1.5 degrees C & 10 billion people: How to feed the world while mitigating climate change?

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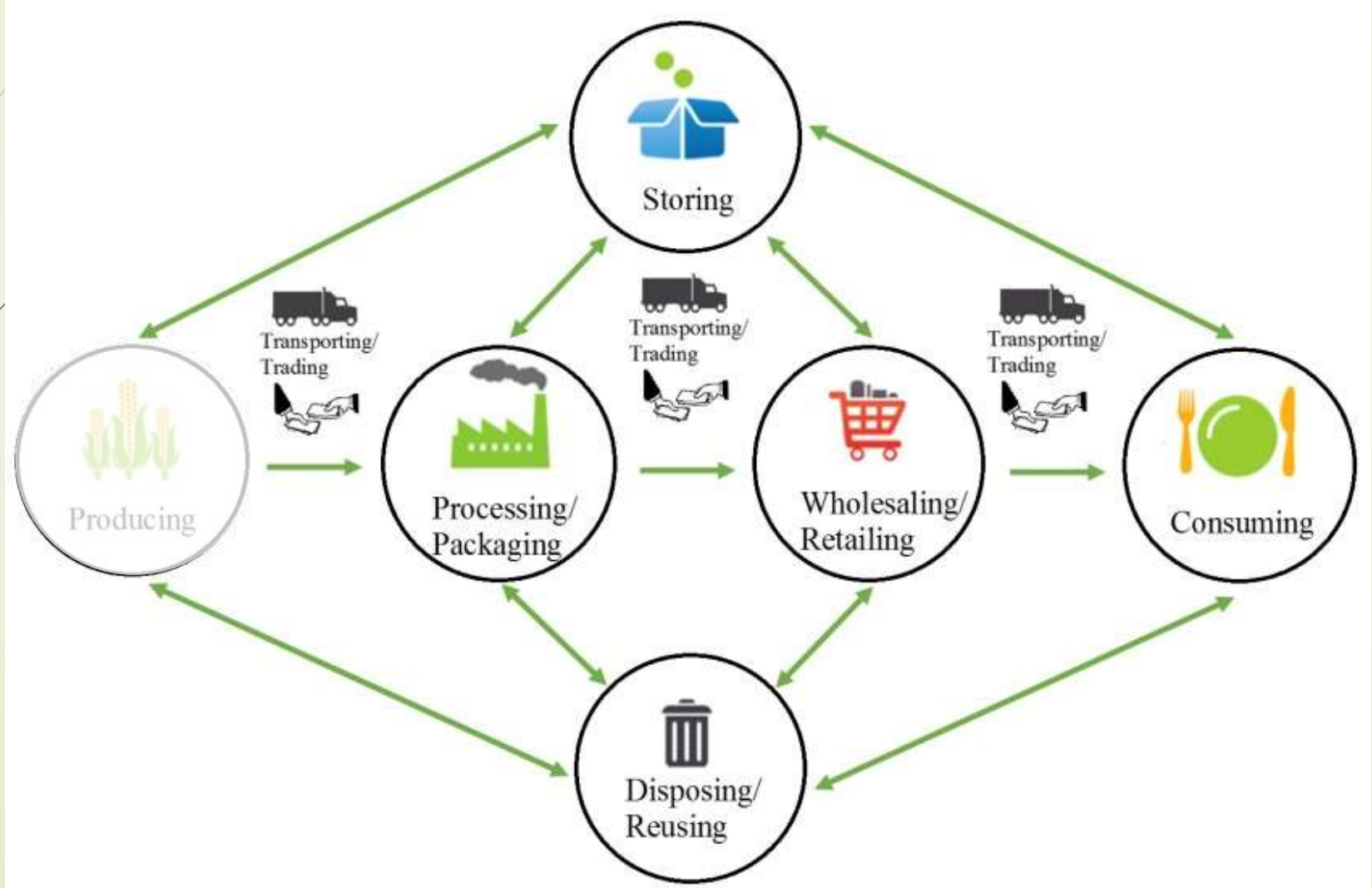
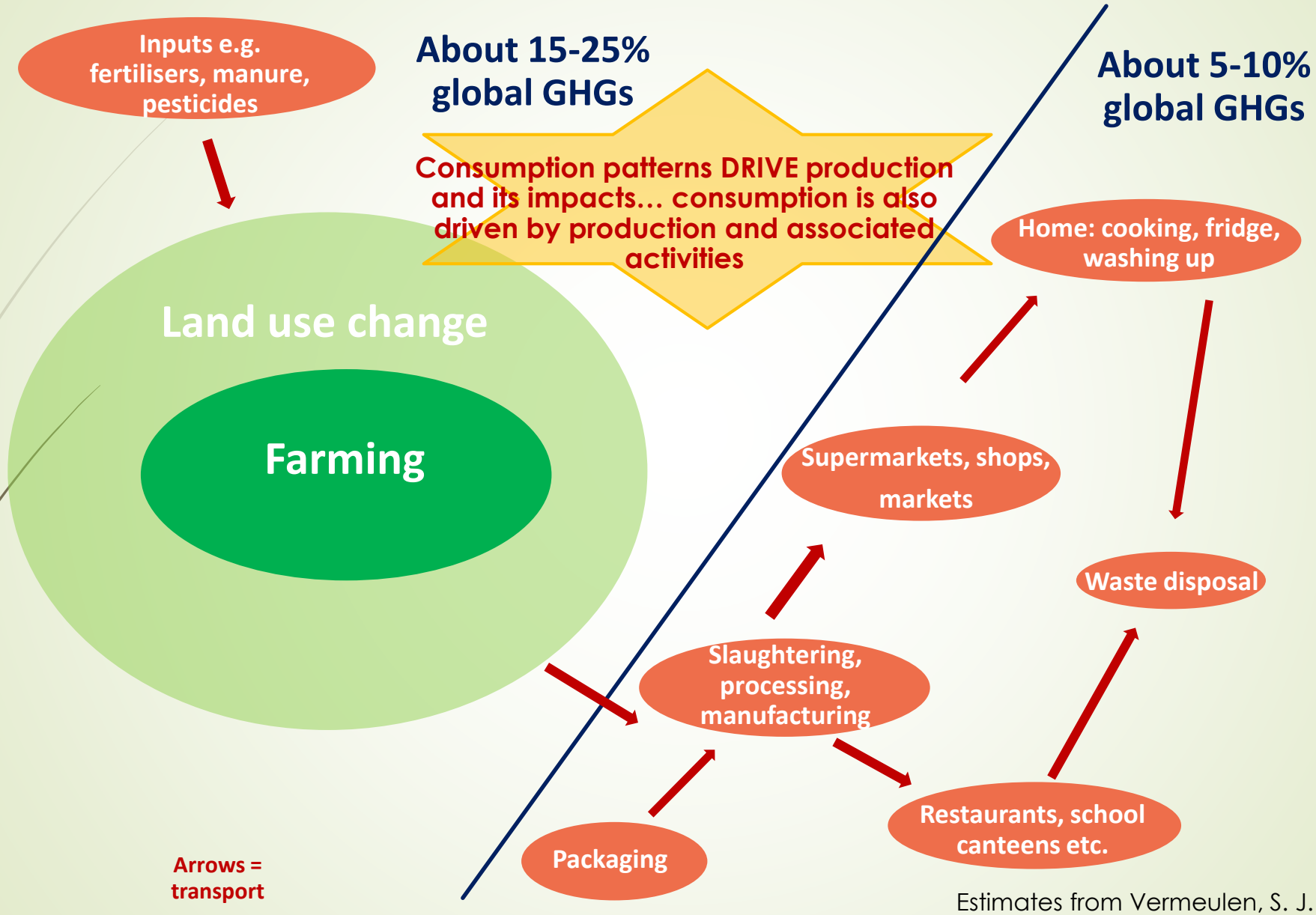
Environmental Change Institute eci

But Food Systems
involve more than ‘producing’ …



Global perspective – food systems contribute 20-30% of GHGs.



Estimates from Vermeulen, S. J. et al.(2012) Climate Change and Food Systems. *Annual Review of Environment and Resources*. 37. p.195-222.

