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

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Contributed paper prepared for presentation at the 59th AARES Annual Conference, Rotorua, New Zealand, February 10-13, 2015

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NEW ZEALAND AGRICULTURAL GREENHOUSE GAS Research Centre

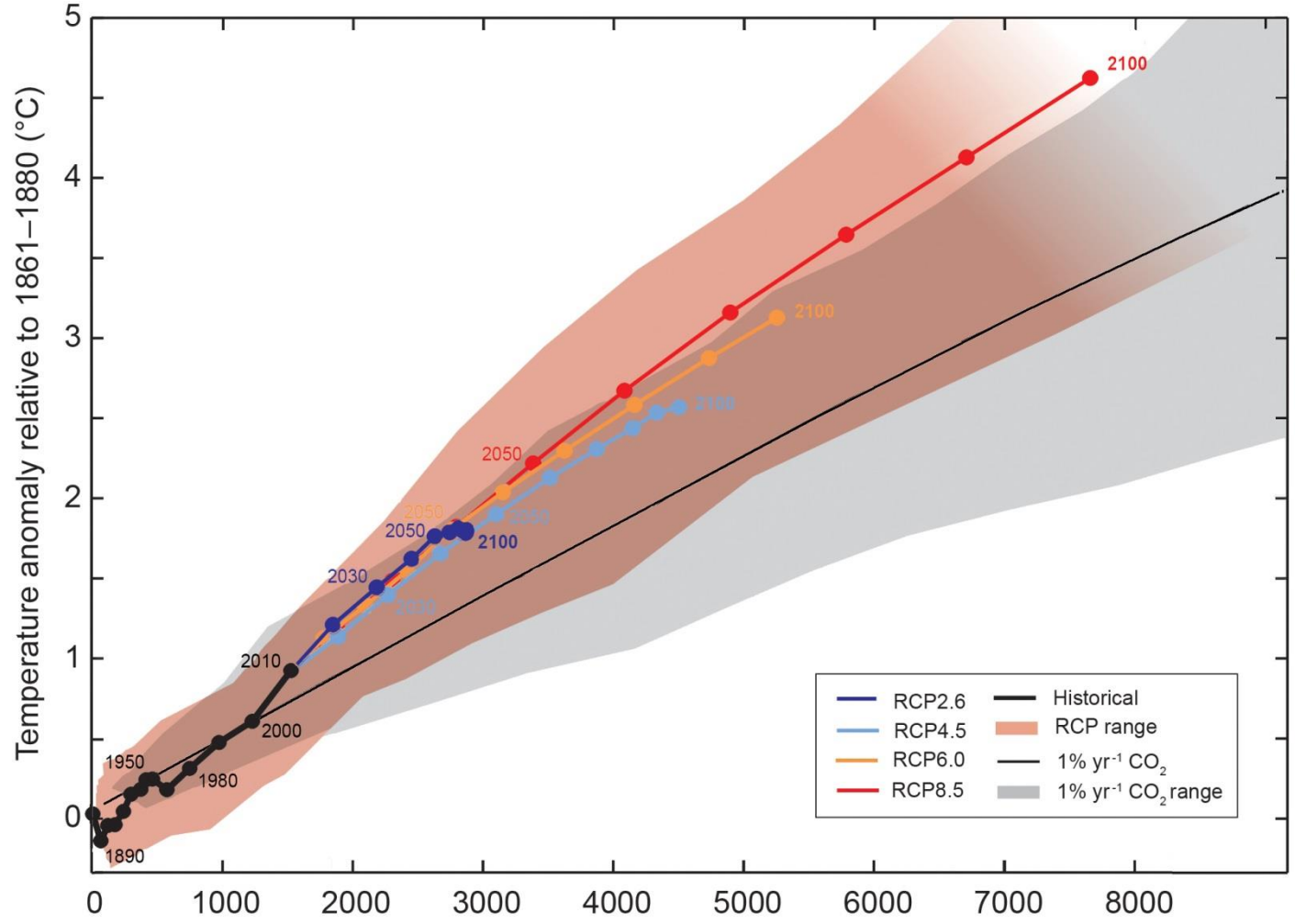
Leading Partners in Science

agresearch · DairyNZ · Landcare Research Manaaki Whenua · Lincoln University · Massey University · NIWA Taihoro Nukurangi · PGgRc · Plant & Food Research · SCION

Overview

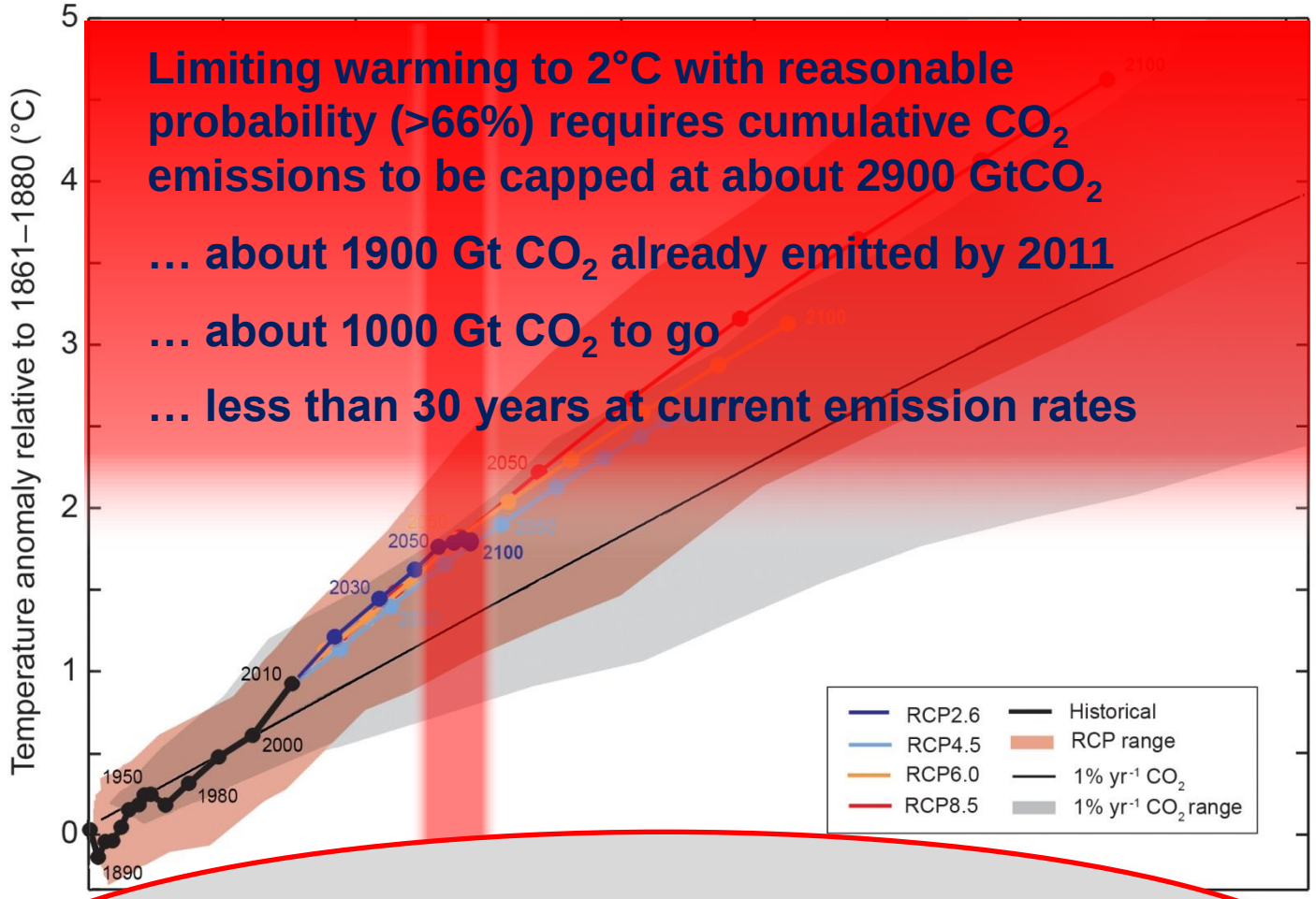
- Cumulative emissions and the 2°C limit
- Interaction of agriculture and CO_2 mitigation
- Expanding agriculture's mitigation potential
- Conclusions

