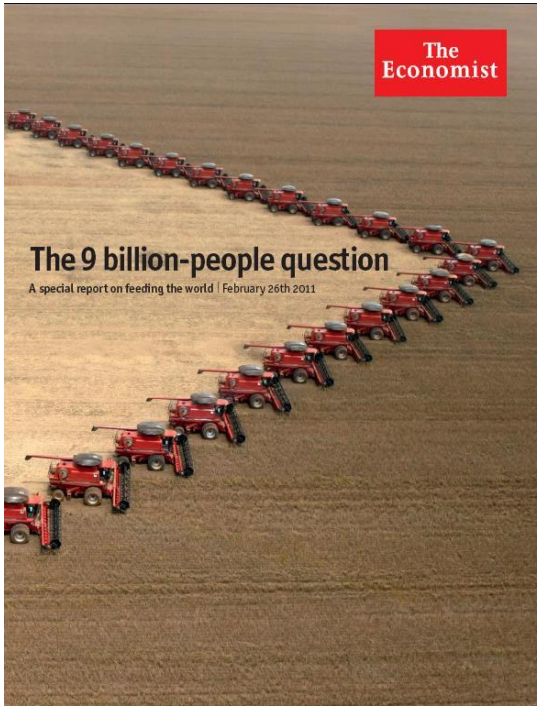
Feeding the 9 billion

BIEE Parker Seminar

March 14 2012

Lord Krebs Kt FRS

Committee on Climate Change



Is there a problem?

1.8 billion people are overweight or obese

1.8 billion people are short of calories or essential nutrients

Peaky

2

The Economist commodity-price index, food*

Source: *The Economist*

*2005=100

Feeding the world in 2050

6000 extra mouths per hour

‘Nutritional transition’ from vegetarian to meat

Energy supply

Depletion of water and other resources

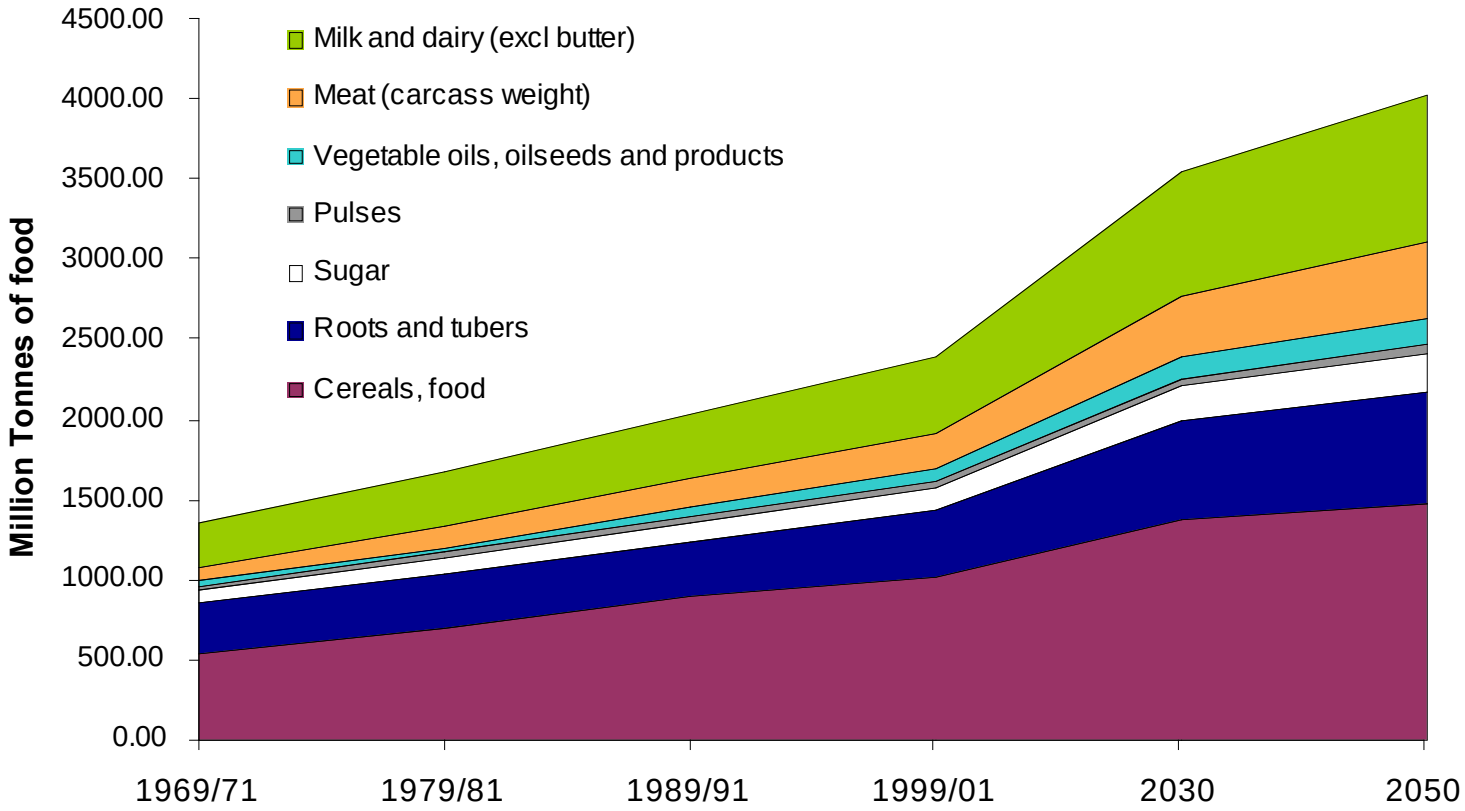
Climate change: mitigation and adaptation

Biofuels

Increased demand for food

World food production must rise by **50 % by 2030** to meet increasing demand (*Source*: *UN 2008)*

World food requirements



1960-2000, world population doubled, but food per person increased by 25% : the *Green Revolution*

Breeding, agrochemicals, irrigation, mechanisation

Dramatic increase in yields since 1960s. Mainly in East Asia and S America, not Africa

But

Rate of improvement slowing down

Not sustainable: pollution, water extraction, loss of biodiversity, energy intensive