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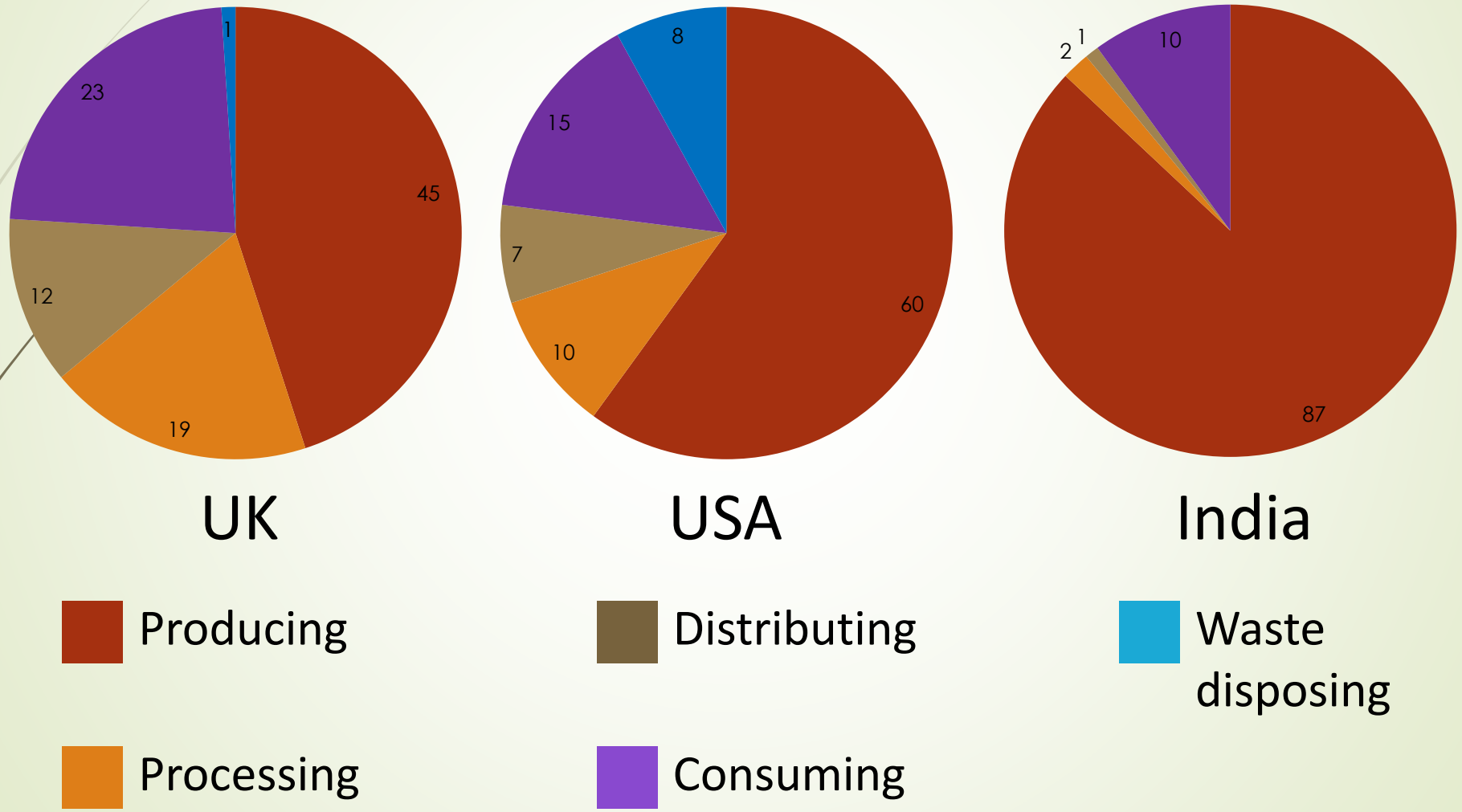
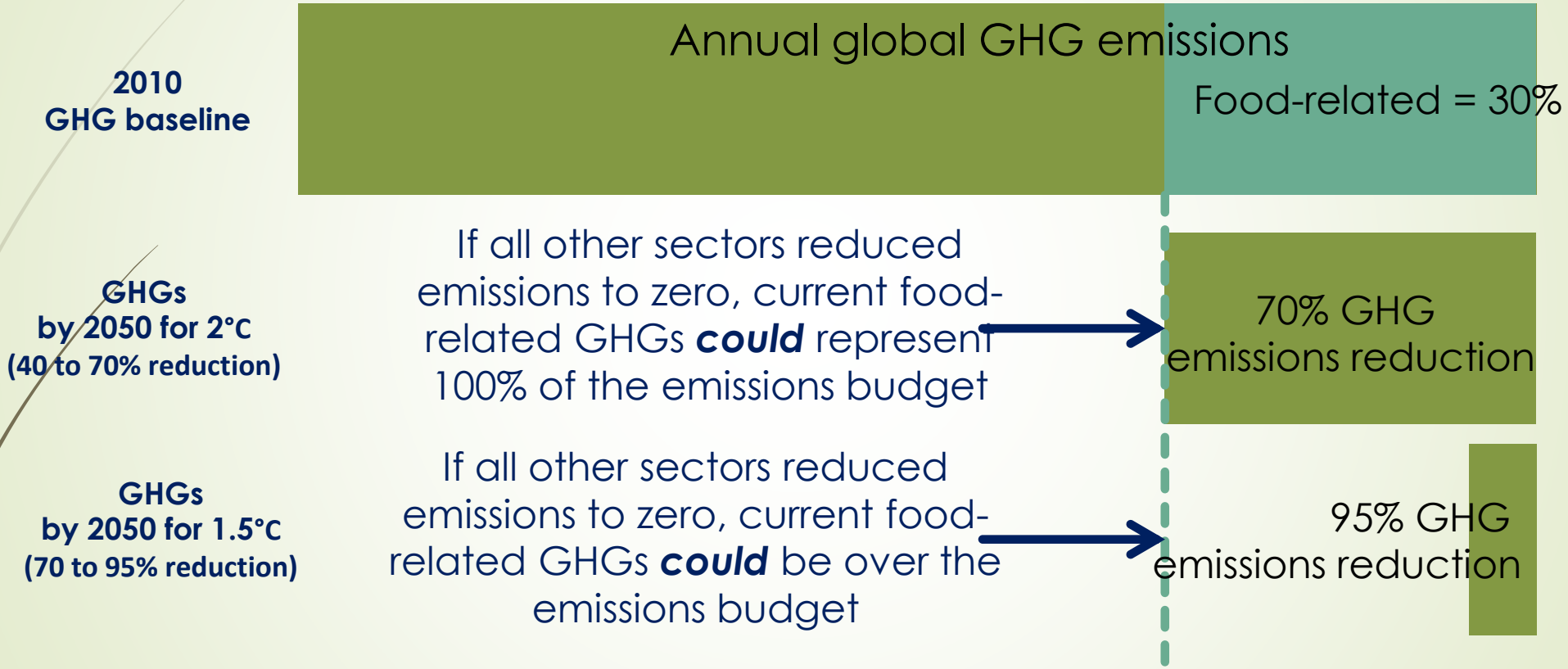
… and a major proportion of GHG emissions from 'OECD' food systems are not from agriculture.