Warming is proportional to cumulative CO_2 emissions



Source: IPCC Working Group I

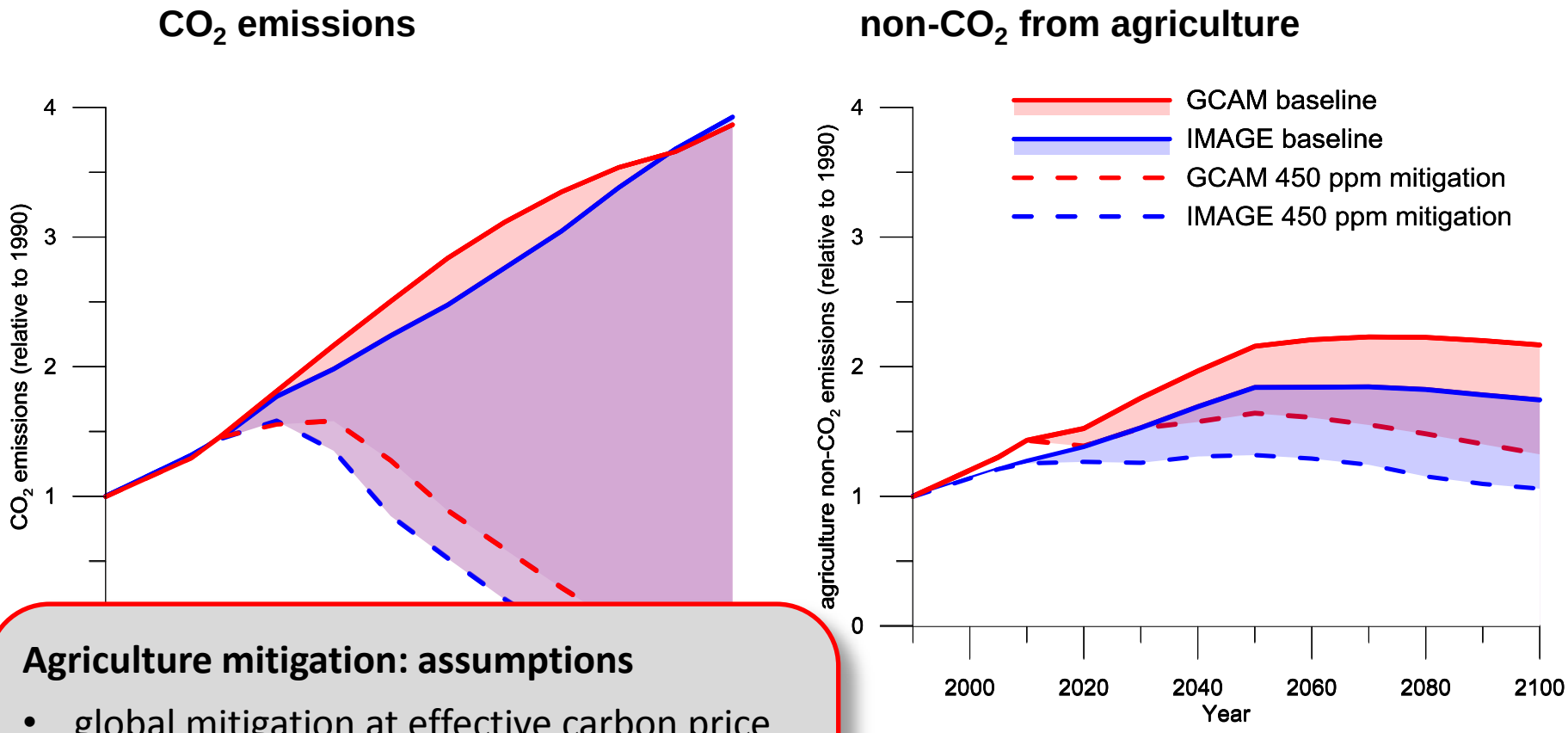
Warming is proportional to cumulative CO_2 emissions



Source: IPCC

what about non-CO_2 emissions, particularly agriculture?

Limiting warming to 2°C requires zero CO_2 by 2100 … but a different level of ambition for agriculture?

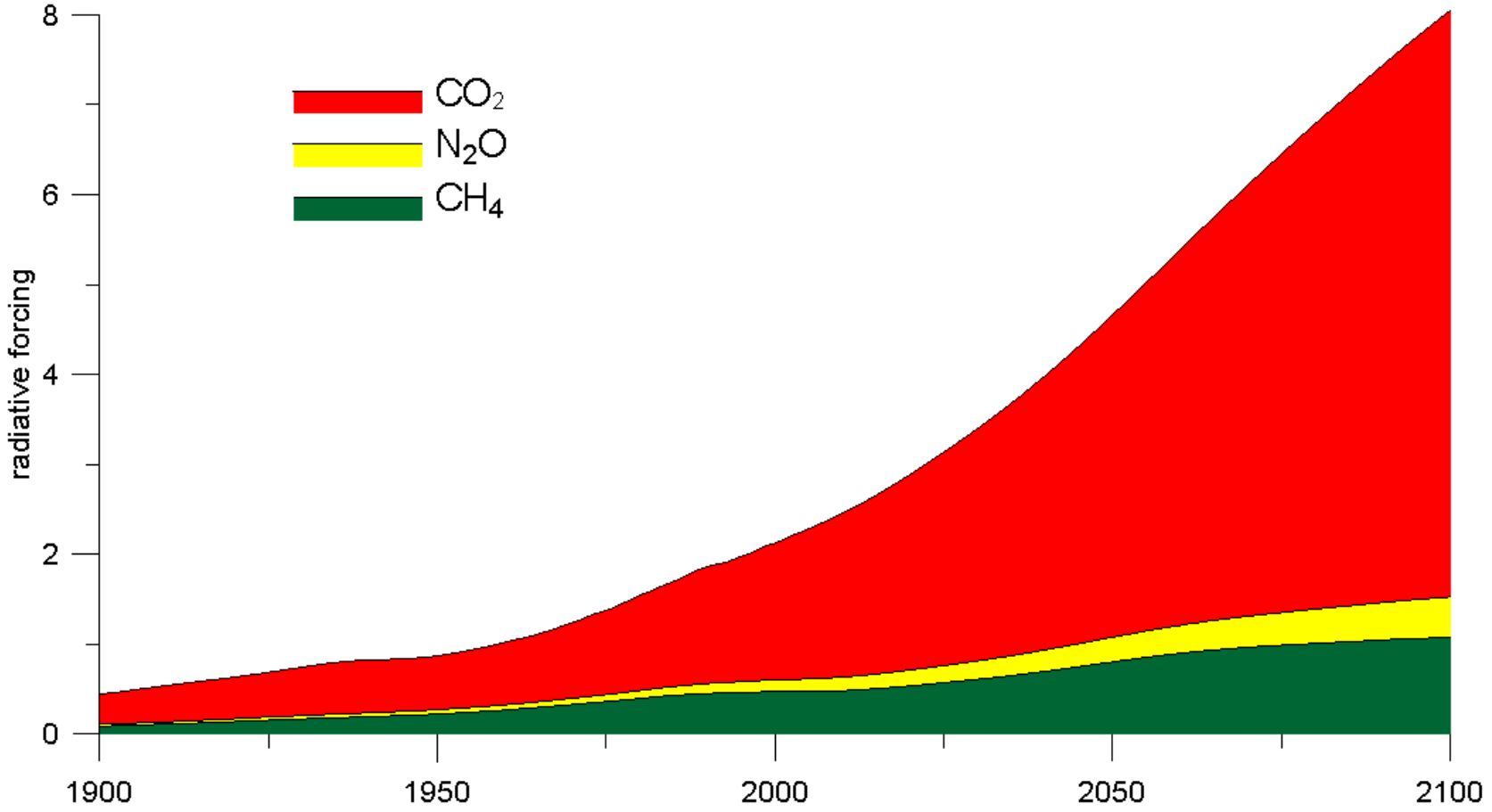


also Clarke et al. (2014) (IPCC WGIII)

