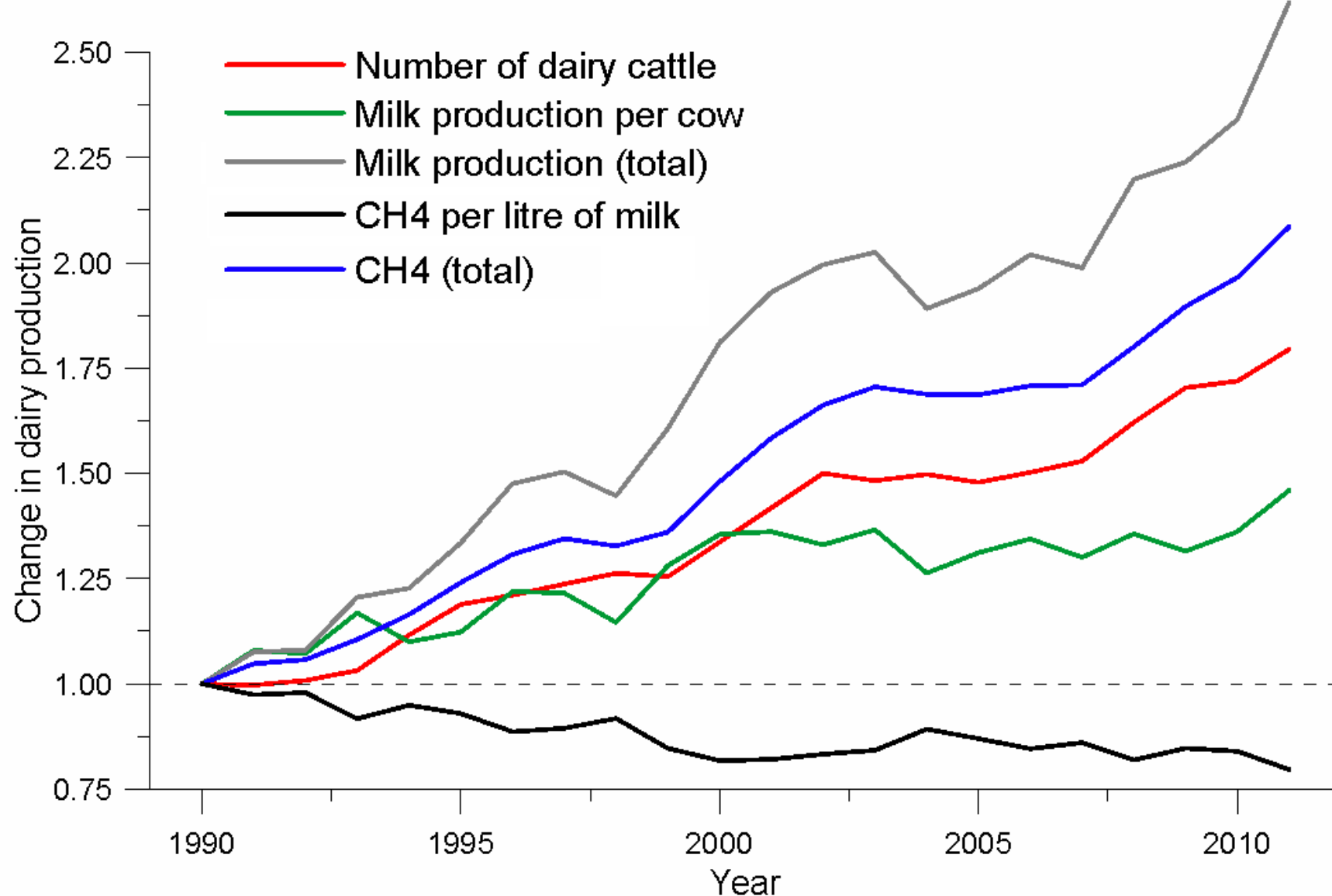


Reducing emissions intensities holds major promise



Significant decline in emissions intensities for livestock products 1960s – 2000s:

- beef: -27%
- milk: -38%
- pork: -45%



Source: MfE, 2013

Demand management

- Supply and demand mgmt
 - 30-40% global food waste
(UK: 18% unavoidable, 18% potentially avoidable, 64% avoidable)
 - Dietary shifts: potentially large gains
 - ✓ reduced rate of land clearing
 - ✓ reduced on-farm emissions
 - ✓ health co-benefits
 - ✓ *strong opposing socio-economic drivers*
 - ✓ *difficult to quantify, let alone enact*
- 
- A close-up photograph showing a person's hand holding a knife, positioned next to a white plate filled with sliced, cooked meat. The scene is set on a wooden surface, likely a table or countertop. The lighting is bright, highlighting the texture of the meat and the wood.



Source: IPCC, 2014

Diets ...

Global changes in diets and the consequences for land requirements for food

Thomas Kastner^{a,b,1}, Maria Jose

^aCenter for Energy and Environmental
Universität, 1070 Vienna, Austria

Edited by B. L. Turner

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Food choices, health and environment: Effects of cutting Europe's meat and dairy intake

Henk Westhoek^{a,*}, Jan Peter Lesschen^b, Trudy Rood^a, Susan Alessandra De Marco^c, Donal Murphy-Bokern^{d,e}, Adrian Leif Mark A. Sutton^g, Oene Oenema^b

^a PBL Netherlands Environmental Assessment Agency, P.O. Box 303, 3720 AH The Hague/Bilthoven, The Netherlands
^b Alterra, Wageningen University and Research Centre, P.O. Box 47, 6700 AA Wageningen, The Netherlands
^c ENEA, CR Casaccia, UTTAMB-ATM, Via Anguillarese 301, 00123 Rome, Italy
^d Cranfield University, Bedford, United Kingdom
^e Lohne-Ehrendorf, 49393 Lohne, Germany
^f Joint Research Centre, Institute for Environment and Sustainability (IES), Via E. Fermi 2749, 20133 Milan, Italy
^g NERC Centre for Ecology and Hydrology, Edinburgh Research Station, Bush Estate, Pentlands, Midlothian, Scotland

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ABSTRACT

Western diets are characterized by high levels of saturated fat and red meat. Production of these foods requires large amounts of land, water, and energy. Although several studies have examined the environmental impacts of different diets, few have examined the impacts of different food production systems. We examined the environmental impacts of different food production systems using a life cycle assessment (LCA) approach. We compared the environmental impacts of different food production systems for meat, dairy products, and crops. We found that the environmental impacts of food production are largely determined by the type of food produced and the type of production system used. We found that the environmental impacts of food production are largely determined by the type of food produced and the type of production system used.

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DOI 10.1007/s10584-014-1104-5