Garnett, *FCRN*, 2009 Edwards et al., *Inst Agric & Trade Policy*, 2009 Pathak et al, *Ag, Ecosys & Env*, 2010

Paris agreement – and food



Vermeulen, S.J., Campbell, B.M., and Ingram, J.S.I. (2012) Climate Change and Food Systems. *Annual Review of Environment and Resources* 37 (1), 195–222
IPCC (2014): Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

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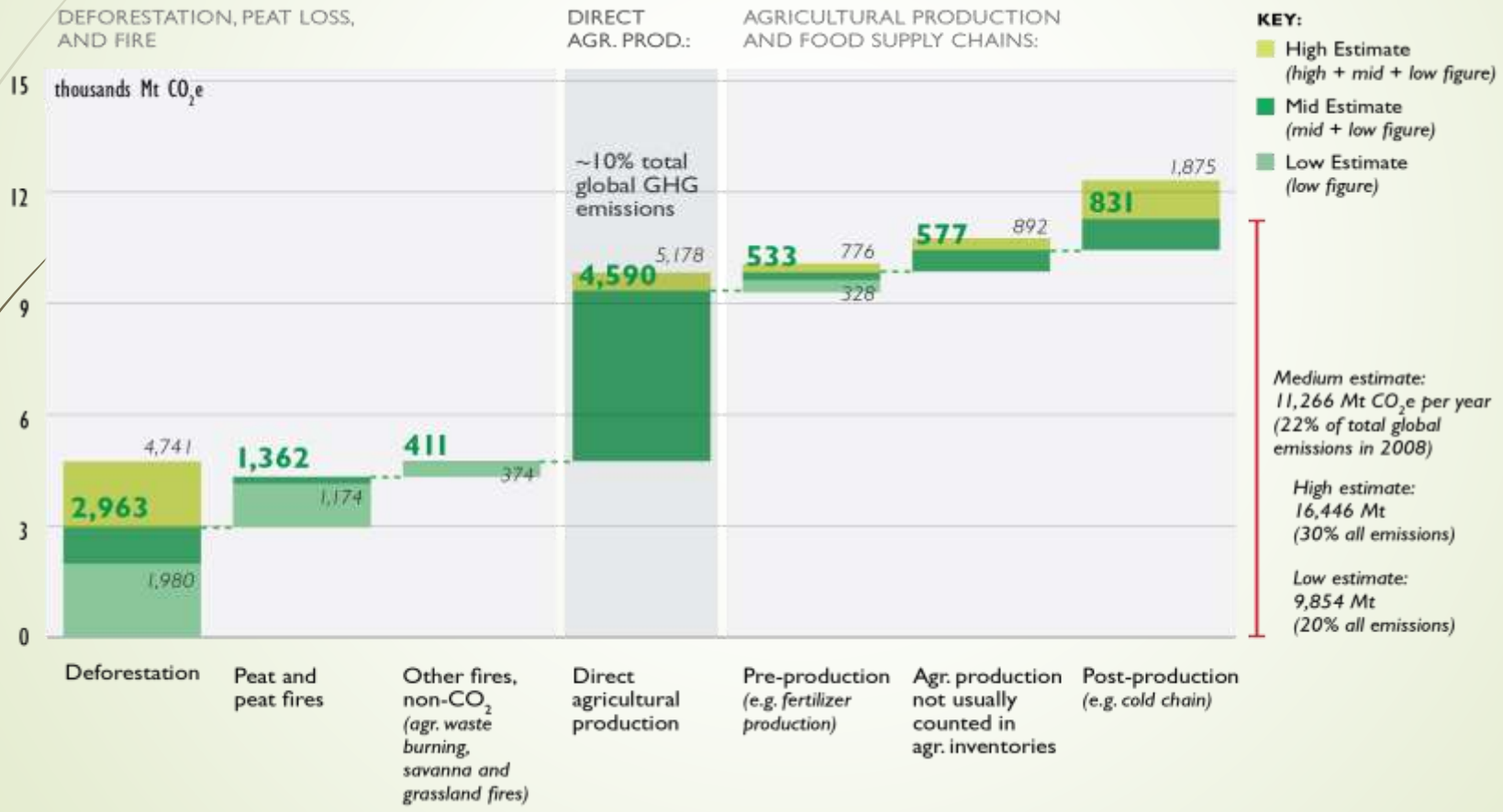
Greenhouse gas emissions from agricultural production and food supply chains total ~20% of emissions

Global agriculture and land use change emissions



Sources: FAOStat, EDGAR 4.2, FRA 2012, Harris 2012, Vermeulen 2012, and others.

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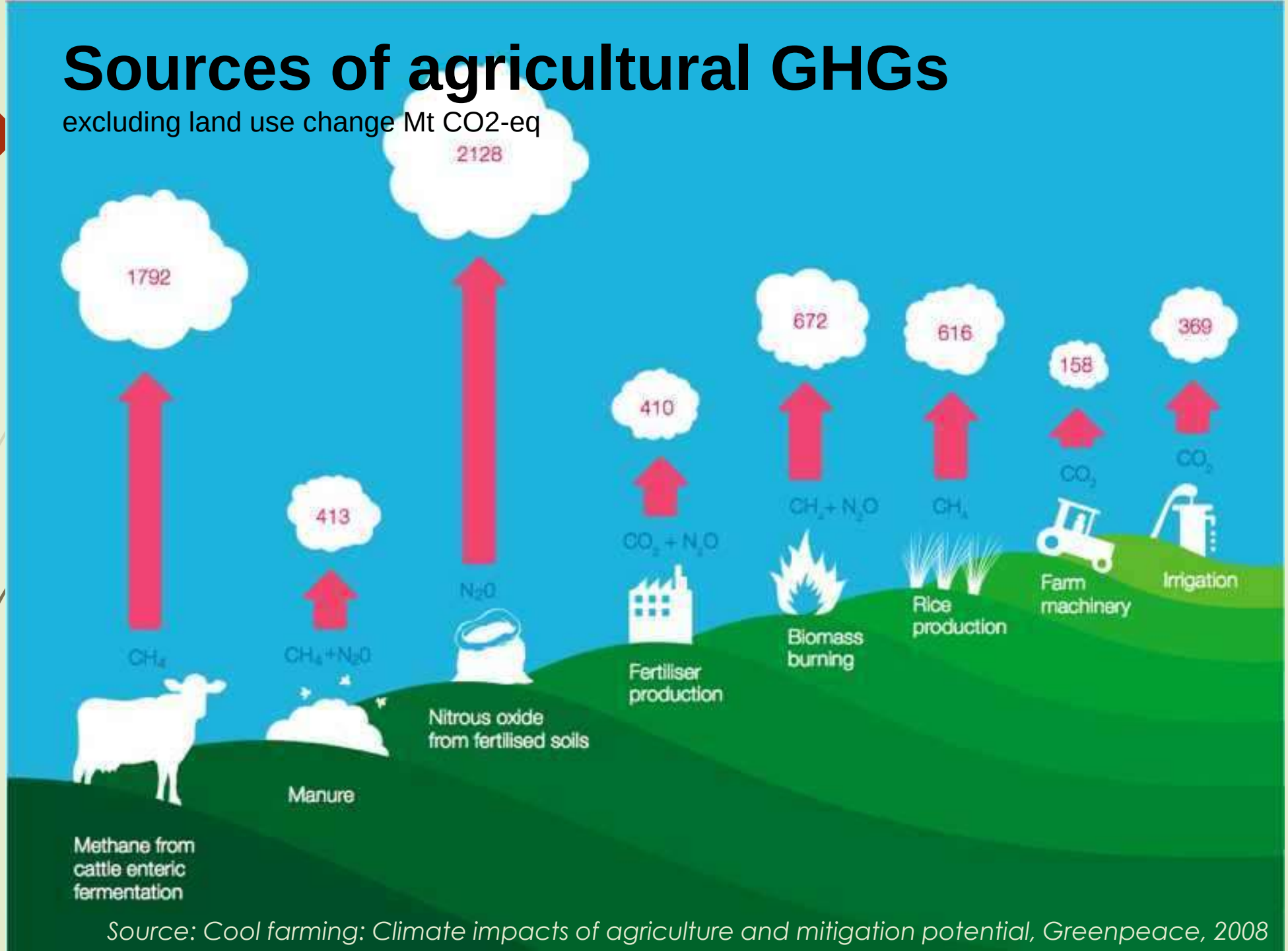
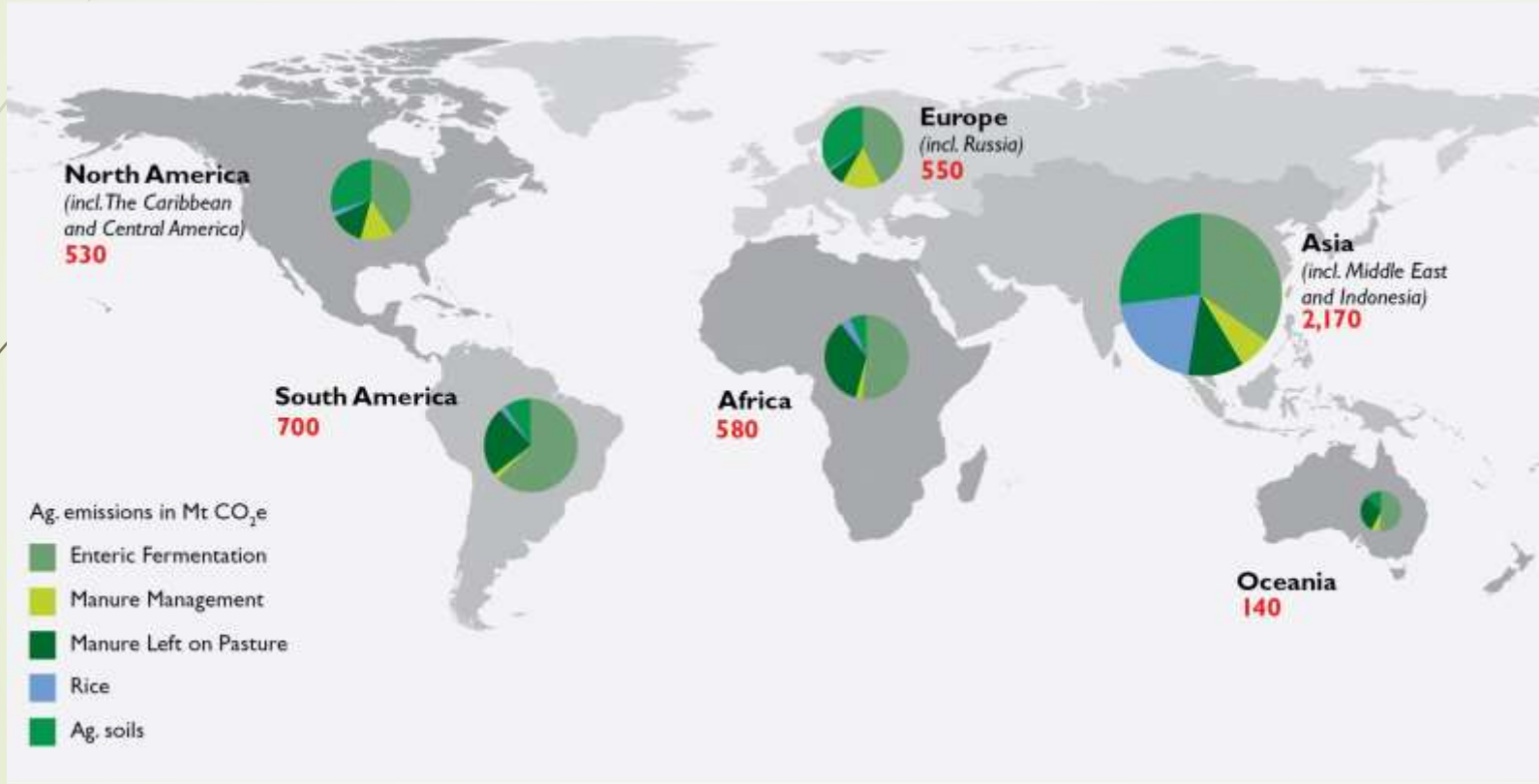
Sources of agricultural GHGs