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 CH_4

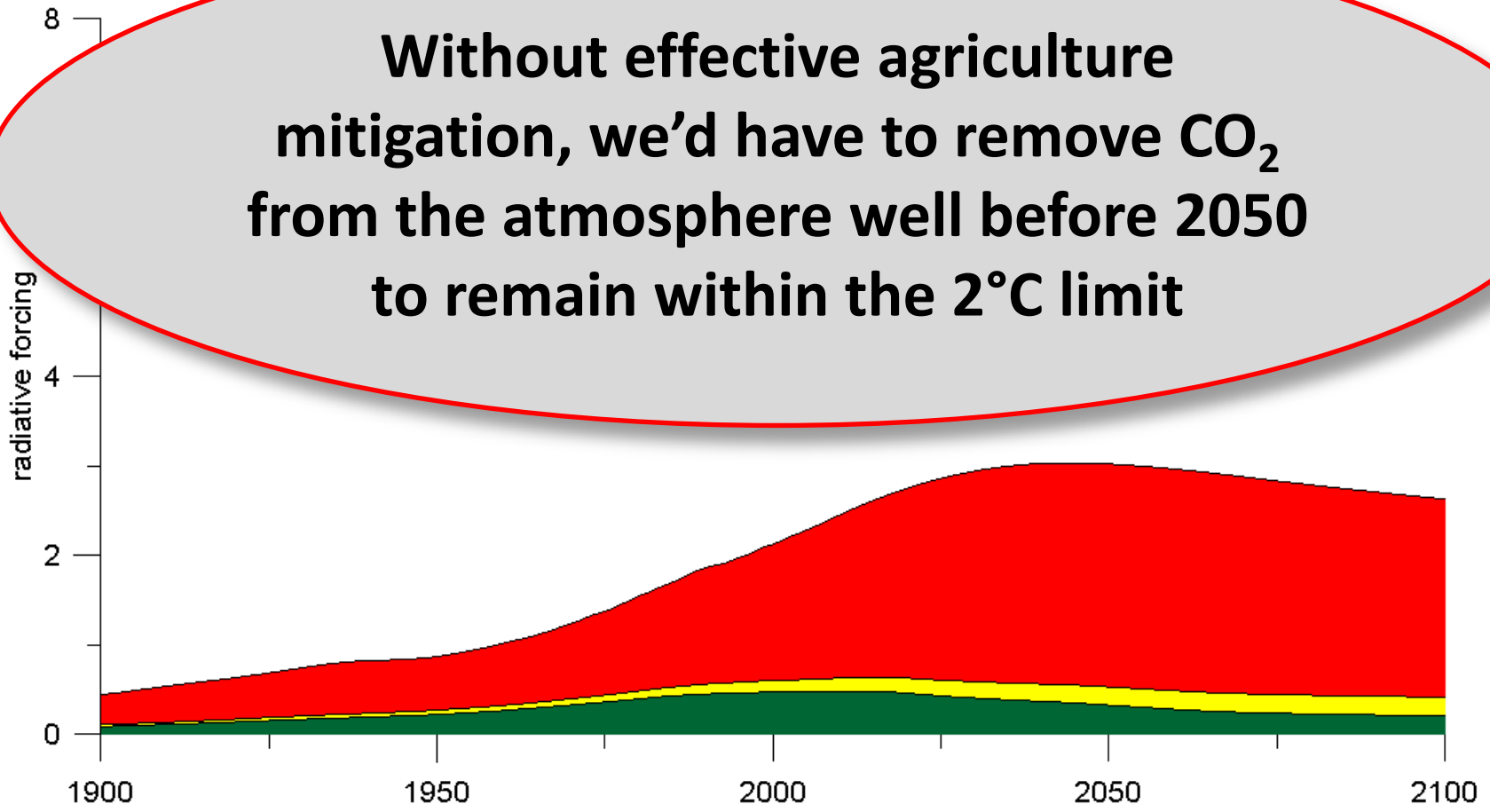
Abatement of non-CO_2 gases keeps the 2°C window feasible (even if only just)



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

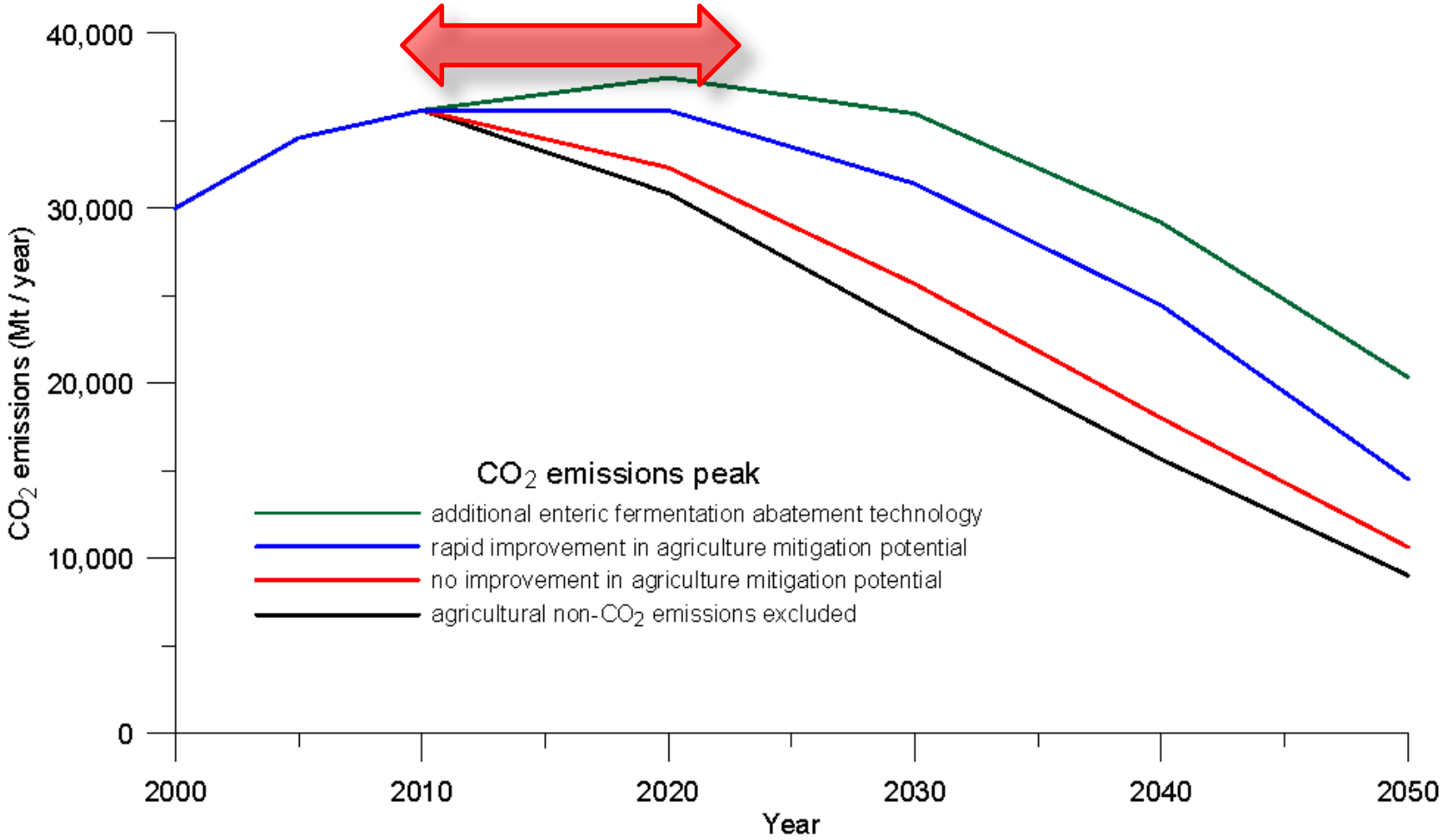
Abatement of non-CO_2 gases keeps the 2°C window fo[illegible] if only just)

Without effective agriculture mitigation, we'd have to remove CO_2 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