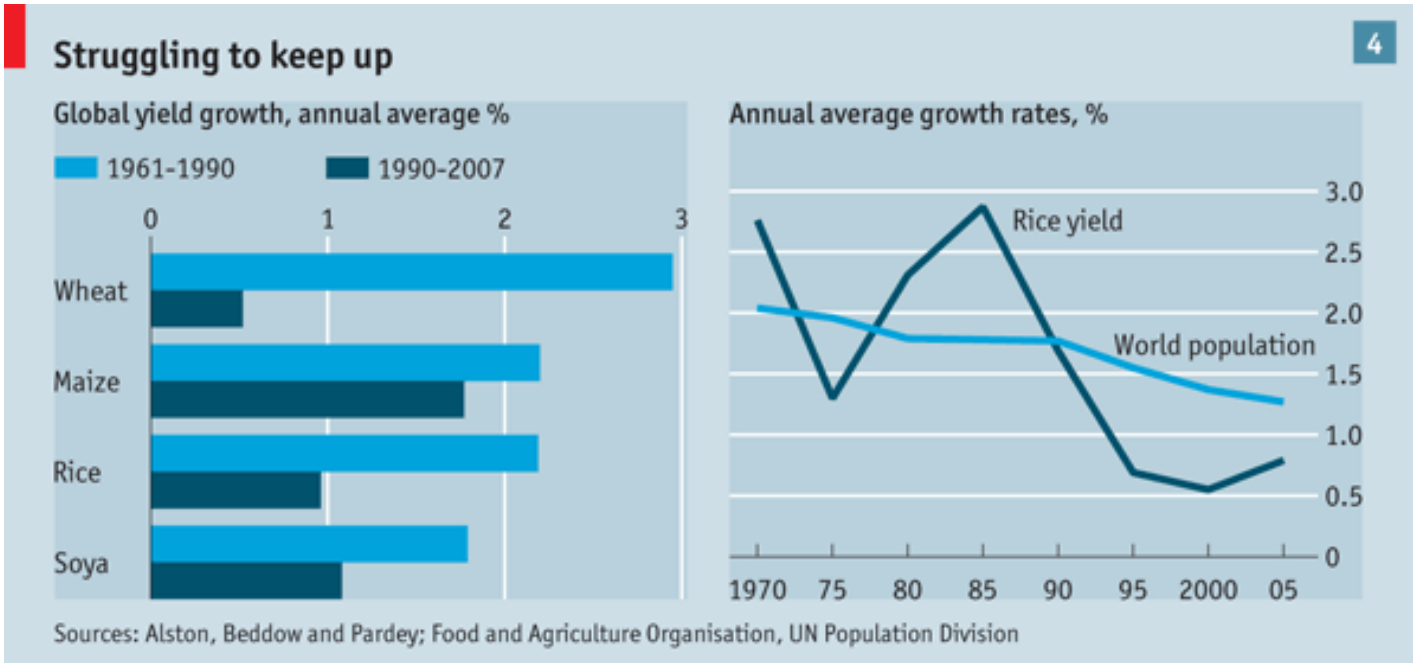
Wheat: then and now

“whoever could make two ears of corn, or two blades of grass, grow upon a spot of ground where only one grew before would do more essential service to his country than that whole race of politicians put together” Gulliver’s Travels

Norman Borlaug

Pieter Brueghel the Elder

The gains of the green revolution have slowed down



The green revolution:Asia versus Africa

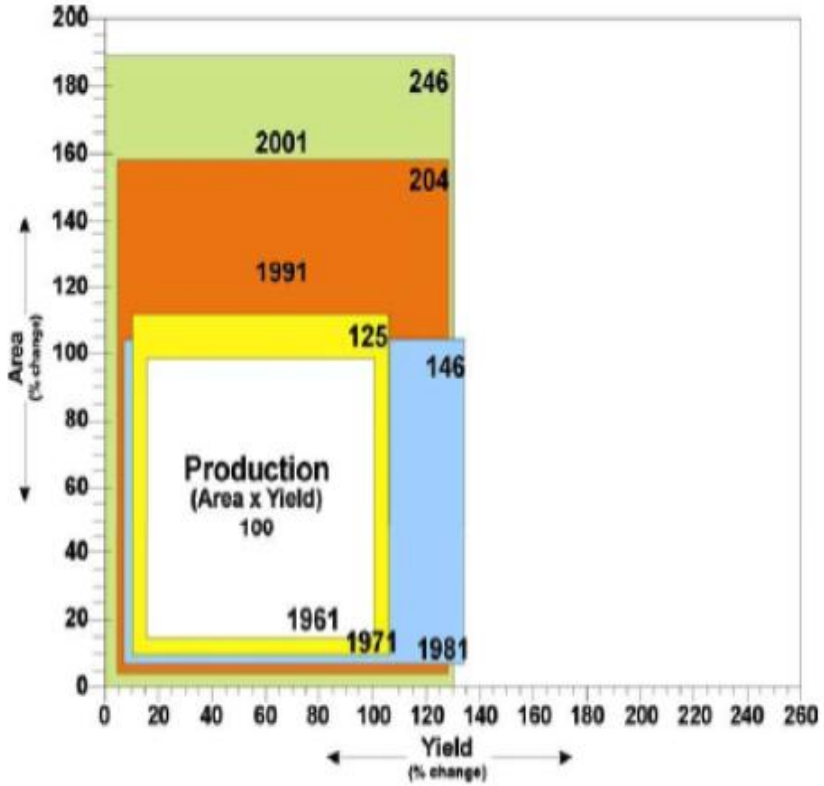


Figure 1. Changes in Cereal Production in Sub-Saharan Africa Due to Changes in Area and Yield (1961 = 100)

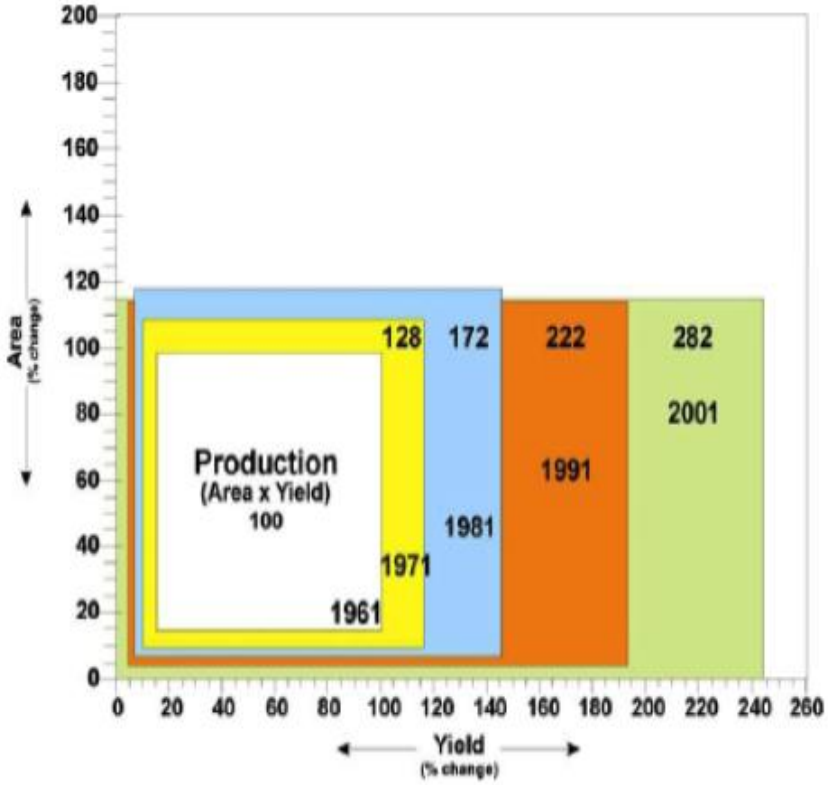
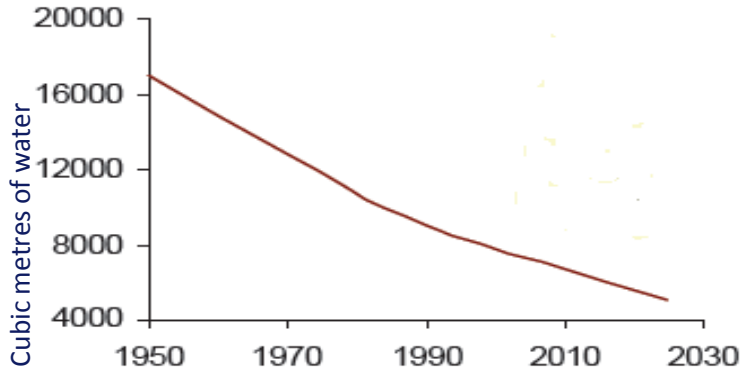