excluding land use change Mt CO2-eq



Source: Cool farming: Climate impacts of agriculture and mitigation potential, Greenpeace, 2008

Direct agricultural emissions are spread across regions and across production sectors



Source: FAOStat data from 2010 (accessed 2013); area of pie charts scaled to regional emissions.

"Ag soils" includes synthetic fertilizers, manure applied to crops, field application of crop residues, and nitrous oxide from cultivated organic soils.

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The global Food and Nutrition security agenda

Goal: Sustainable Food and Nutrition Security

Insufficient cals Insufficient nutrs *currently ~ 1 billion*	Sufficient cals Insufficient nutrs *currently ~ 2 billion*	Sufficient cals Sufficient nutrs *currently ~ 3 billion*	Excess cals (incl. some with insufficient nutrs) *currently >2.5 billion*

Different, overlapping forms of malnutrition:
the 'new normal'

"Nearly every country in the world faces serious health problems linked to the consumption of either too little nutrient-rich food or too much energy-dense food."

Asia & Pac ~ 525m

SSA ~ 225m

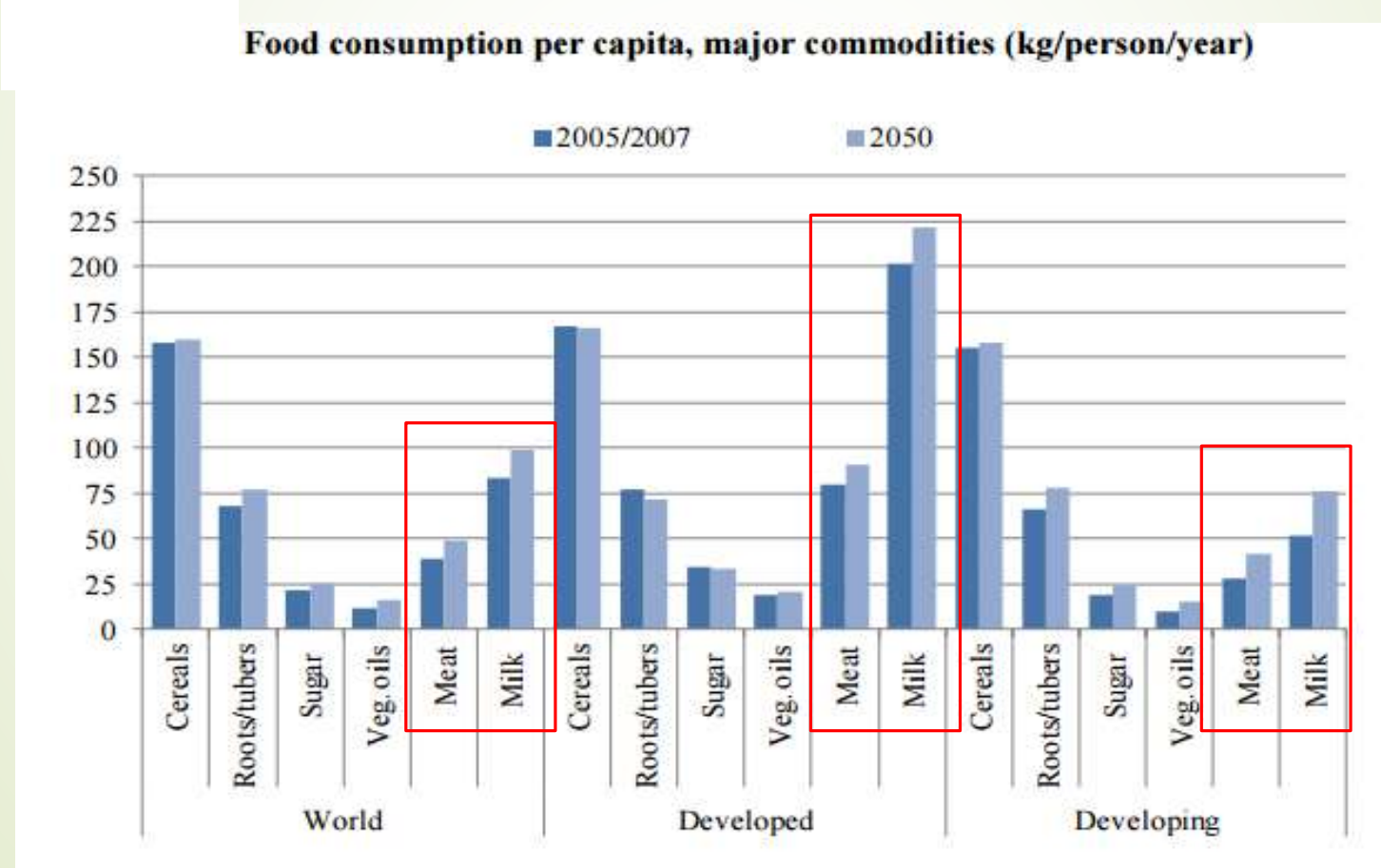
Global: 33% of adults are overweight or obese.