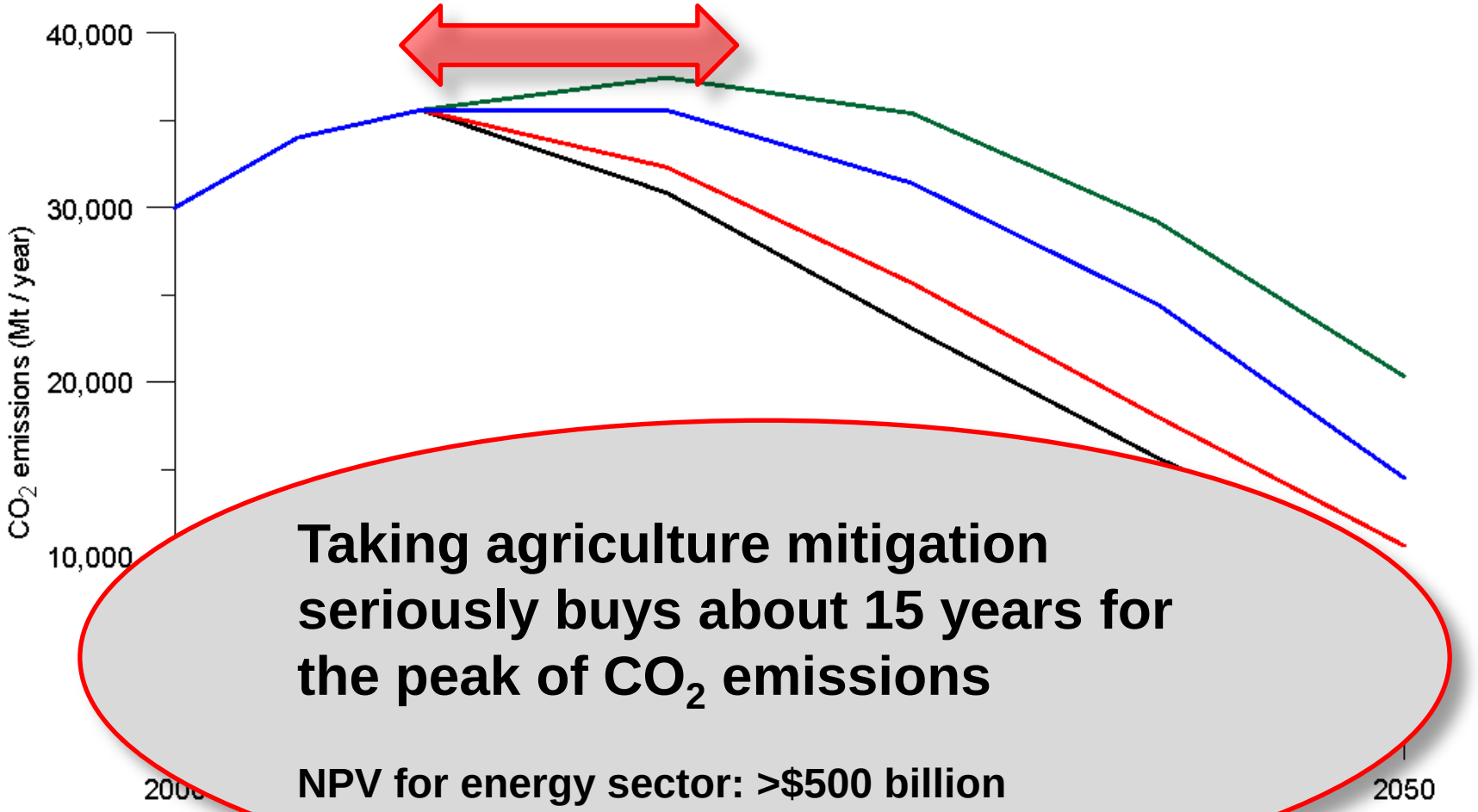
Interactions between agriculture and CO_2 mitigation



All pathways shown result in radiative forcing of 450ppm CO_2-eq in 2100

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

Interactions between agriculture and CO_2 mitigation



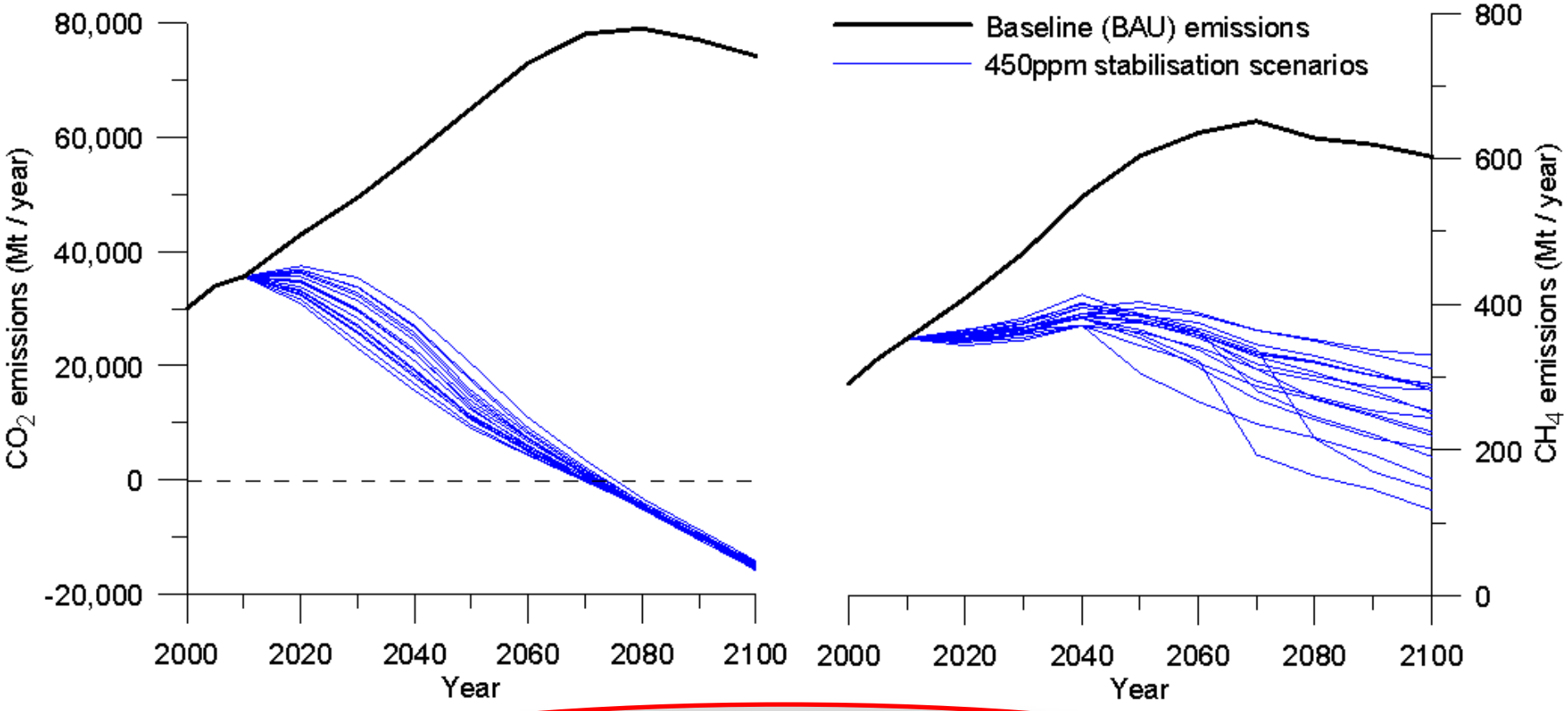
Taking agriculture mitigation seriously buys about 15 years for the peak of CO_2 emissions