Figure 2. Change in Cereal Production in Asia Due to Changes in Area and Yield (1961 = 100)

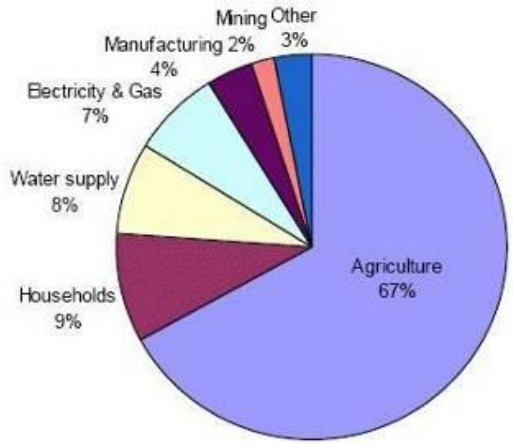
Source: NRC, 2008/Henoa and Baanante 2006

Availability of fresh water

Fresh water availability per head of world population



Source: UNEP, 2002



Source: ABS 2005

1 in 3 people are already facing water shortages

Source: Comprehensive Assessment of Water Management in Agriculture 2007

Total world water demands are predicted to increase by **over 30% by 2030**

Source: IFRPI

Where next?

The ‘doubly green revolution’

Sustainable intensification:

improved yields

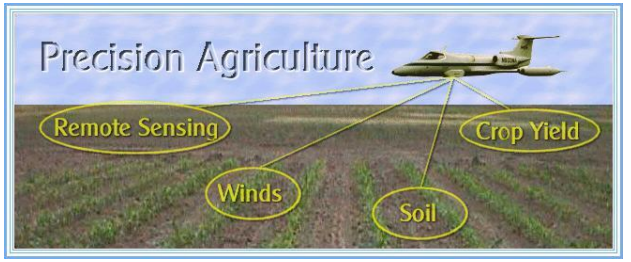
less environmental impact

less energy and other resource intensive

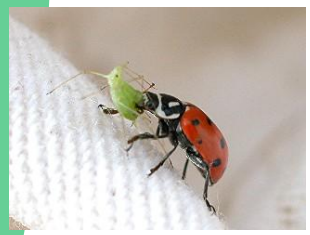
Sustainable intensification

Closing the yield gap with existing technologies

New technologies (GM, ICT, GPS)



Socio-political change



Ecological knowledge

Genetically modified crops

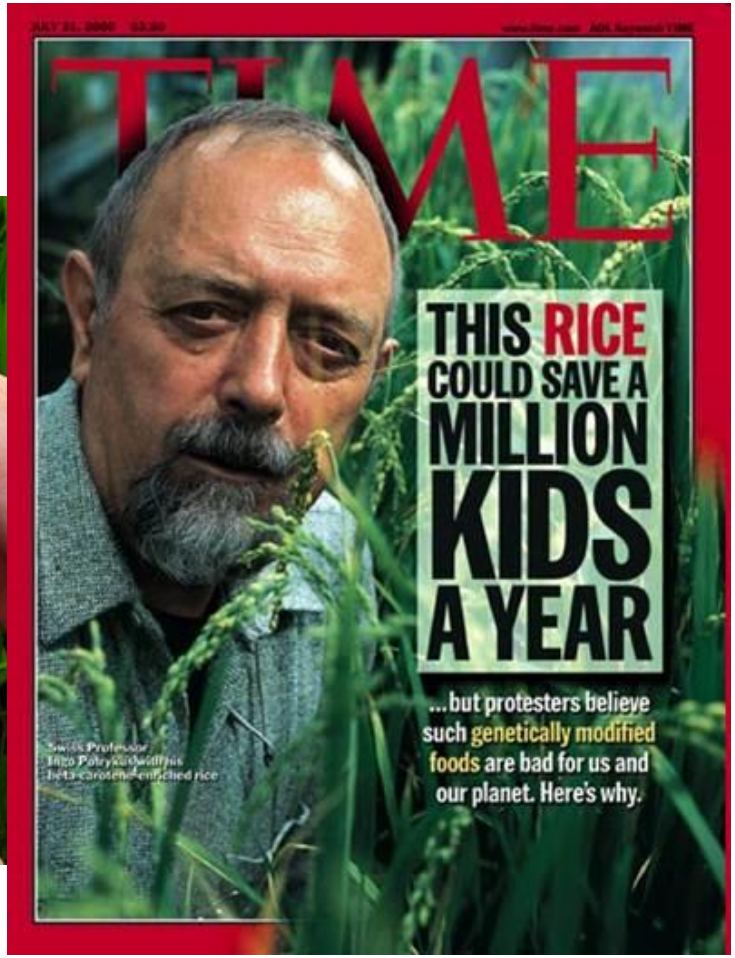
Not a ‘magic bullet’

But could play an important role:

- reduce use of agrochemicals
- drought/salinity/disease resistance
- better nutritional value

[77% of world’s soya, 85% of US maize is GM today]

Golden rice: contains beta-carotene, could help prevent blindness



Are GM foods ‘safe’ to eat?

