Greenhouse gas emissions from food production; what do the numbers tell us?

Bob Rees, Joanna Cloy and Madeleine Bell

True cost accounting:
How can we pay for sustainable food?
Nourish Scotland, 4 June, 2014

Leading the way in Agriculture and Rural Research, Education and Consulting

SRUC

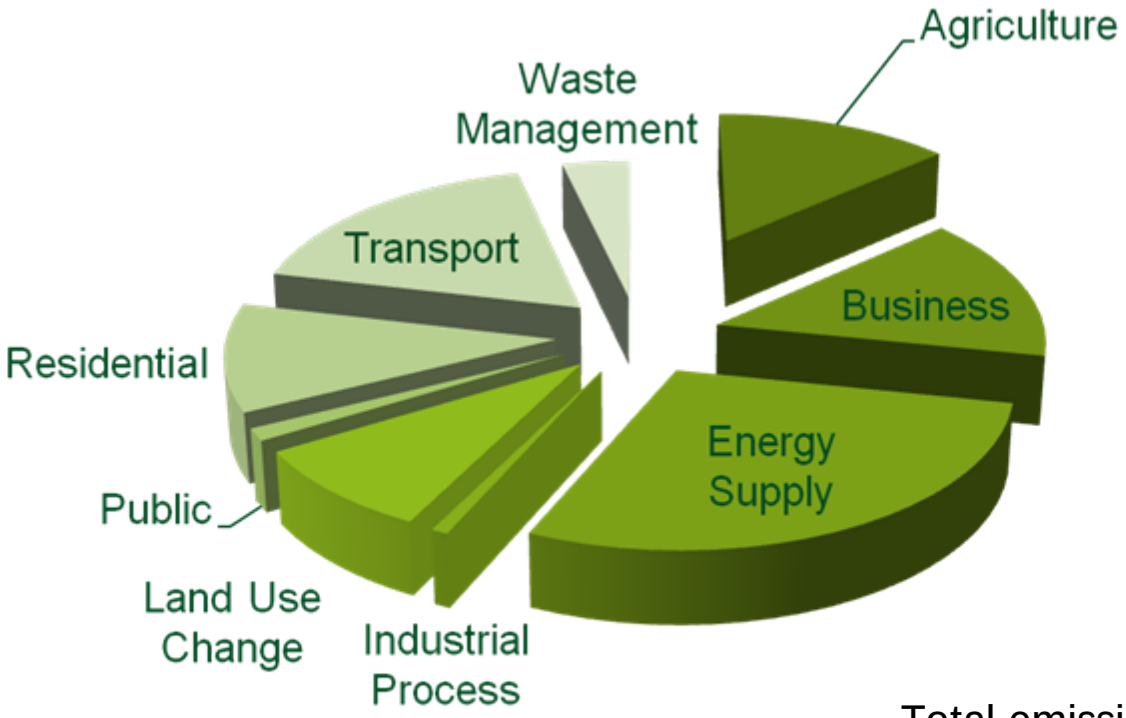