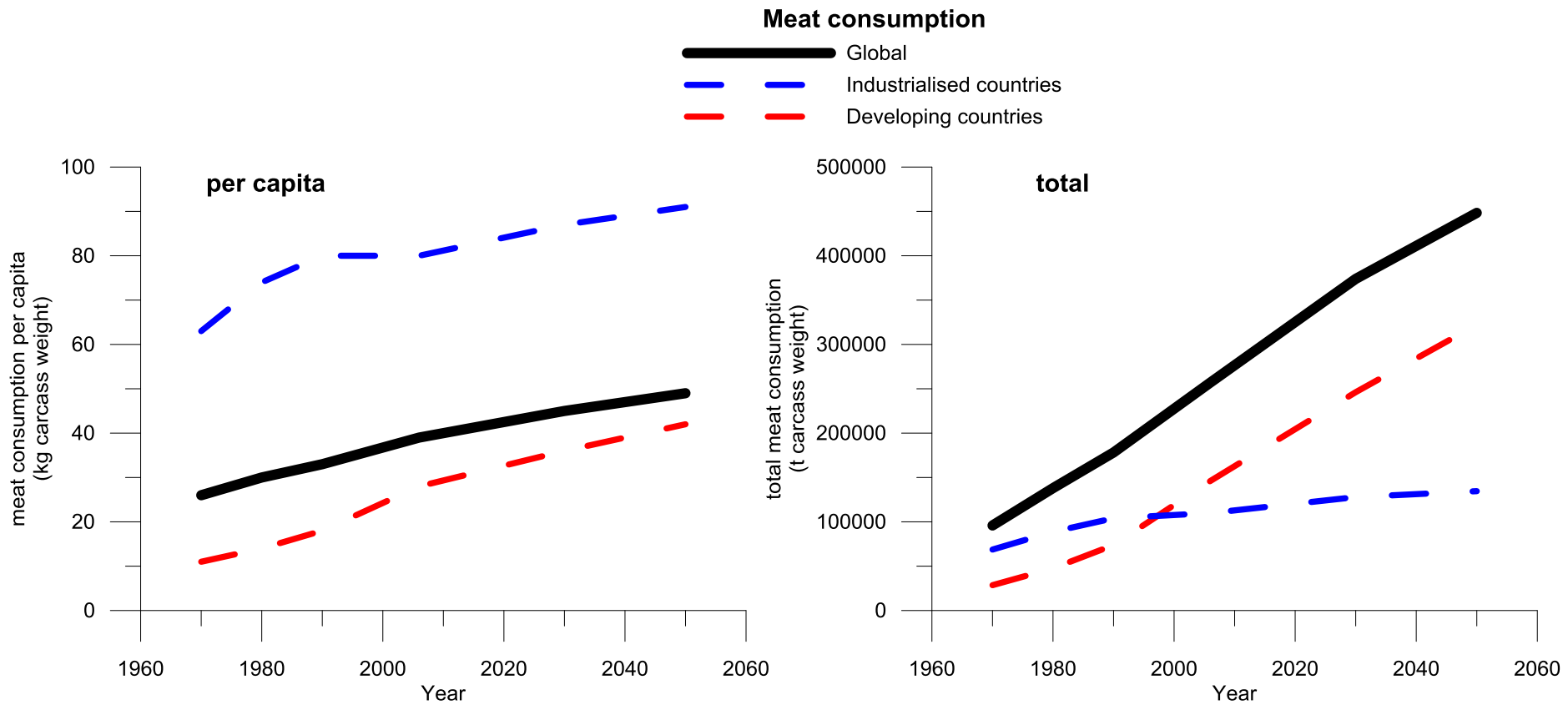
The importance of reduced meat and dairy consumption for meeting stringent climate change targets

Fredrik Hedenus · Stefan Wirsenius ·
Daniel J. A. Johansson

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Abstract For agriculture, there are three major options for mitigating greenhouse gas (GHG) emissions: 1) productivity improvements, particularly in the livestock sector; 2) dedicated technical mitigation measures; and 3) human dietary changes. The aim of the paper is to estimate long-term agricultural GHG emissions, under different mitigation scenarios, and to relate them to the emissions space compatible with the 2 °C temperature target. Our estimates indicate that, to meet the 2070 emissions target, a combination of productivity improvements, technical mitigation measures, and human dietary changes is required. The most important mitigation measure is human dietary changes, which can reduce emissions by 1.5 Gt CO₂e per year. Productivity improvements can reduce emissions by 0.5 Gt CO₂e per year, and technical mitigation measures can reduce emissions by 0.5 Gt CO₂e per year.

Diets ...