Daily Mail
06 February 2002

FRANKENFOODS
The truth at last

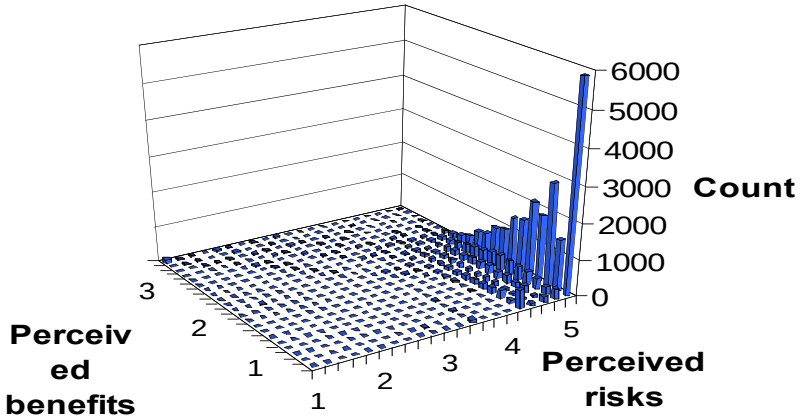
Metro
05 February 2002

GM food tests must be tougher, warn experts

British scientists turn on GM food

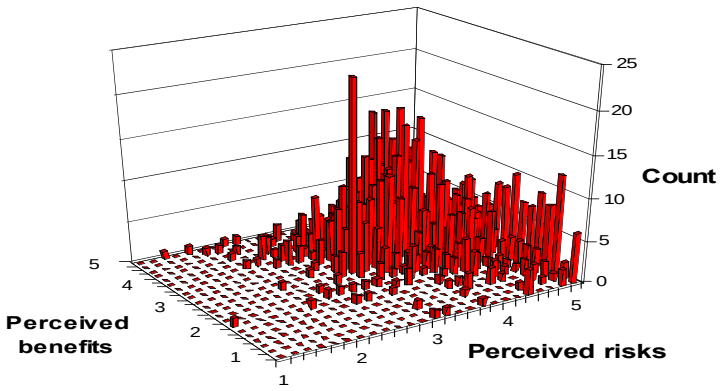
Financial Times

GM Food and Crops: Perceived Risks and Benefits



GM Nation?

(36,557 responses)



UEA/Mori (1,363 respondents)

GM Labelling

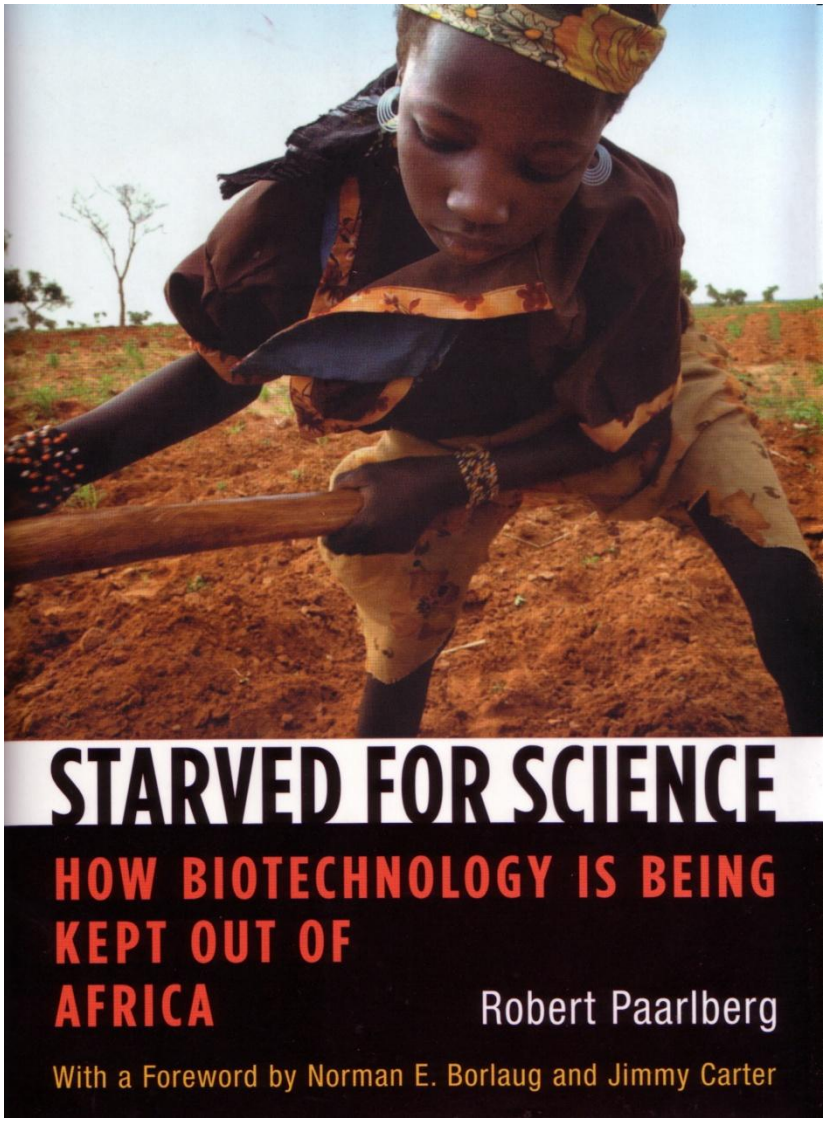
Label

- GMOs (e.g. soya beans, sweet corn)
- GM Derivatives (e.g. soya flour, maize flour, oils, cornstarch etc)

Don't label

- Products of GM technology (e.g. hard cheeses, animals fed on GM feed)
- < 0.9% inadvertent GM content

Global inequalities



"Many governments in Africa today, out of deference to European example, have driven GM foods and crops out of their own markets by adopting European style regulatory approaches"

Paarlberg 2008

Starve rather than accept GM maize as food aid

"Simply because my people are hungry, that is no justification to give them food that is intrinsically dangerous to their health"

President Levy Mwanawasa of Zambia (2002)