Nitrous oxide

Methane

Carbon dioxide

National reporting

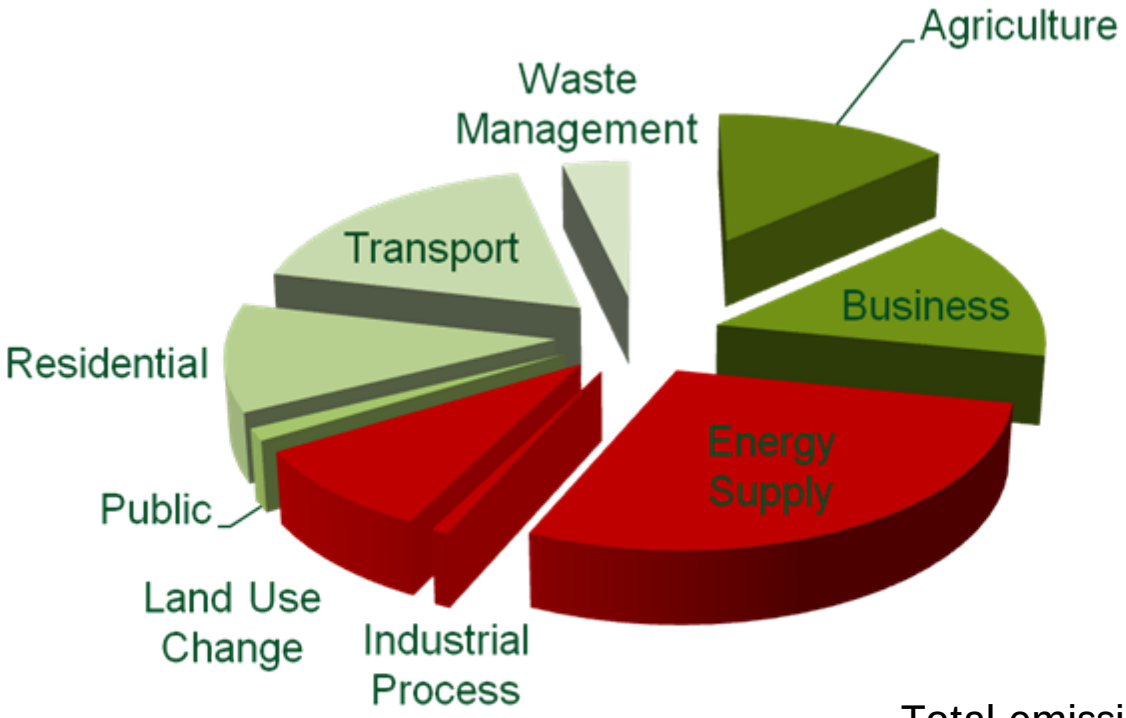
Scotland 2011



Total emissions: 49 Mt CO_{2e}

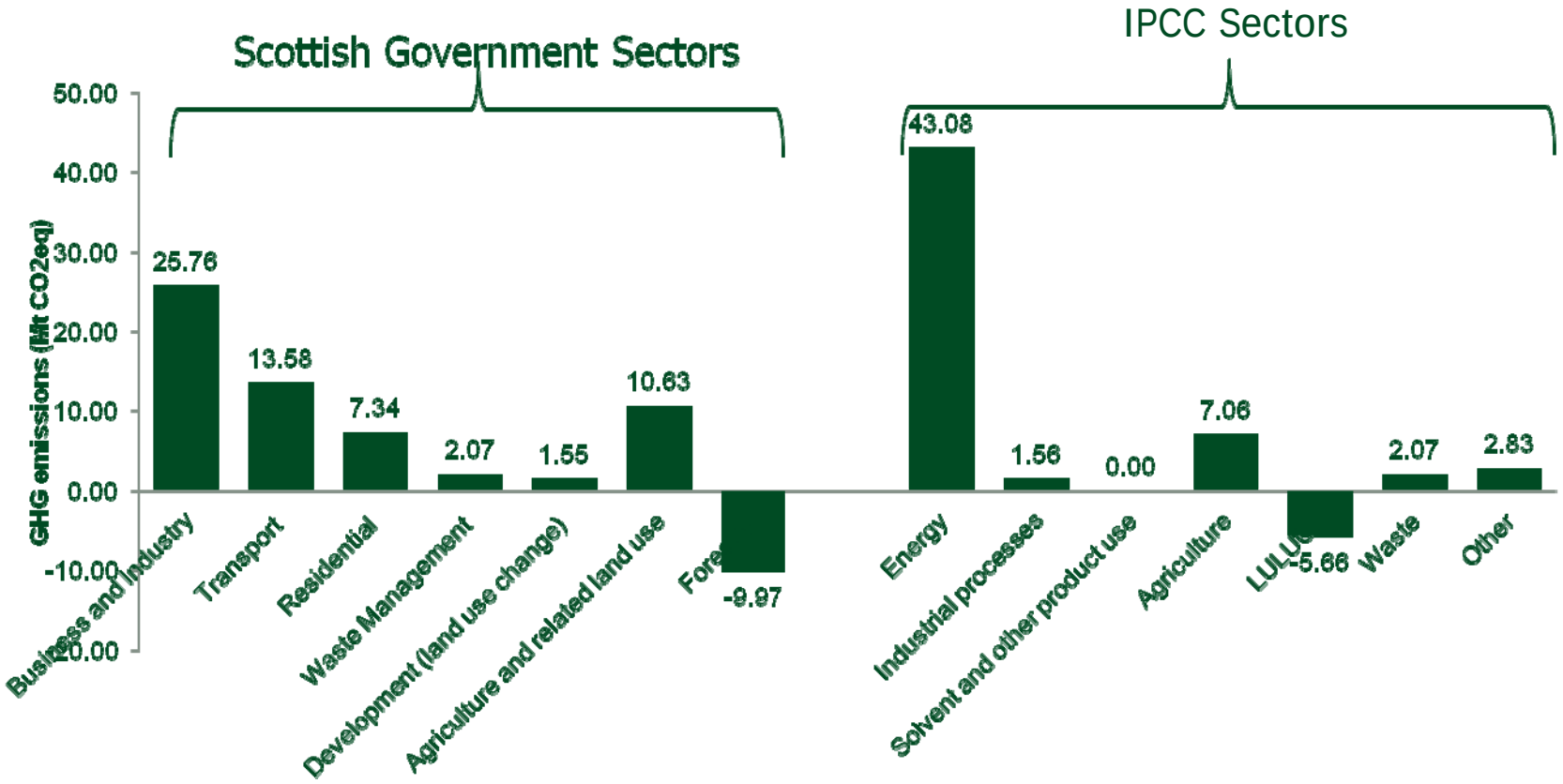
National reporting

Scotland 2011



Total emissions: 49 Mt CO_{2e}

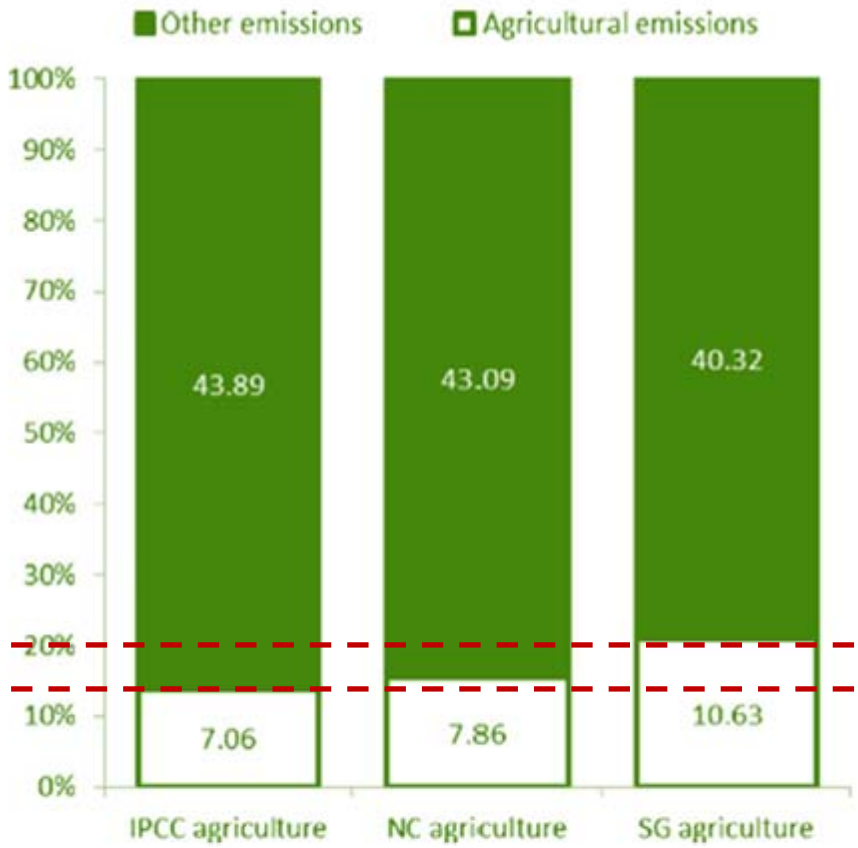
Greenhouse gas emission reporting



National emissions, 2010

Land use and land use change

GHG emissions accounting



~20 %

< 15 %

Fig. 2 – The contribution of agriculture to Scotland's total net GHG emissions in 2009 using 3 alternative approaches (NC: National Communications; SG: Scottish Government) to inventory production. Numbers on bars indicate emissions in Mt CO_{2eq}.