International Food Policy Research Institute, 2015

Food 'demand' is expected to rise substantially until 2050

if we don't do anything about it

more people eating more



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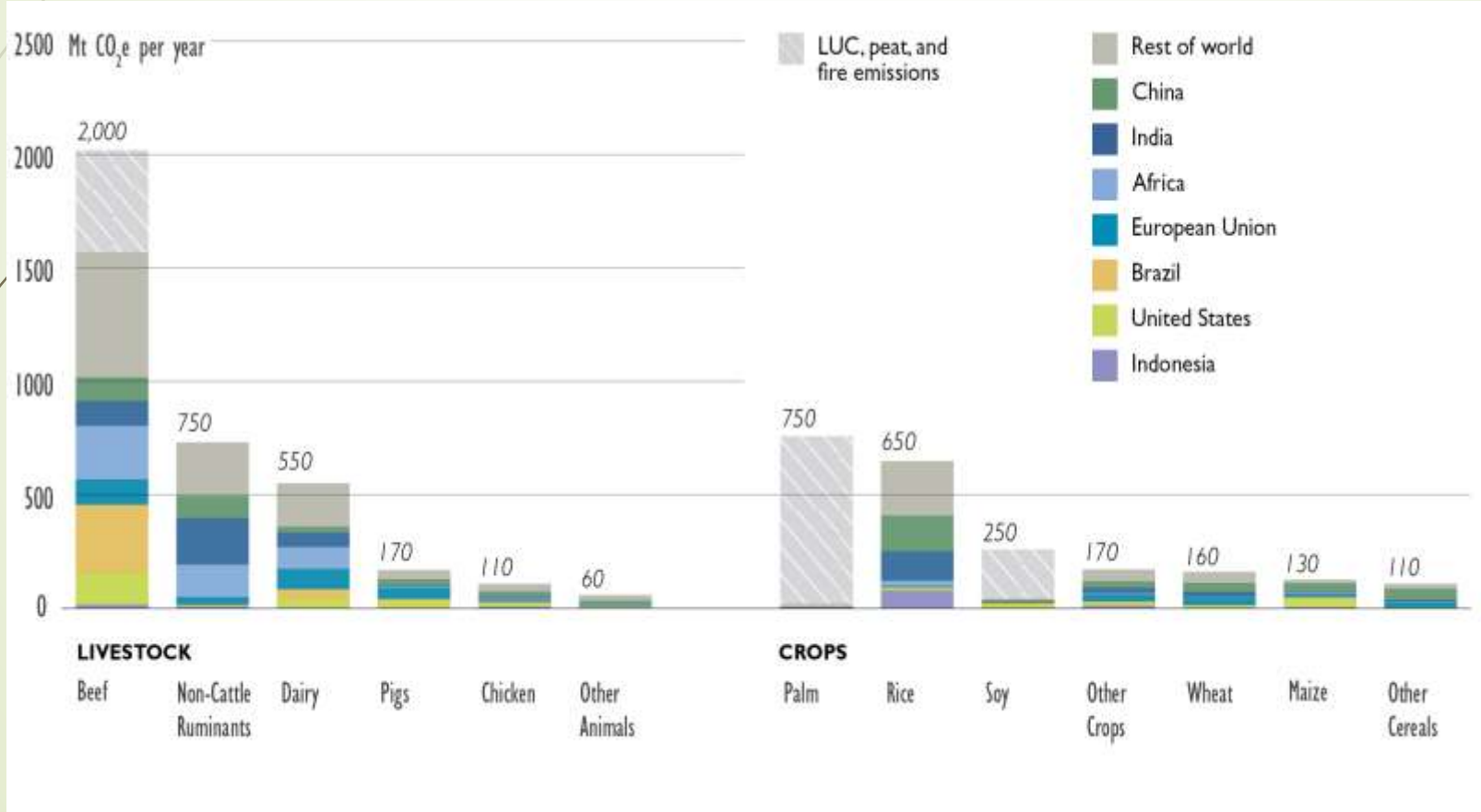
Alexandratos, N. and Bruinsma, J. (2012) *World agriculture towards 2030/2050: the 2012 revision*. ESA Working paper No. 12-03. Rome, FAO

Beef cattle and other ruminants dominate agricultural emissions

Beef, dairy, and other ruminant meat account for roughly two-thirds of direct agricultural emissions. Beef, palm, and soy are the largest agricultural-commodity drivers of land use emissions.



Source: FAOStat data 2008; Gerber et al. 2013; Paul West, Institute on the Environment, University of Minnesota

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What can we do about it?
An example: 12 Strategies for Philanthropy

Supply-Side Measures	Sustainable intensification
	Improving nitrogen fertilizer management and production
	Reducing Emissions from Enteric Fermentation
	Sequestering carbon in agricultural systems
	Reducing methane emissions from rice cultivation
	Managing manure
Demand-Side Measures	Reducing food wastage
	Shifting dietary trends
Cross-Cutting Measures	Subsidies and trade
	Finance and investments
	Corporate supply chains
	Tracking emissions in agriculture

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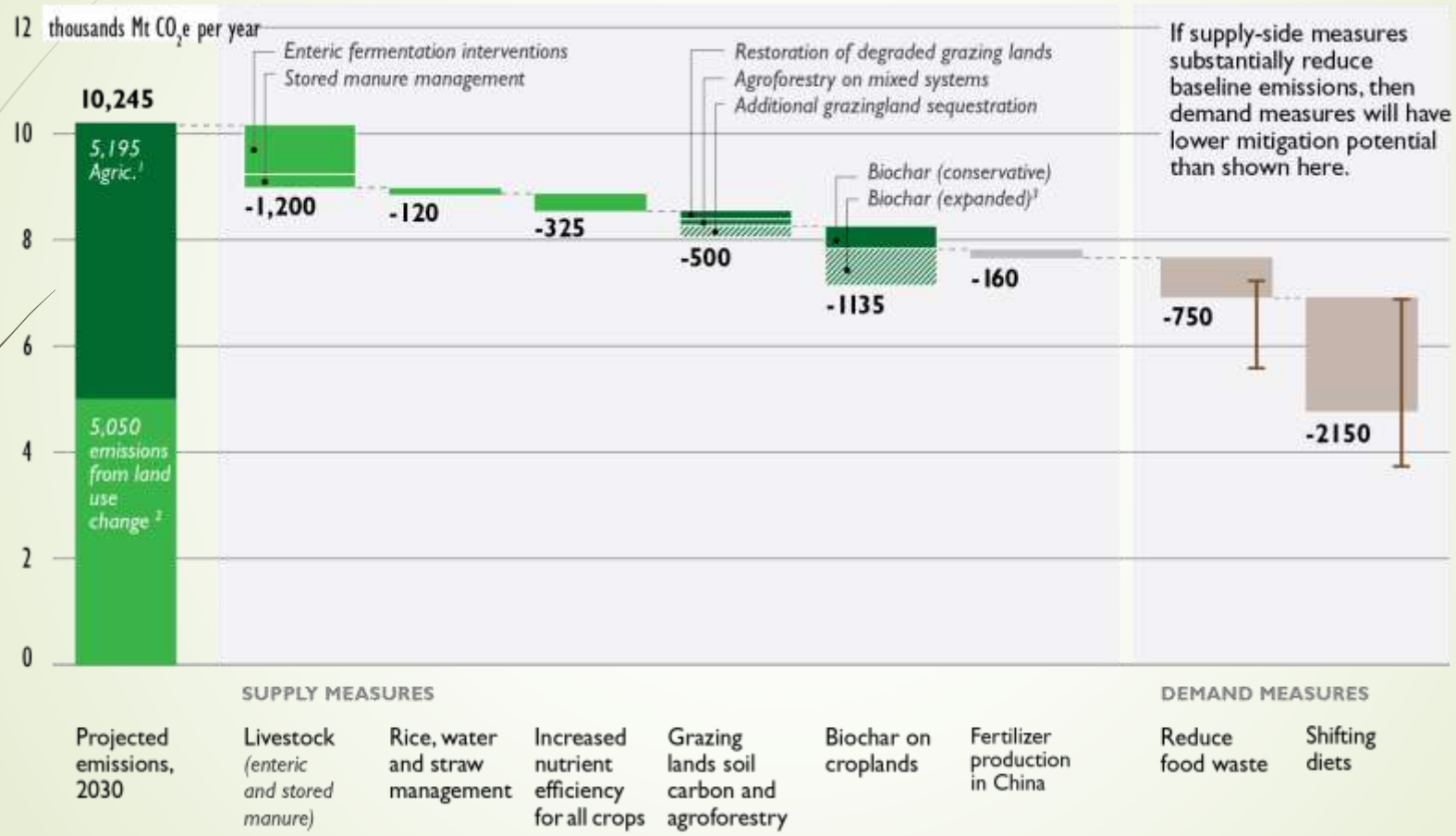
Technical agricultural mitigation potential in 2030