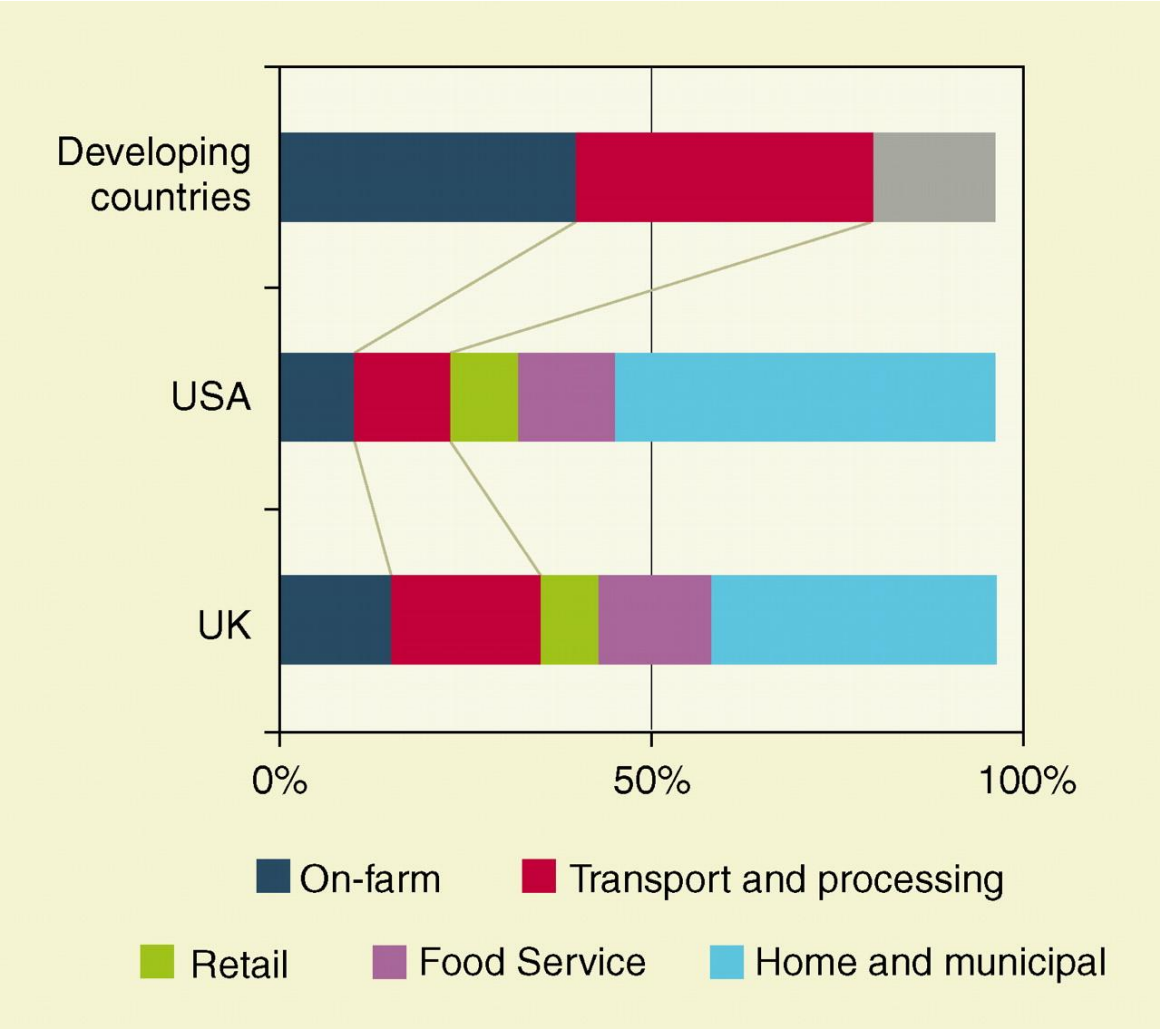
Decline in support for agricultural development in 20 years to 2003 (% bilateral aid)

USA	25	1
UK	11.4	4.1
France	8.5	2.2
Germany	9.1	2.9

source: Paarlberg 2008

Other contributions: reducing waste; redistribution

Fig. 3 Makeup of total food waste in developed and developing countries.