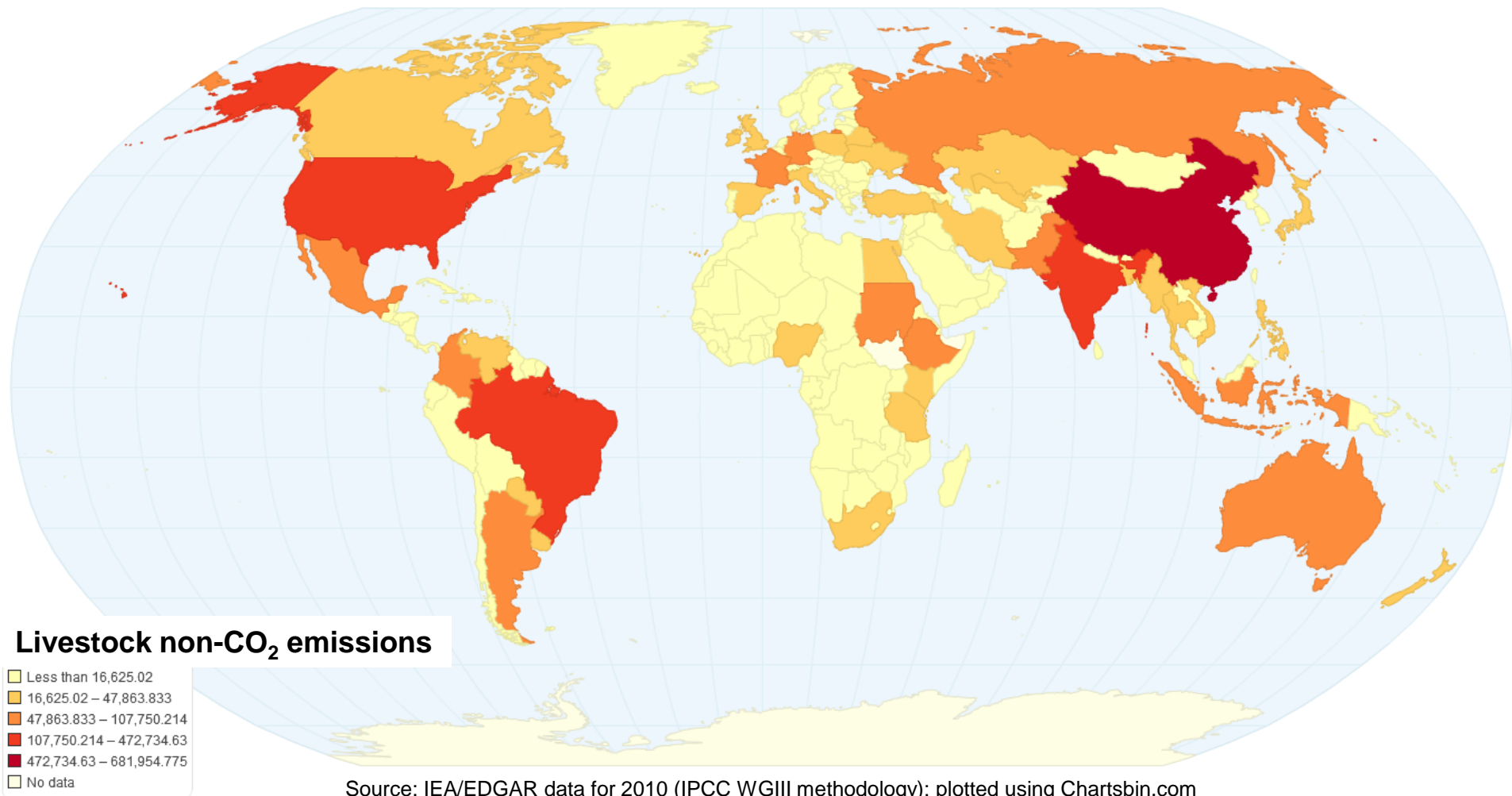
Source: FAO (2012), Alexandratos and Bruinsma