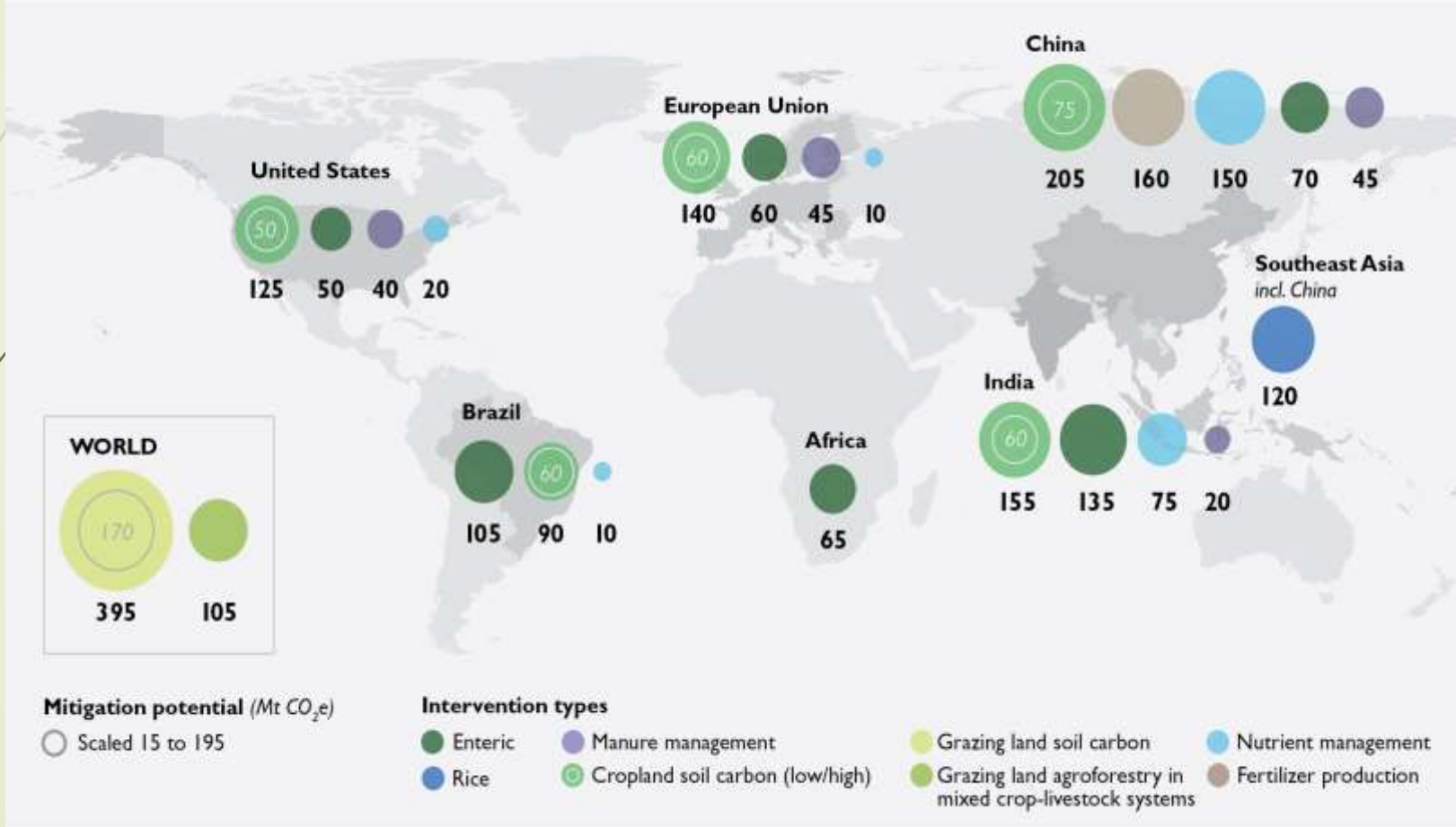
Note: This waterfall implies that all segments are additive. In fact, they are not and this analysis did not model mitigation potential, but rather looked at discrete opportunities statically.



Source: CEA analysis. See Annex 3 in the full report for methodology.

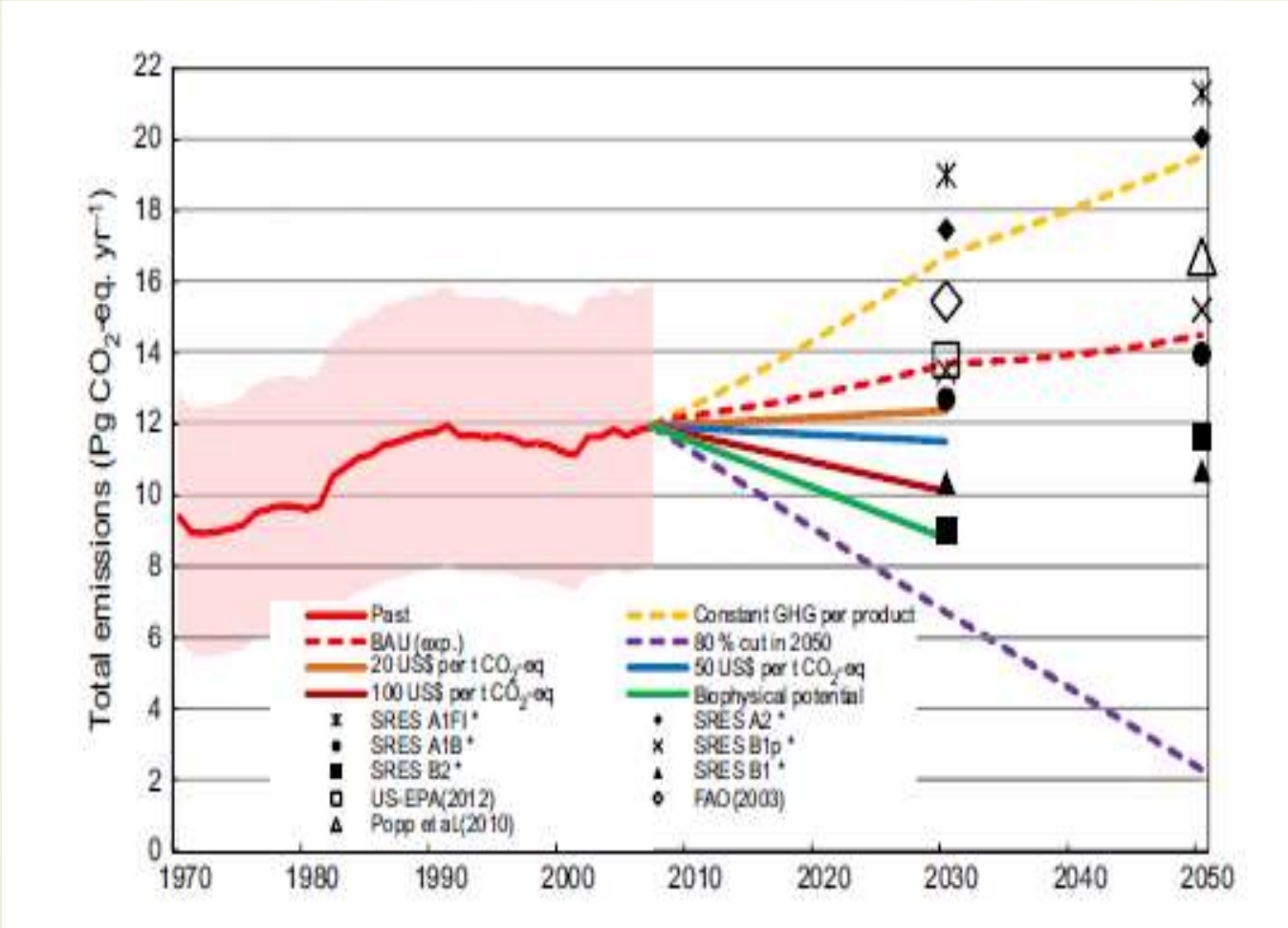
Agricultural Mitigation opportunities by country

Mitigation opportunities are clustered primarily in the major agricultural economies: US, EU, China, India, Brazil



Source: CEA analysis. See Annex 3 in the full report for methodology.