H C J Godfray et al. Science 2010;327:812-818

Published by AAAS

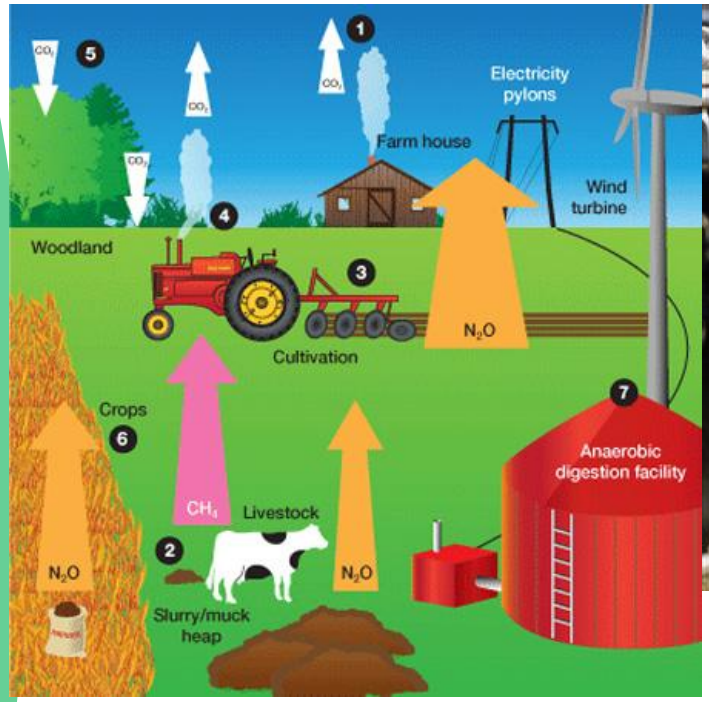
UK food waste

16 mt food and drink wasted per year

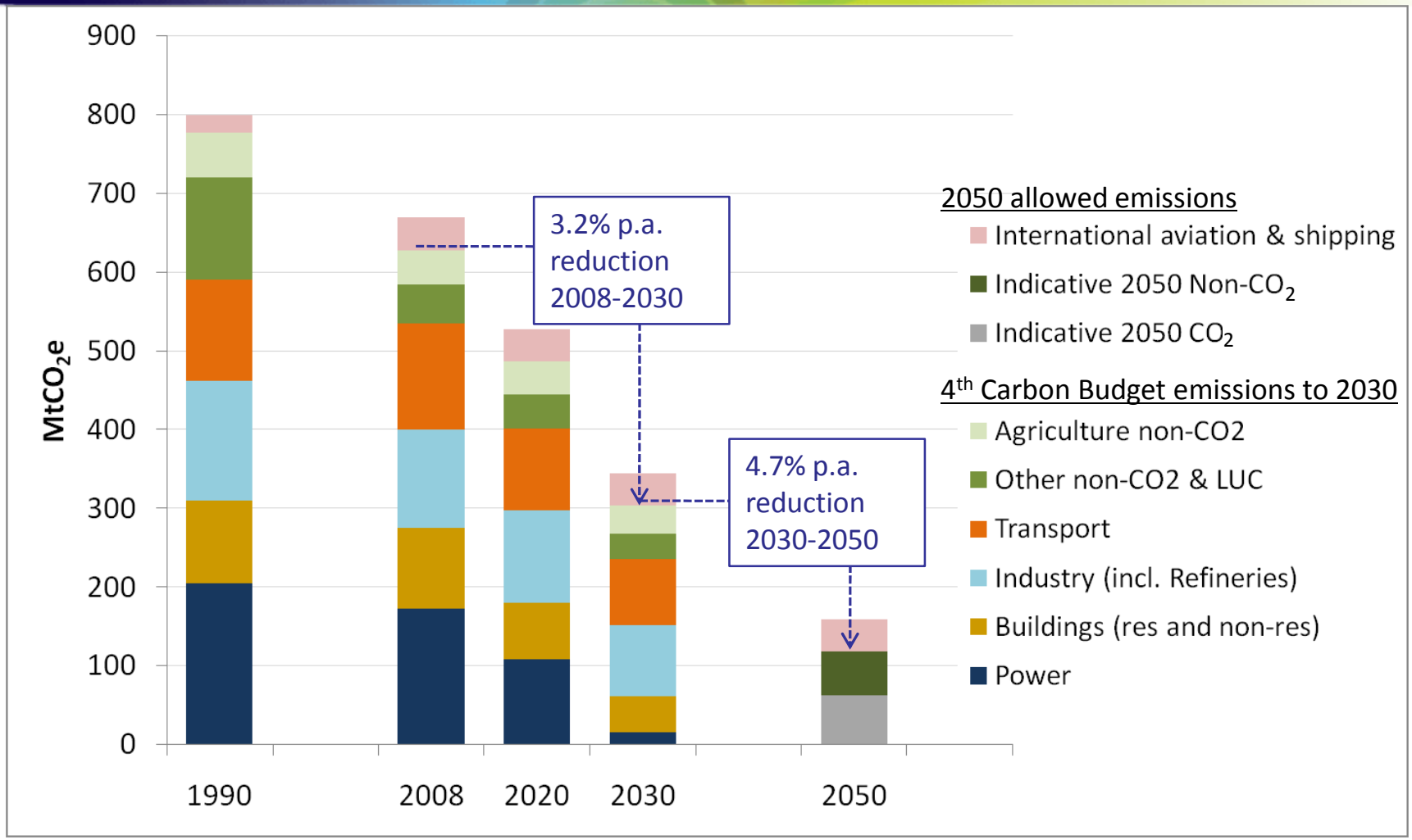
8.3 mt by households, of which 5.3 mt is avoidable (WRAP estimate)

(equivalent to 6.5mt CO_2e from UK agriculture)

Reducing greenhouse gas emissions from agriculture



Large emissions reduction needed to 2050



Source: CCC (2010) The Fourth Carbon Budget

GHGs in the UK food chain (total in 2006 = 160mt CO_2e)

25% Net trade (net imports, excluding transportation)

3% Prefarm (fertiliser, pesticides & machinery production)

33% Farming and fishing

13% Households (shopping, storage and preparation)

3% Catering (hotels and restaurants)

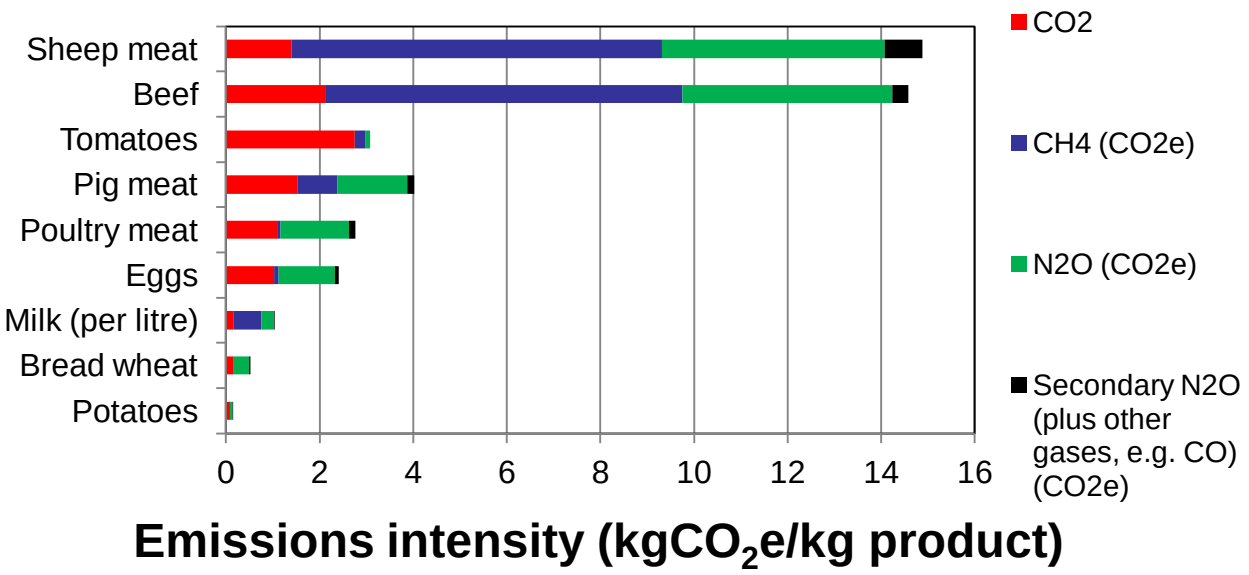
6% Retail

9% Commercial transportation (UK and overseas)

8% Manufacturing

[*Excludes waste, packaging, hot water in home*]

Should we become vegetarians?



Summary

1. Feeding the world in 2050 is a major challenge
2. Inequalities in nutrition are part of this challenge
3. Don’t through any tools out the tool box
4. Simultaneously tackle climate change
5. Some current trends are in the wrong direction