Bell et al, 2013

1990 – 2010: a reduction in GHG emissions from Agriculture?

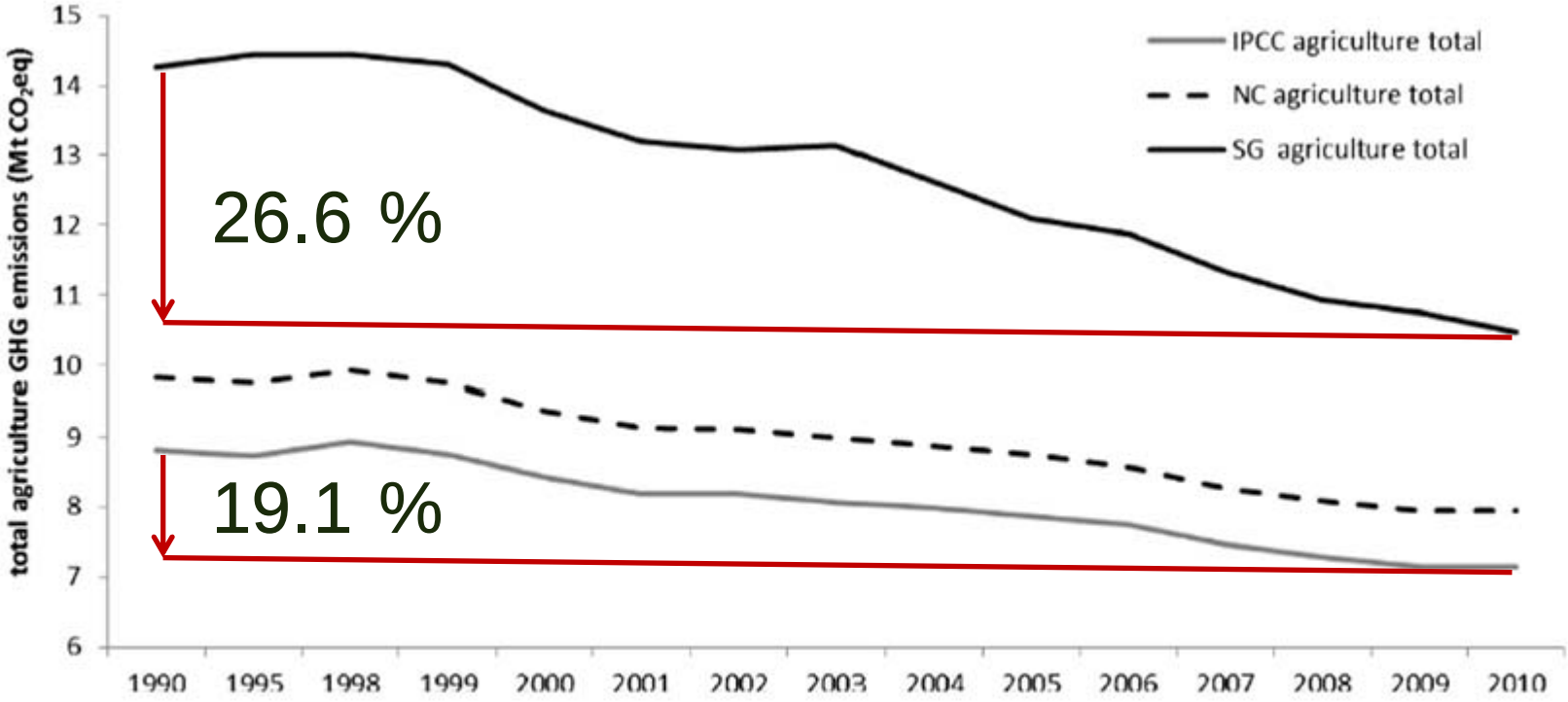


Fig. 4 – The extent of the reduction in Scotland's agricultural emissions from 1990 to 2010. The IPCC sectorial approach would imply a 1.67 (19.0%) drop in emissions, the NC inventory would imply a 1.88 (19.1%) drop in emissions, and the SG approach would imply a 3.80 (26.6%) drop in emissions. (NC: National Communications; SG: Scottish Government).