Range in estimated agricultural mitigation potential is enormous – risky to rely.
Nothing gets you to an 80% cut.



Bennetzen E H, Smith P and Porter J R (2016). Decoupling of greenhouse gas emissions from global agricultural production: 1970–2050. Global Change Biology, 22, 763–781, Doi: 10.1111/gcb.13120

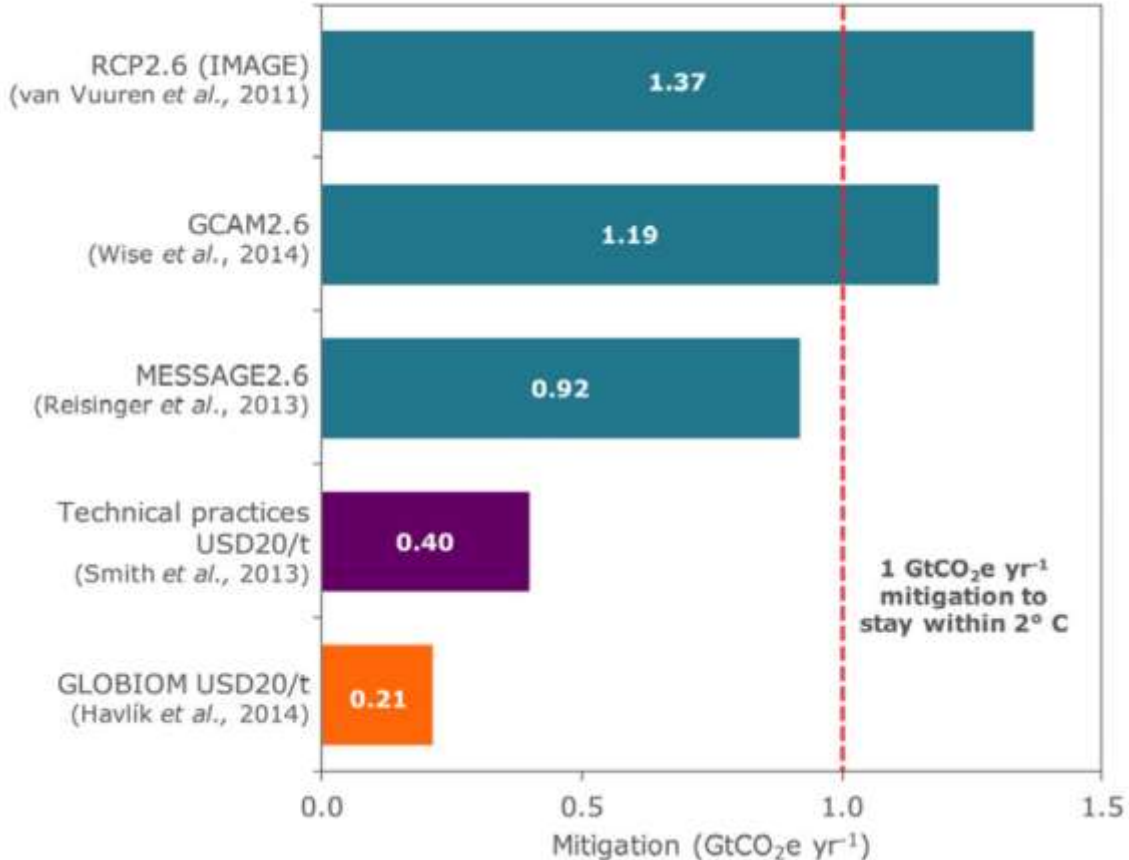
A target for agriculture?

- Potential target for agriculture (not the whole food system) from CH4 and N2O to reach the 2C target proposed at

  ~1 GtCO2e/yr by 2030

- BUT: '…. plausible agricultural development pathways with mitigation co-benefits deliver **only 21 to 40 % of needed mitigation'**

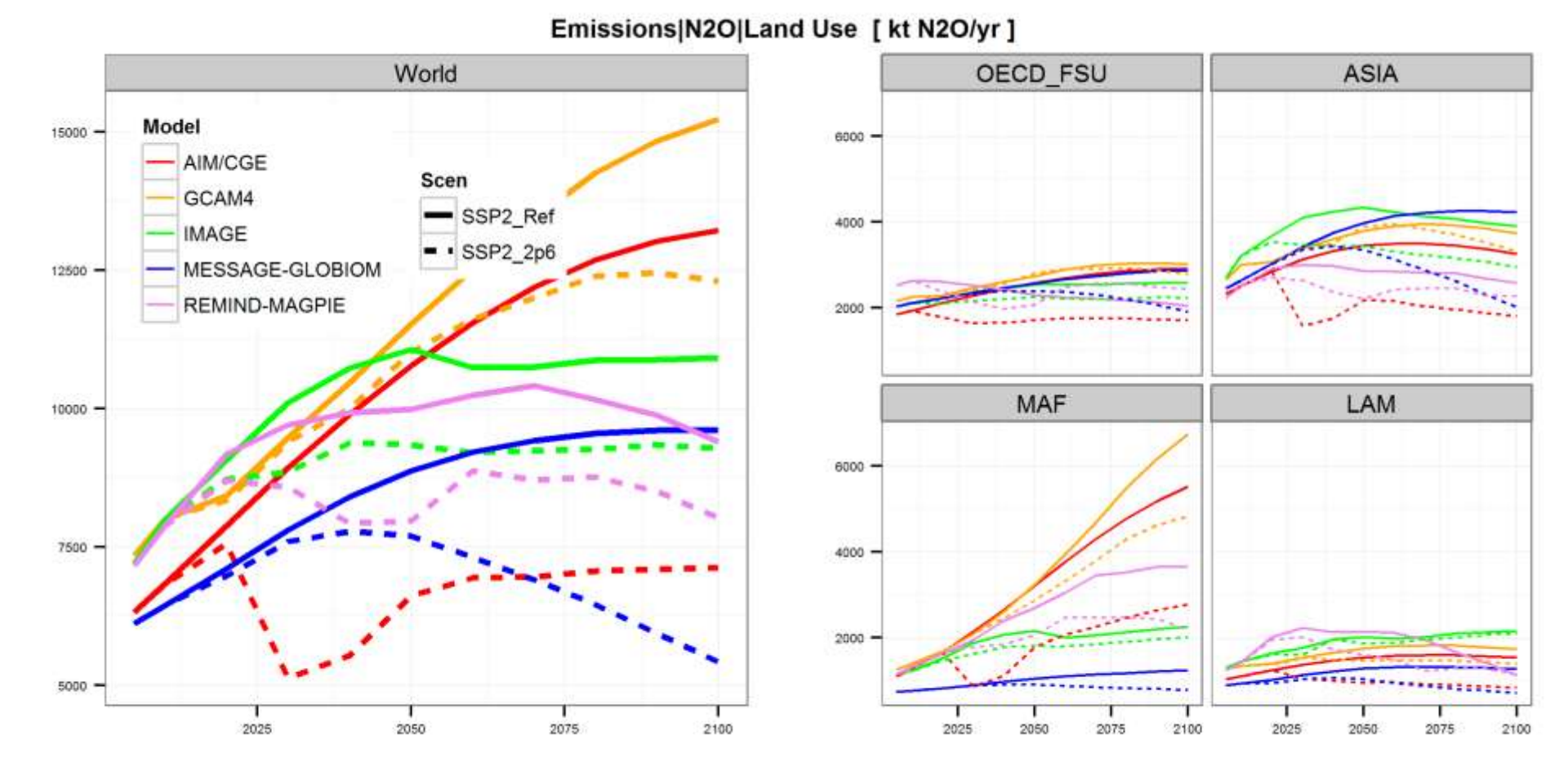
- And: What about the **trade-offs** with food security and adaptation goals for the agriculture and food sector?