NPV for energy sector: >$500 billion

All pathways show… …ppm CO_2-eq in 2100

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

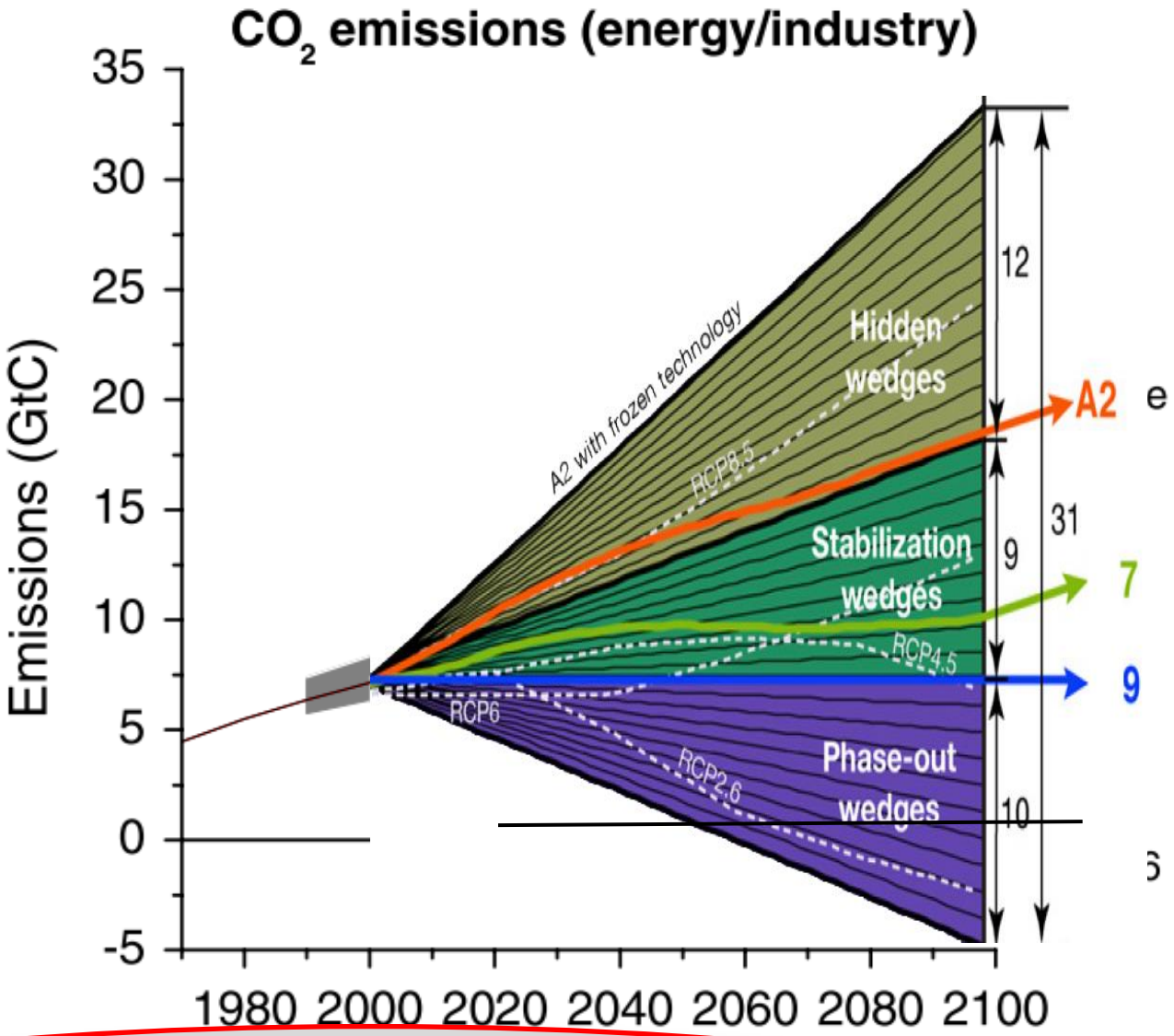
Interactions between agriculture and CO_2 mitigation



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

CO_2 mitigation to zero by 2100 is non-negotiable

How can we get there?



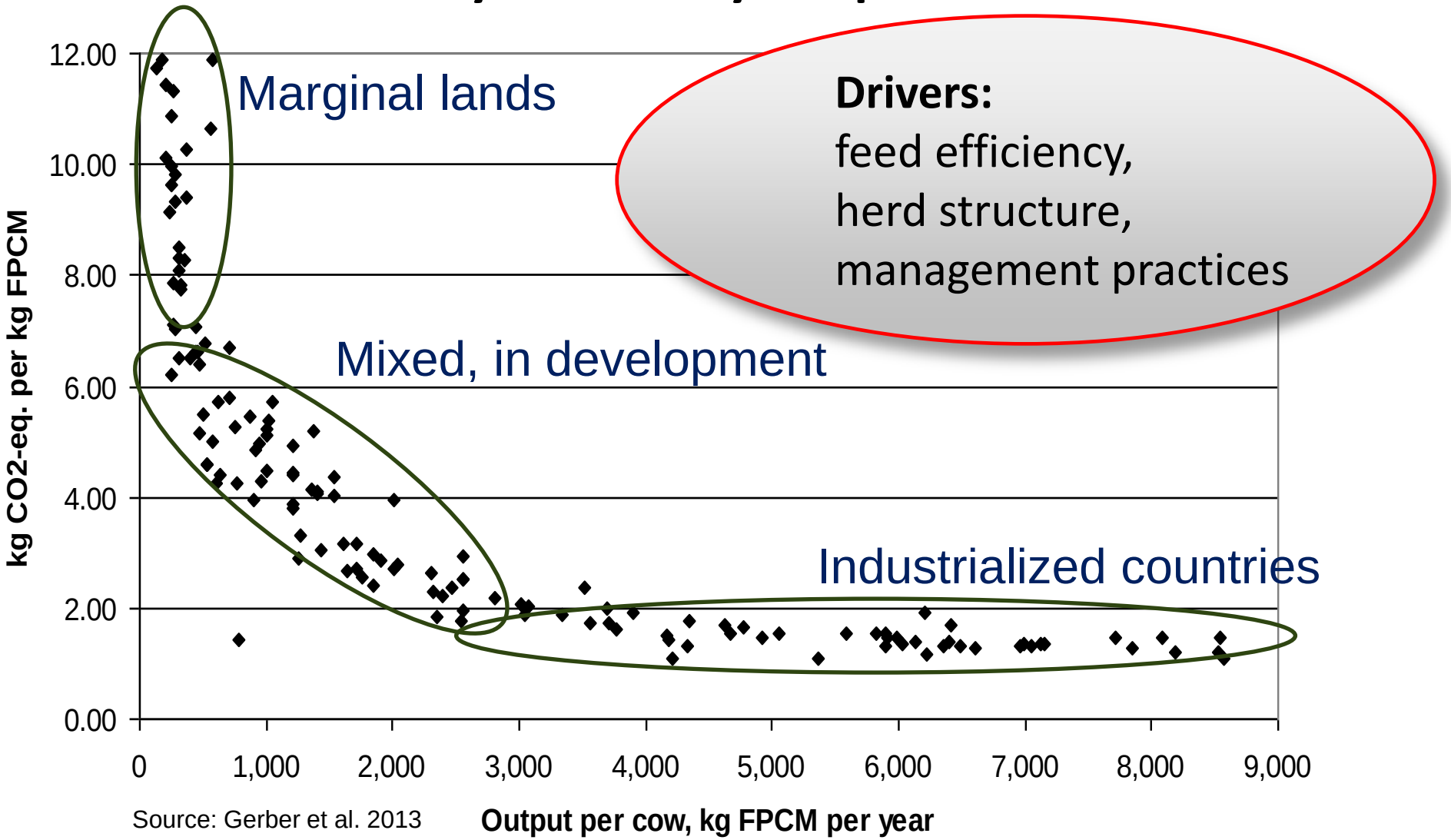
Sources: van Vuuren et al. 2011

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

Agriculture's wedges

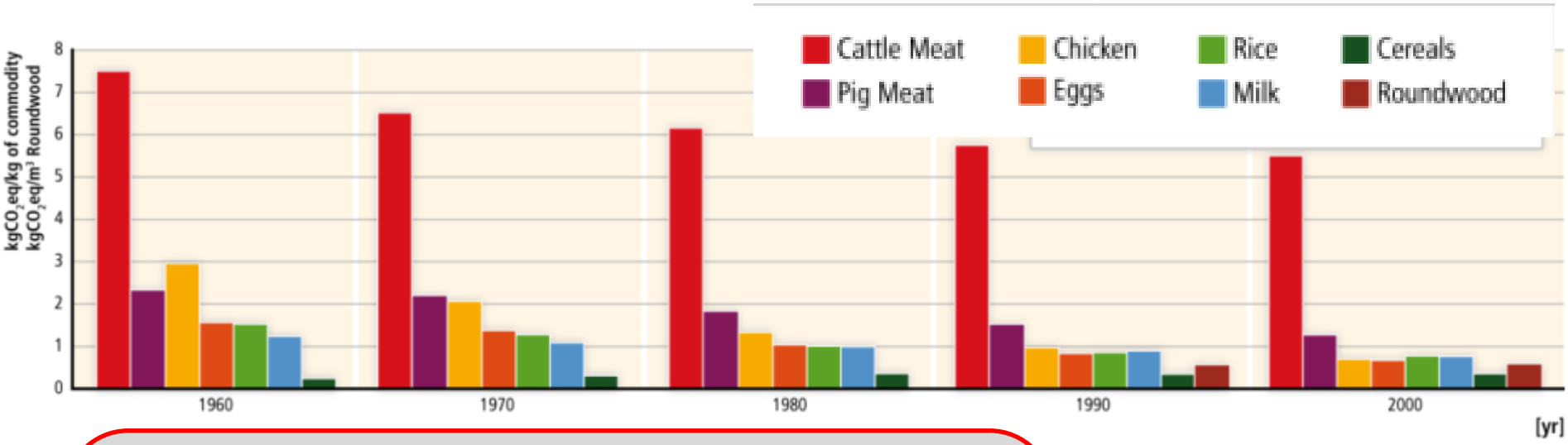
- Efficiency gains
- Demand management
- New/improved technologies