New technologies

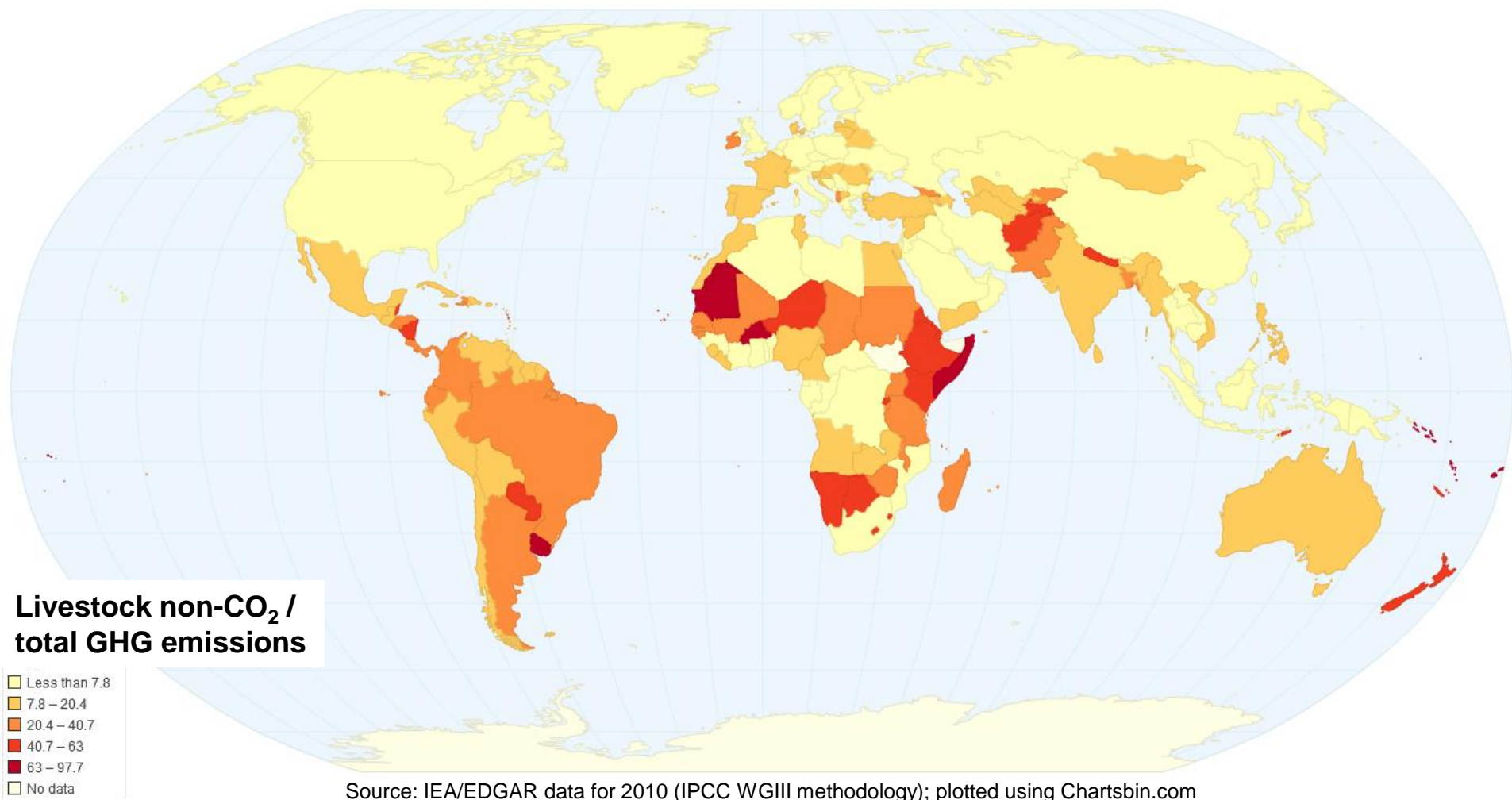
- New technologies:
 - ✓ breeding low-emitting animals
(*proof-of-concept* → *market adoption*)
 - ✓ vaccine/inhibitor against methanogens
(→ *proof of concept*)
 - ✓ low-emissions feeds
(*proof-of-concept* (N , CH_4) → *systems testing*)
 - ✓ soil carbon enhancement/avoiding loss
(*measurement, models, persistence*)