Wollenberg, E., Havlik, P. et al (2016) Running ahead: A 2 C target for agriculture, accepted in Global Change Biology

AgMIP community gearing up for more land use work, but…

Direct non-CO2 emissions (intensity) to be reduced



Four overarching recommendations

1) Shift consumption patterns

- Diets
- Food waste
- (Biofuels)

~ 3 Gt CO_2e per year

2) Reduce direct emissions

- Cattle/grazing lands in Brazil
- Dairy cattle/feed efficiency in India
- Fertilizer on croplands in China
- Rice in Southeast Asia
- Managing manure

~2 Gt CO_2e per year

3) Pursue catalytic, cross-cutting interventions

- Financing standards
- Corporate supply chain transparency
- Agriculture trade issues (WTO, UNFCCC)
- Reform of major subsidy programs

No CO2e estimate

4) Support carbon sequestration, but not in lieu of other mitigation opportunities

- Explore synergies in SSA and Brazil
- Invest in better data
- Make long-term investments (biochar)

~0.7 – 1.6 Gt CO2e per year

Lower impact but unhealthy

- Mainly grains (except rice), tubers & legumes
- Low in nutrient rich foods e.g. fruits, vegetables & animal products
- Lacking diversity
- Low waste & energy but high risk storage & cooking practices

Poor in poor countries

Healthy & lower impact

- Eat enough – but not too much
- Eat more tubers, whole grains, fruit and vegetables (mainly field grown, resistance to spoilage, and not requiring energy-intensive transport)
- Eat meat sparingly, if at all – and all of it
- Dairy products in moderation or fortified replacements
- Unsalted seeds and nuts
- Small quantities of fish from certified sources
- Limit processed foods high in fats, sugars and salt
- Don't waste food & cook efficiently

Better?

High impact & unhealthy

- High in animal products
- Low in vegetables and fruits
- Low in grains & tubers
- High in energy & fat dense, nutrient poor processed foods
- High waste & inefficient cooking

Rich & emerging economies

Healthy but high impact

- Moderate levels of lean meats
- High impact vegetables and fruits (e.g. air freighted produce & hothoused 'ratatouille' vegetables & salads
- Fish consumed from unsustainable stocks
- Chilled fresh food produce
- Inefficient cooking & high waste

The wealthy healthy

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Key questions for the food system:

1) Given the current mix of sources of GHGs, what could and should be the contribution that global food systems make to reach the 1.5degrees C target?

2) Based on possible contributions of the agriculture and food sector, what are the best, local to global strategies to achieve the emission reductions, or even help to sequester carbon, that also have the potential to contribute to achieving a food and nutrition secure population?

→ Little work done so far on mitigation pathways to 1.5 degrees C by the agriculture and food community

A nested scenario exercise on possible transition pathways to a low emissions global food system – in preparation

- *Phase 1*: Global scenarios exercise on the role of agriculture and food systems in reaching the 1.5 degree C climate target and its implications for the food sector.

- *Phase 2*: Regional and local scenarios exercises, based on the scenarios and options developed in Phase 1, on pathways to achieve emission reductions in agriculture and food systems for reaching the 1.5 degree C climate target.

- **Participation of key stakeholders from governments, agricultural and food industry and civil society is essential**

Thank you!

Monika.Zurek@eci.ox.ac.uk

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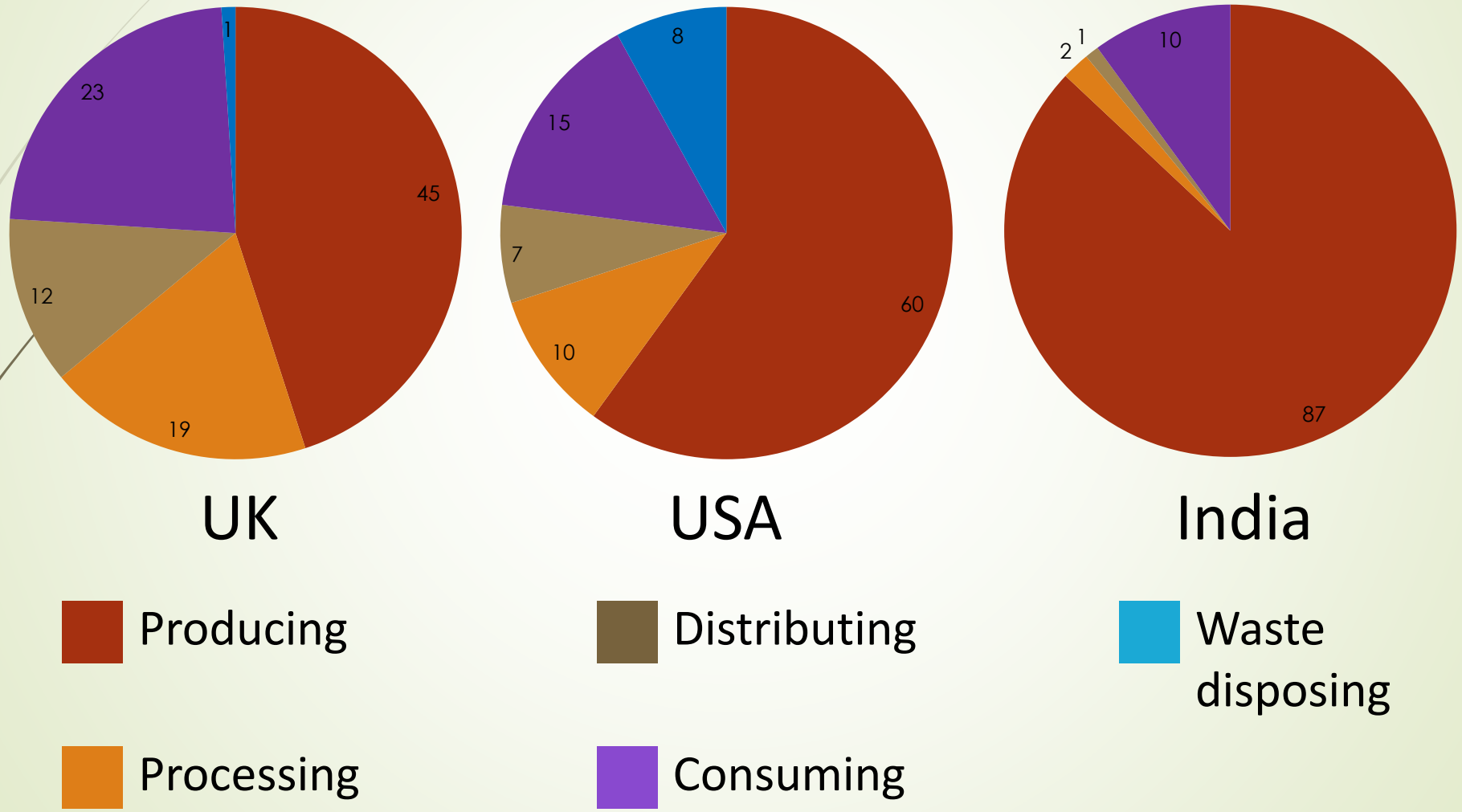

Garnett, *FCRN*, 2009 Edwards et al., *Inst Agric & Trade Policy*, 2009 Pathak et al, *Ag, Ecosys & Env*, 2010

Hence, the global food system will be asked to contribute to the ambitious targets in several ways:

- Reduce greenhouse gas (GHG) intensity of the production (emissions per unit produced);
- Carbon sequestration in soils ;
- Sustainable intensification to free up land for afforestation and biomass for energy production;

- Shifts towards more sustainable diets (less and better calories) leading to lower production levels and changed production overall;
- Reduction of losses and wastes across the supply