Emissions intensity and milk yield per cow



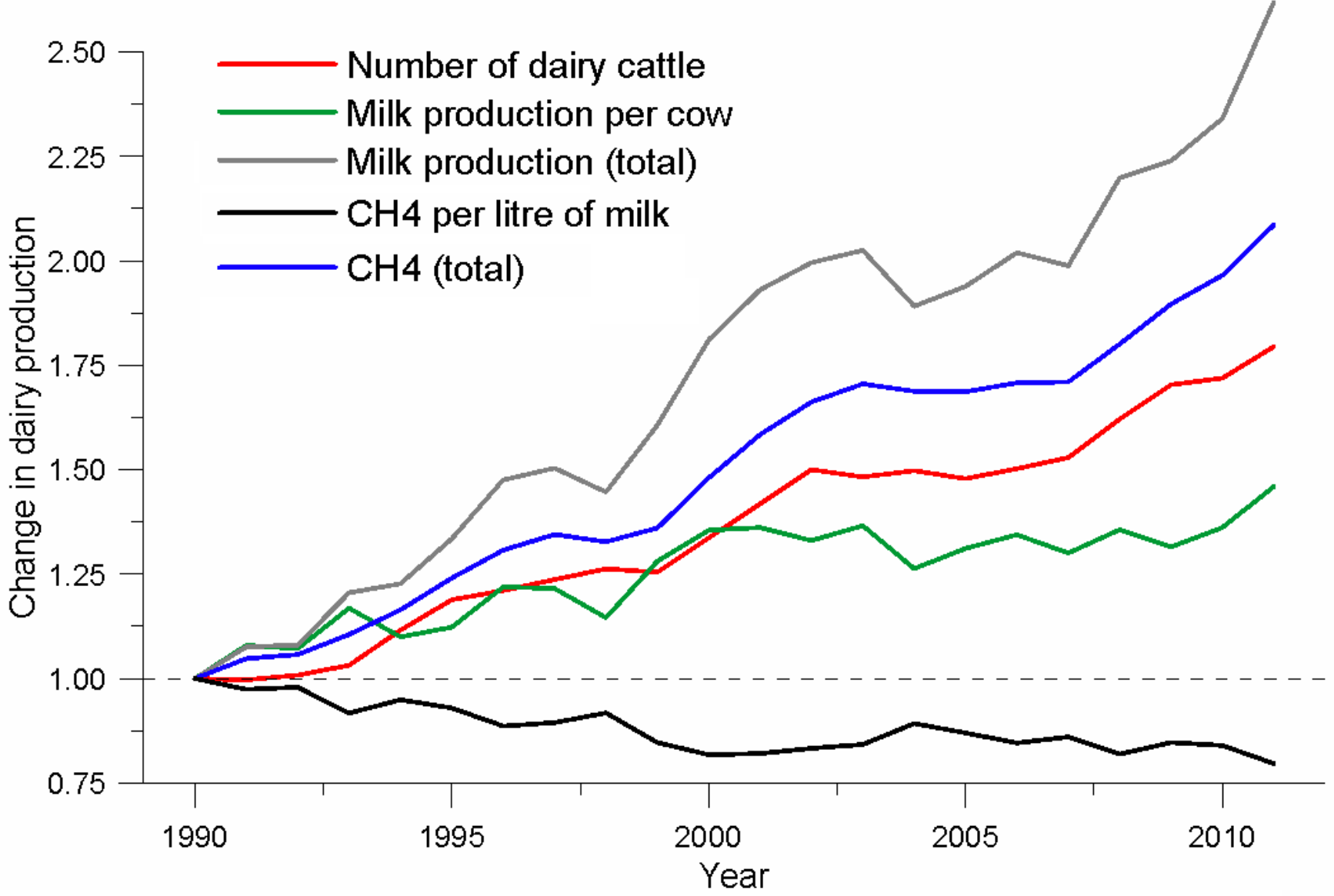
Source: Gerber et al. 2013

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*

Source: IPCC, 2014

Diets …

PNAS

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

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…f Groningen, 9747 AG, Groningen, The Netherlands; [b]Institute of Social Ecology, Alpen-Adria-…phy and Regional Sciences, University of Graz, 8010 Graz, Austria

Edited by B. L. Turner… …pproved March 8, 2012 (received for review October 15, 2011)

Provision of society … …uman …tral, …nd … parts of the world during the a period of 46 y. We first describe recent changes in diets, yields, and population numbe… lighting differences in these drivers across … time and their influence on develo… is followed by a structu… quantify the …

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

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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…
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ABSTRACT

Western diets are characte… saturated fat and red meat… production requires large… Although several studies… emissions and land use, … as nitrogen emissions) … methods, we examin… animal-derived foods … in production. We te… meat, dairy produ… emissions, 25–40… food production … would become a… use efficiency …

Climatic Change (2014) 124:79–91
DOI 10.1007/s10584-014-1104-5

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

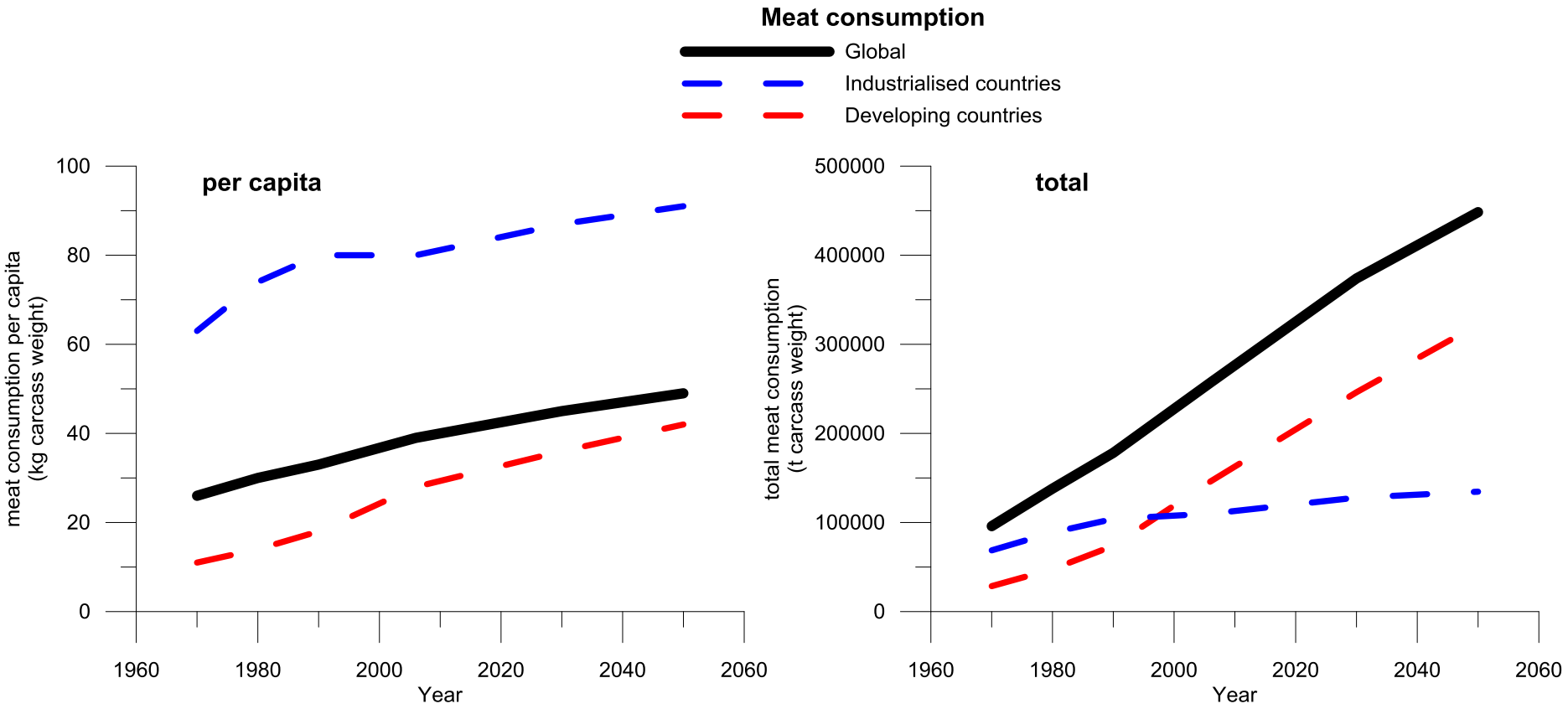
Fredrik Hedenus · Stefan Wirsenius · Daniel J. A. Johansson