Reducing emissions from UK agriculture

Agricultural emissions are currently 8% of the UK total

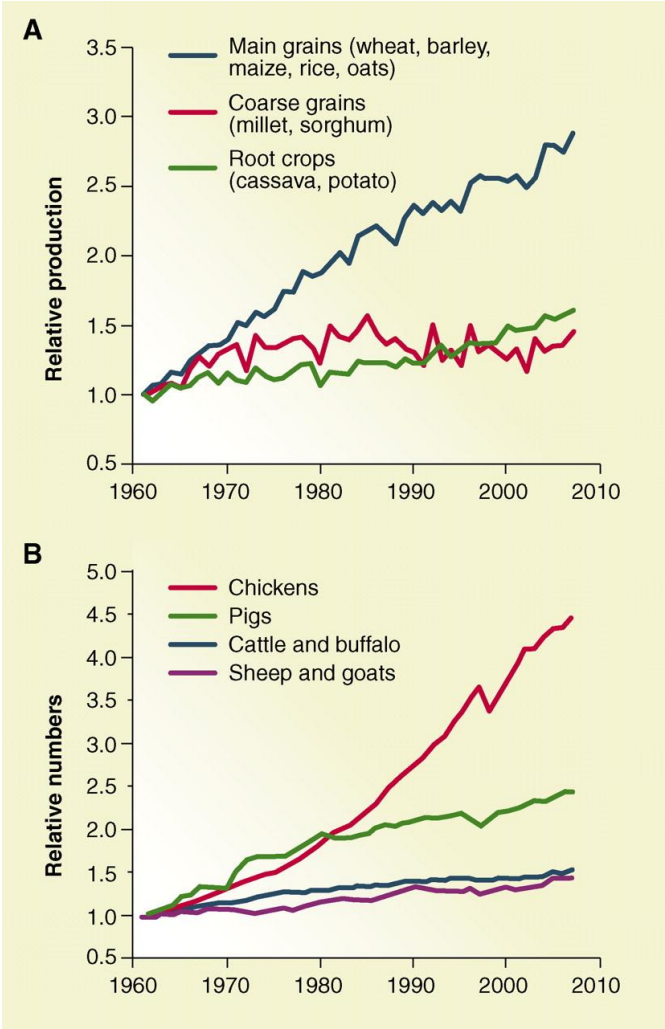
Agriculture will account for 28% of permitted 2050 emissions, if left unabated

It is possible to reduce emissions by 18% by 2030

70% of abatement potential will also increase farmers profits

Agricultural emissions could be up to 40 $MtCO_2e$ in 2030 if left unabated

Fig. 1 Changes in the relative global production of crops and animals since 1961 (when relative production scaled to 1 in 1961).



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Biotechnology can help provide solutions

Current losses due to pests and diseases worldwide

Plants grow in an oasis next to the desert in Dunhuang, Gansu province

- Genomics to provide targeted and predictive non-GM plant breeding (e.g. for yield, sustainability, quality)
- GM may also provide future solutions, notably for improved drought and saline tolerance; and resistance to pests and disease

Feeding 9 Billion people in 2050: do we need GM food?