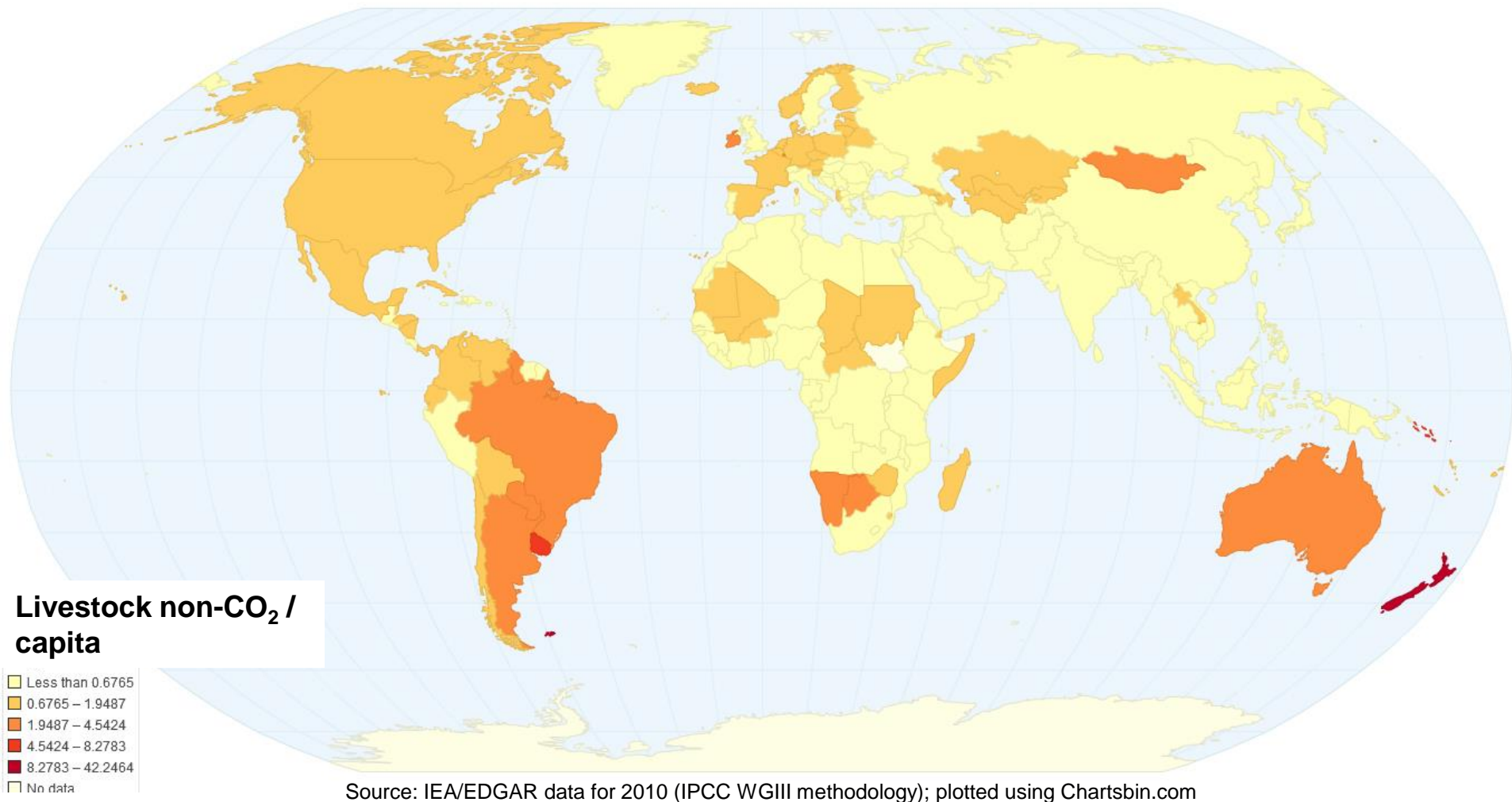
Focusing global attention remains a challenge