Received: 5 July 2013 / Accepted: 3 March 2014 / Published online: 28 March 2014

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

NEW ZEAL… AGRICULTURA… Research Cen…

Diets …

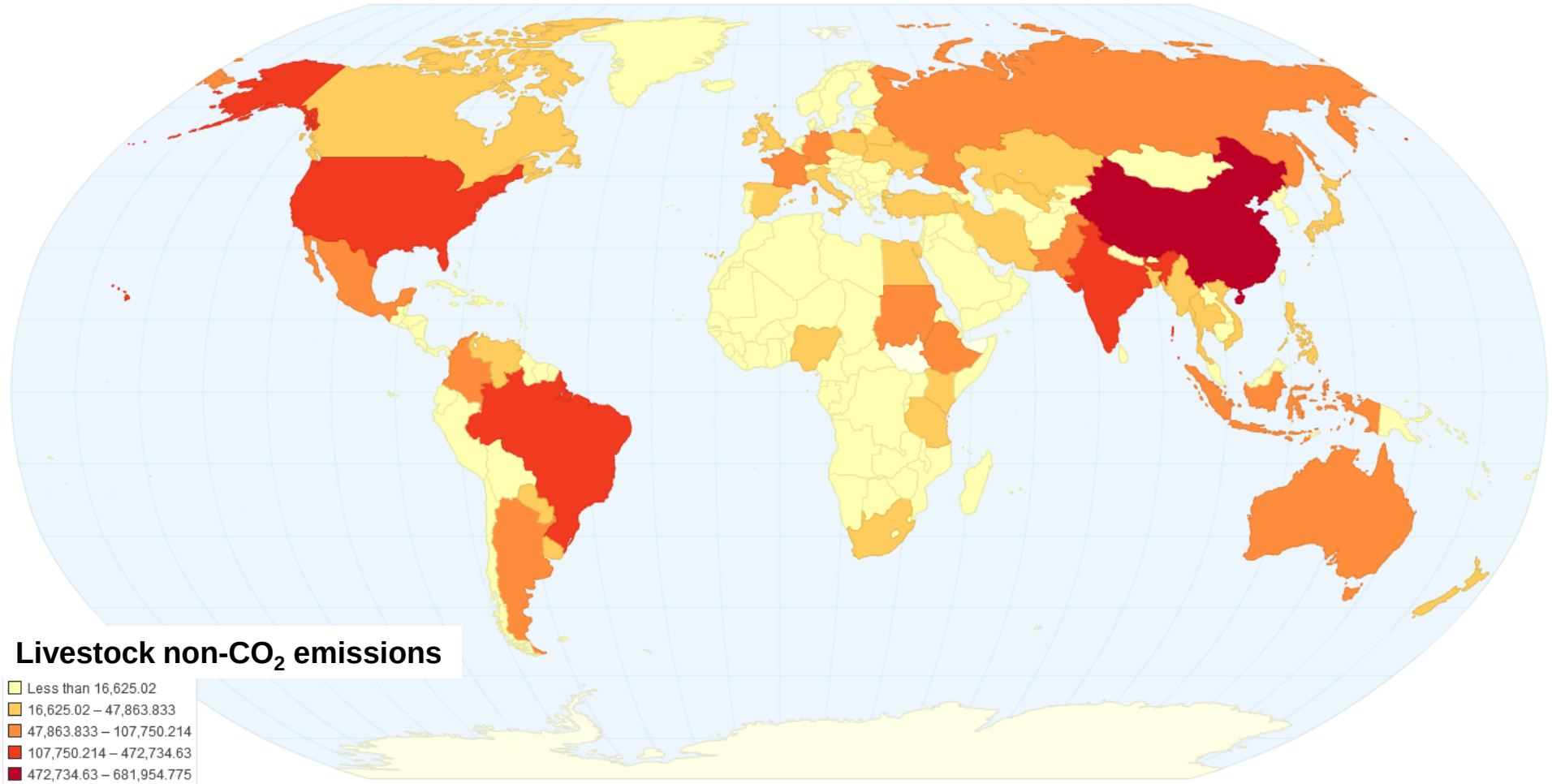


Source: FAO (2012), Alexandratos and Bruinsma

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



Source: IEA/EDGAR data for 2010 (IPCC WGIII methodology); plotted using Chartsbin.com

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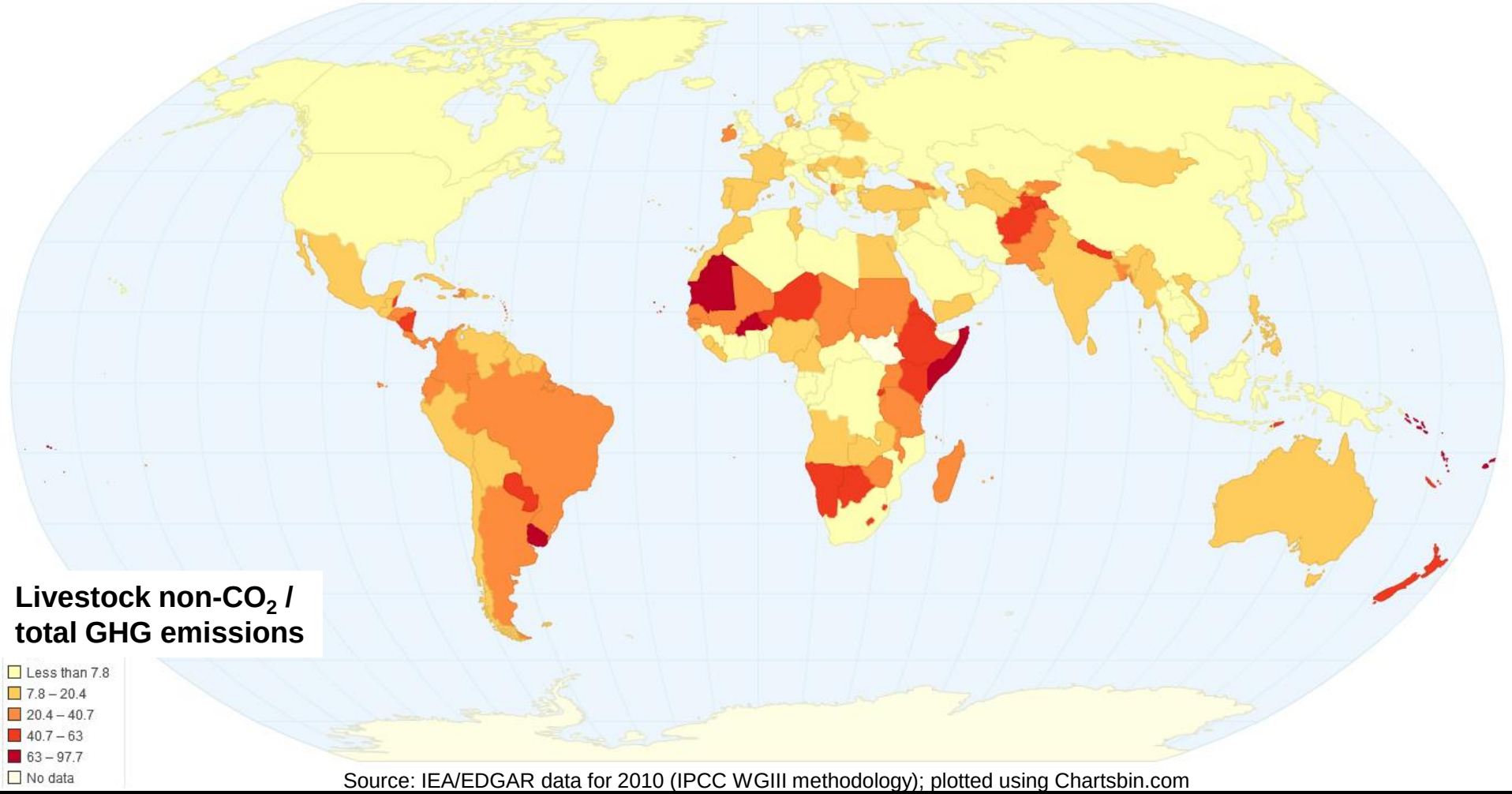