800 million go hungry today, similar number suffer from vitamin deficiency

By 2050 the world will need 70% more food than today

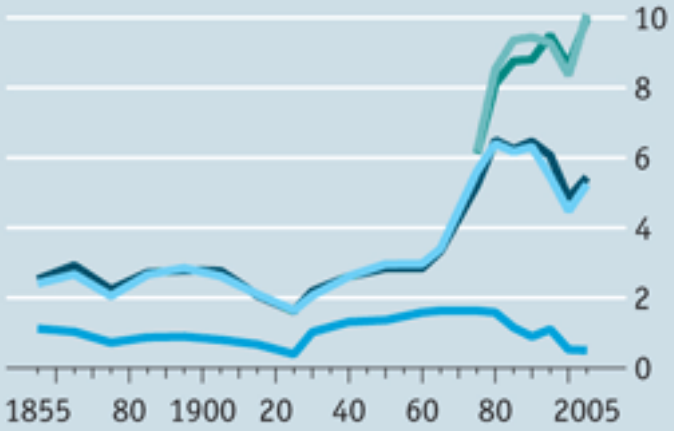
Why? More people, eating better diets

Fertile ground

1

Broadbalk average wheat yields

Tonnes per hectare



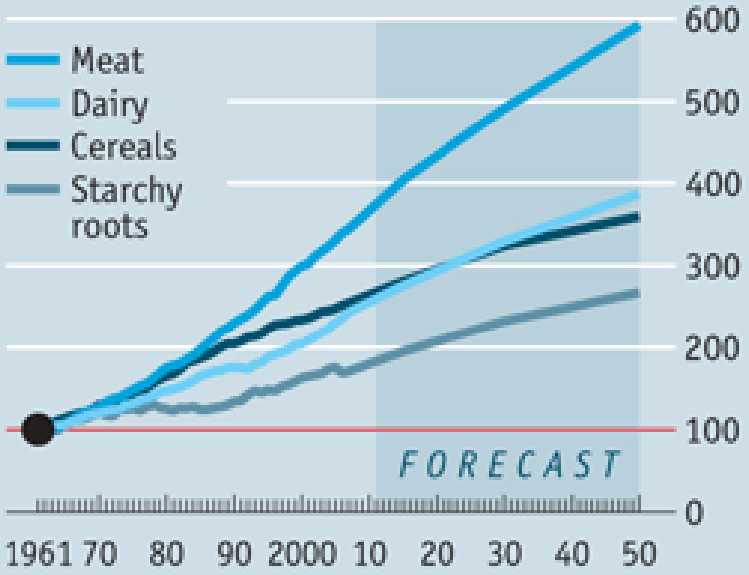
Source: Rothamsted Research

*With too little nitrogen †For maximum yield ‡Plus spring nitrogen

Meat on the menu

3

Global food demand, 1961=100

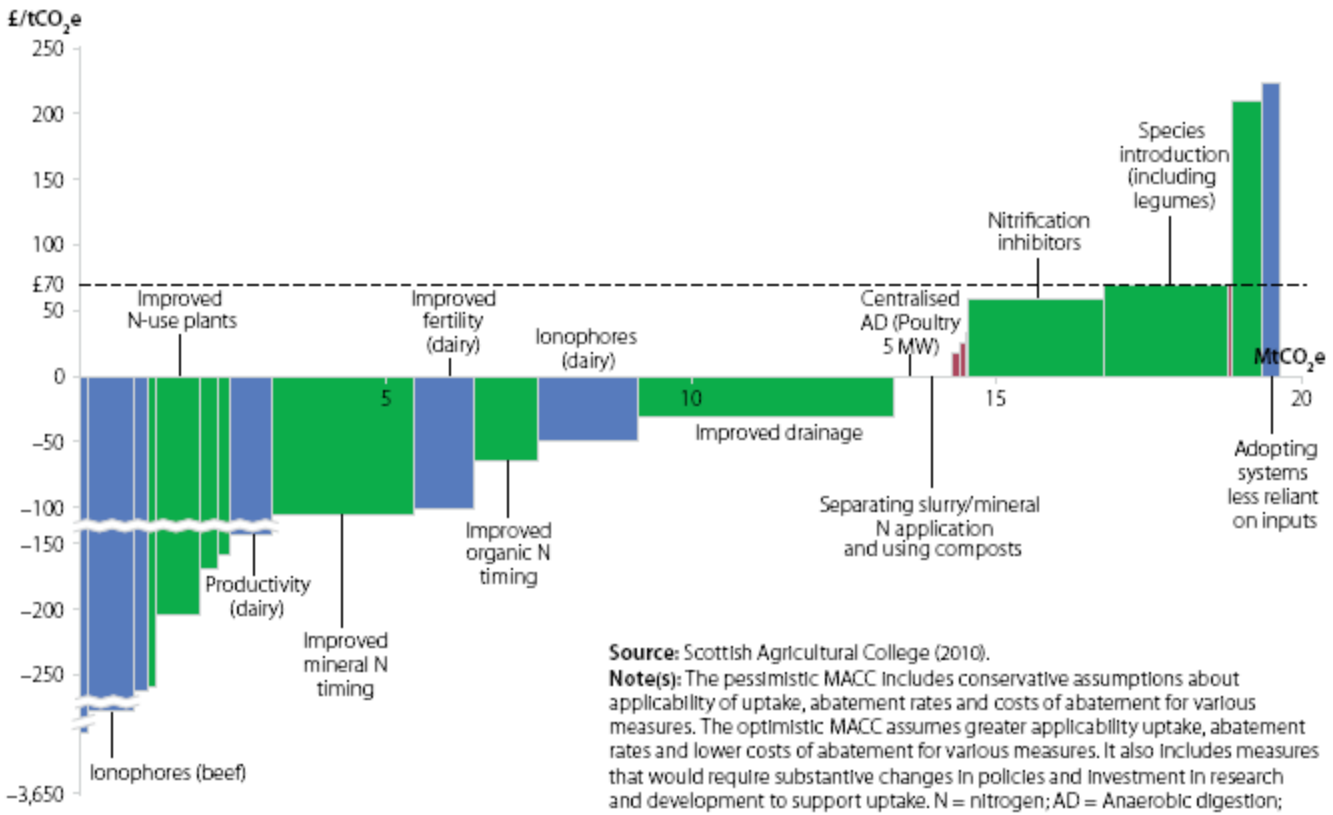


Source: Food and Agriculture Organisation


Not much left
5
Uncultivated land*, latest estimate, hectares, m
Share of spare land with travel time to market <6 hours, %
0
50
100
150
200
Sub-Saharan Africa
47
Latin America & Caribbean
76
Eastern Europe & Central Asia
83
East & South Asia
23
Middle East & North Africa
87
Rest of world
48
Source: World Bank
*High agro-ecological potential and population density <25 persons/km²

Bangs per buck in reducing GHG agriculture GHG: marginal abatement cost curve to 2022

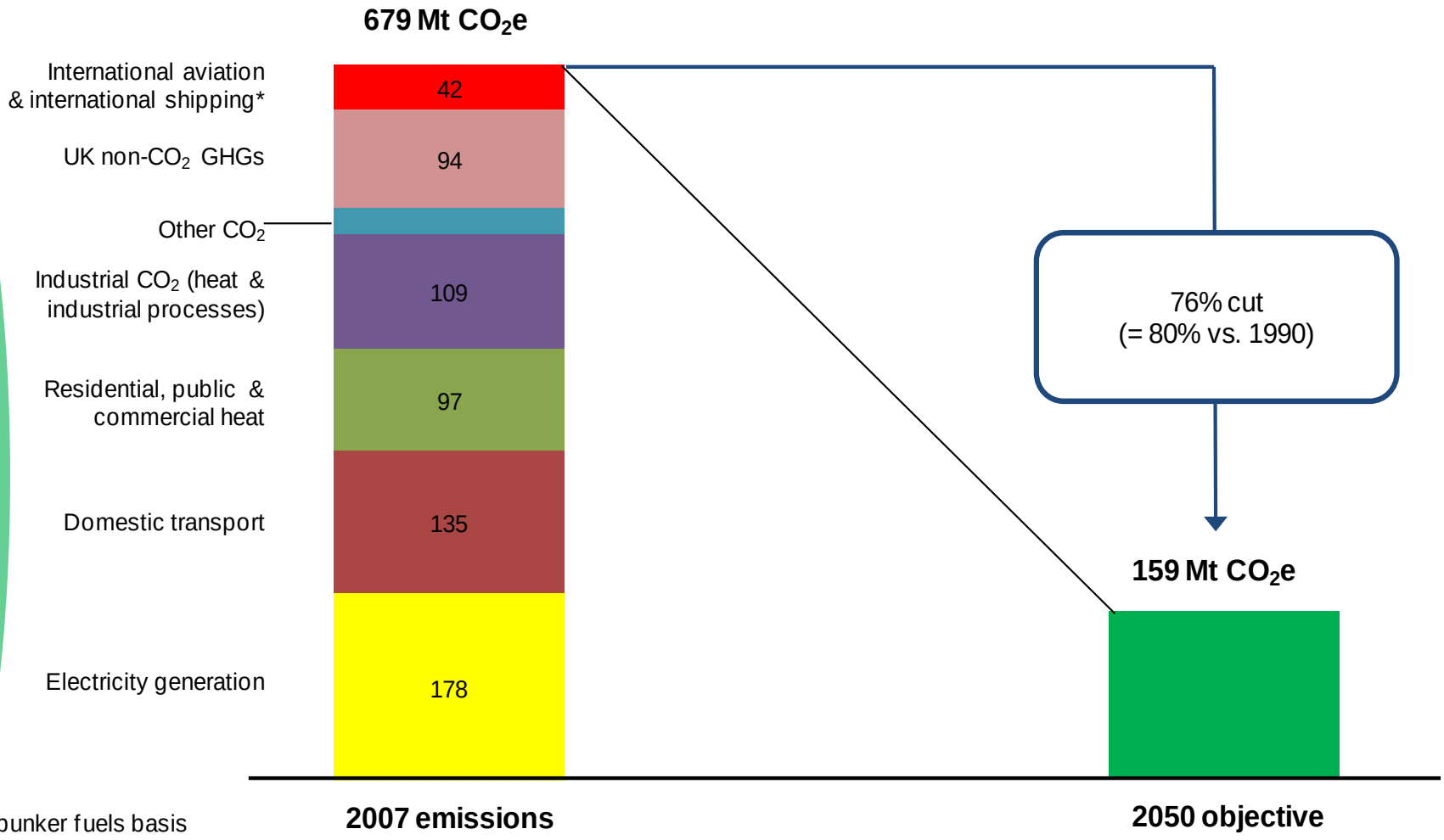
Figure 7.8b: Agriculture MACC maximum technical potential, optimistic case (2022)



Source: Scottish Agricultural College (2010).

Note(s): The pessimistic MACC includes conservative assumptions about applicability of uptake, abatement rates and costs of abatement for various measures. The optimistic MACC assumes greater applicability uptake, abatement rates and lower costs of abatement for various measures. It also includes measures that would require substantive changes in policies and investment in research and development to support uptake. N = nitrogen; AD = Anaerobic digestion; propionate precursors are feed additives that reduce the production of methane in ruminants; Ionophores are feed additives that can improve the performance of cattle and are at present banned in the EU. More details and a full measure list is available in the technical annex on the CCC website.

Scale of the challenge



* bunker fuels basis