Focusing global attention remains a challenge



Focusing global attention remains a challenge



Global Research Alliance

Launched in December 2009



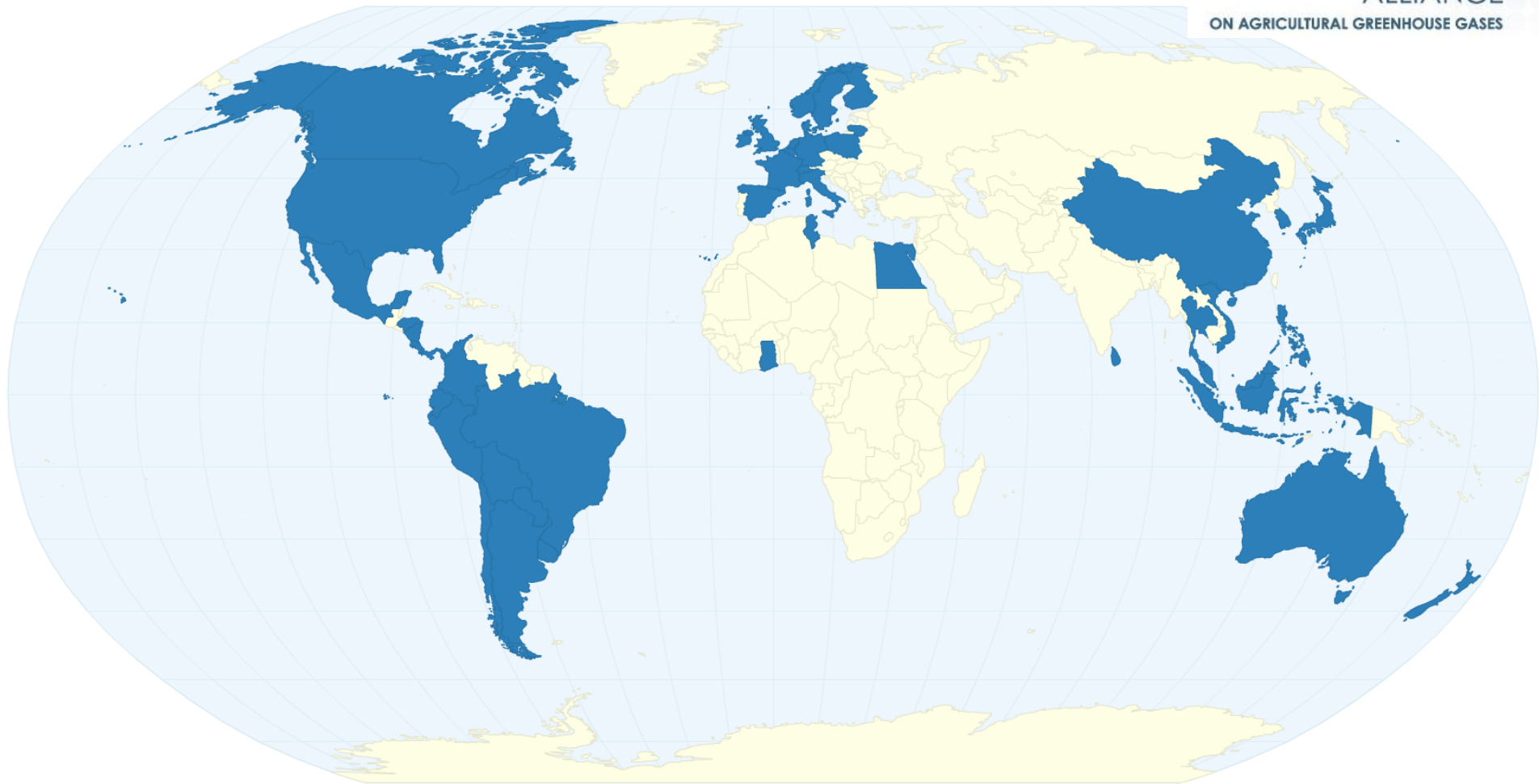
Brings countries together on a voluntary basis to find ways to grow more food without growing greenhouse gas emissions:

- **Reduce the emissions intensity** of agricultural production systems and increase their potential for soil carbon sequestration, while enhancing food security
- **Improve understanding, measurement and estimation** of agricultural emissions
- **Improve farmers' access** to agricultural mitigation technologies and best practices

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ON AGRICULTURAL GREENHOUSE GASES



Member countries January 2015; source: www.globalresearchalliance.org; plotted using chartsbin.com

www.nzagrc.org.nz
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Thank you