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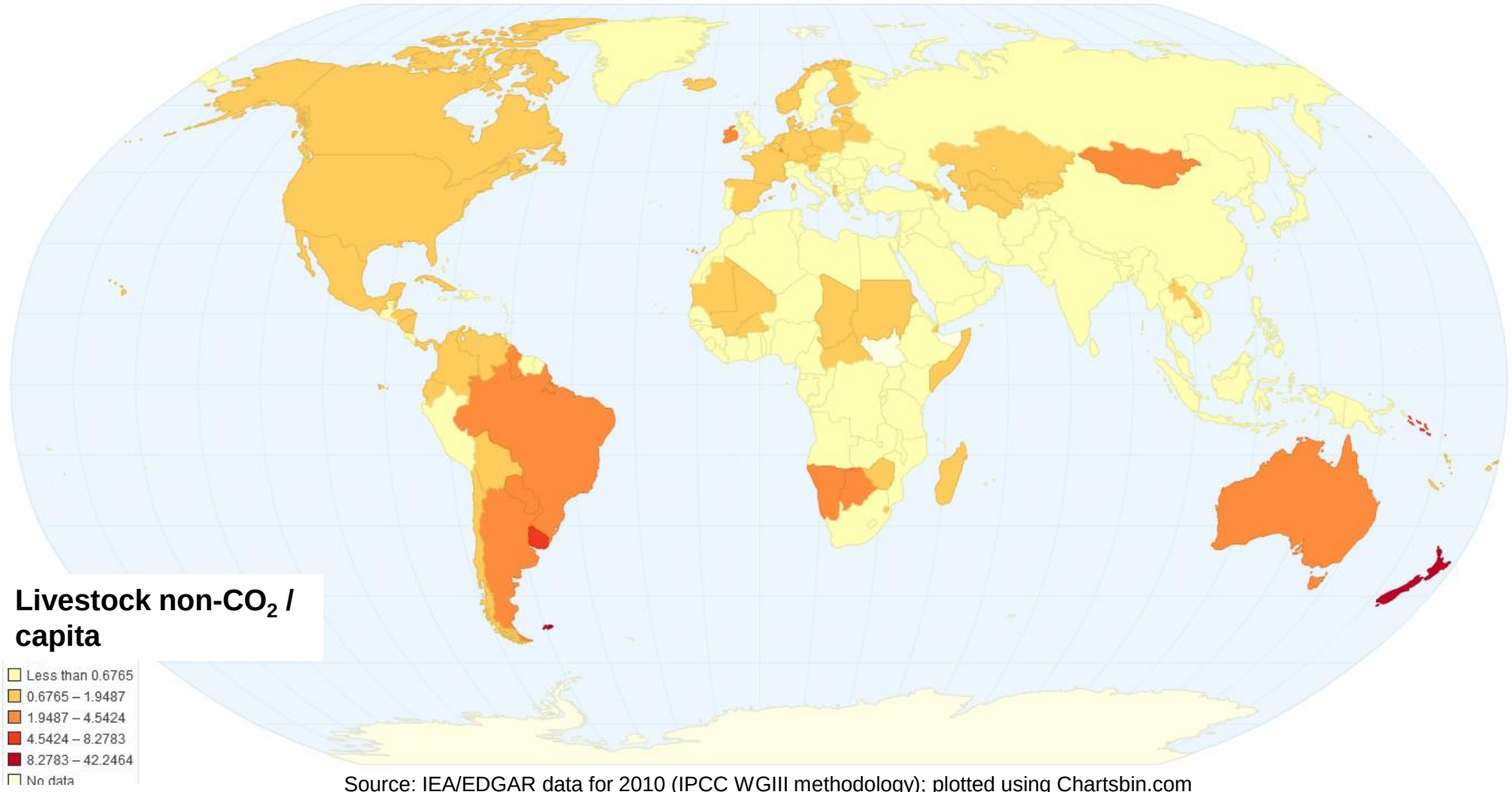

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Global Research Alliance

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

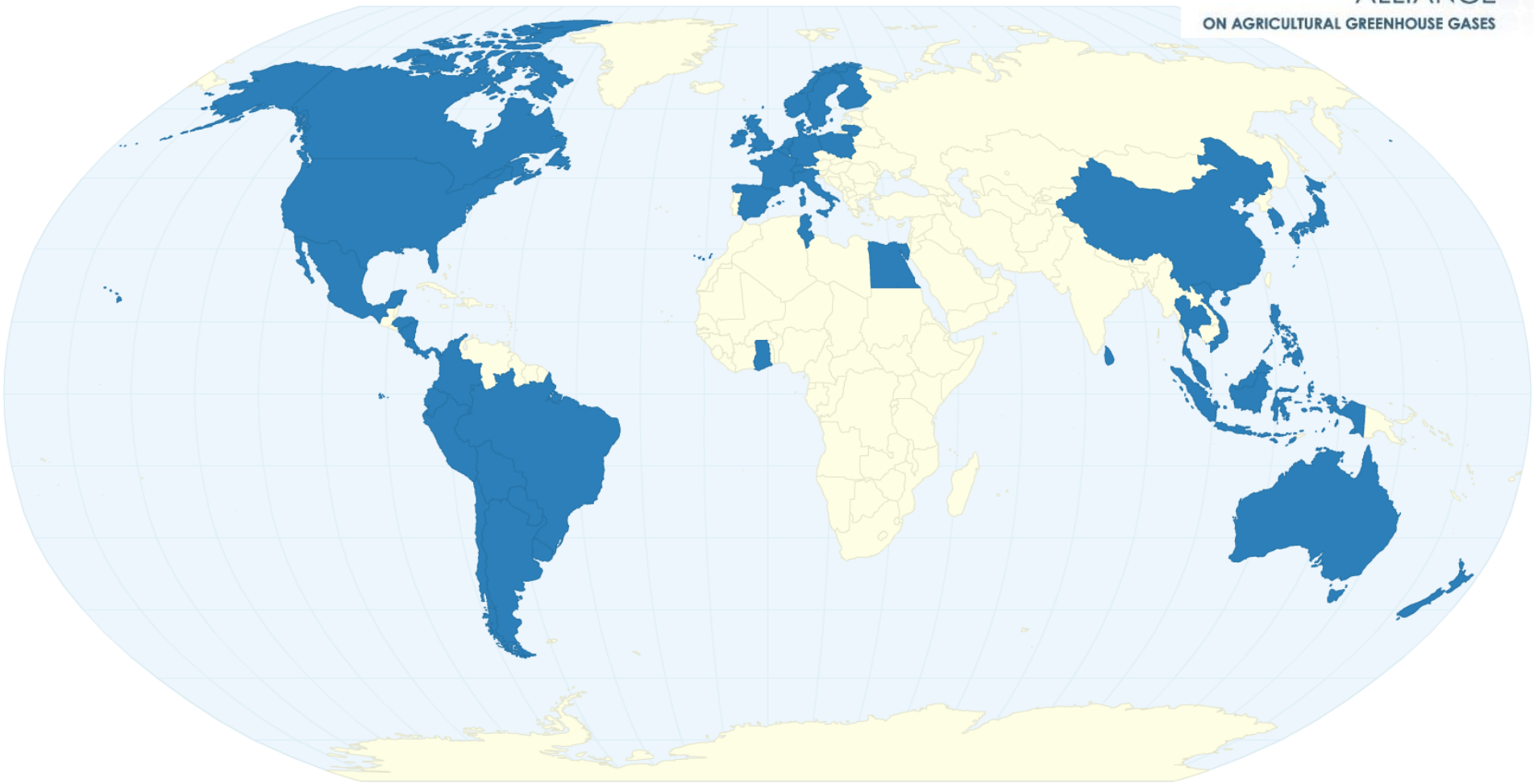
Launched in December 2009

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

Global Research Alliance

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES



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

www.nzagrc.org.nz

www.globalresearchalliance.org

Thank you