Bell et al, 2013

1990 – 2010: a reduction in GHG emissions from Agriculture?

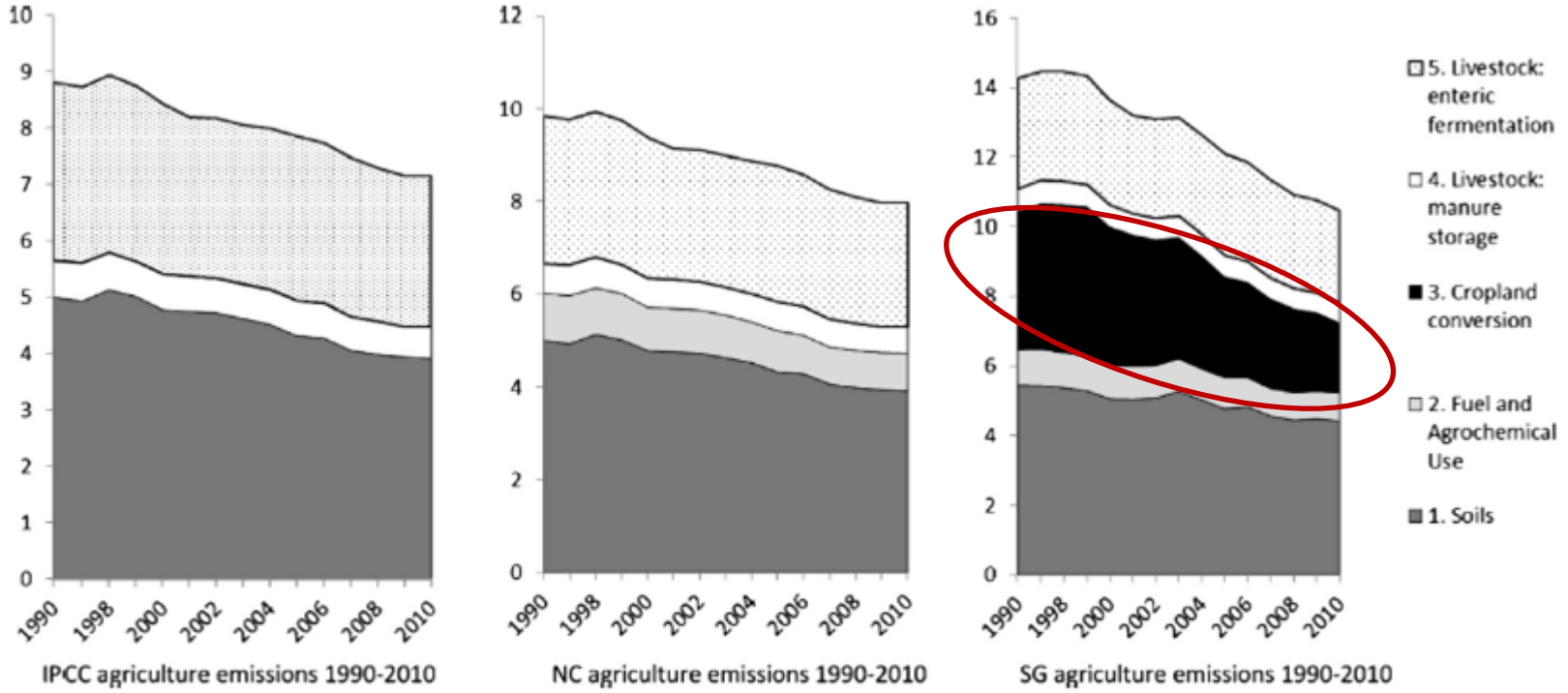
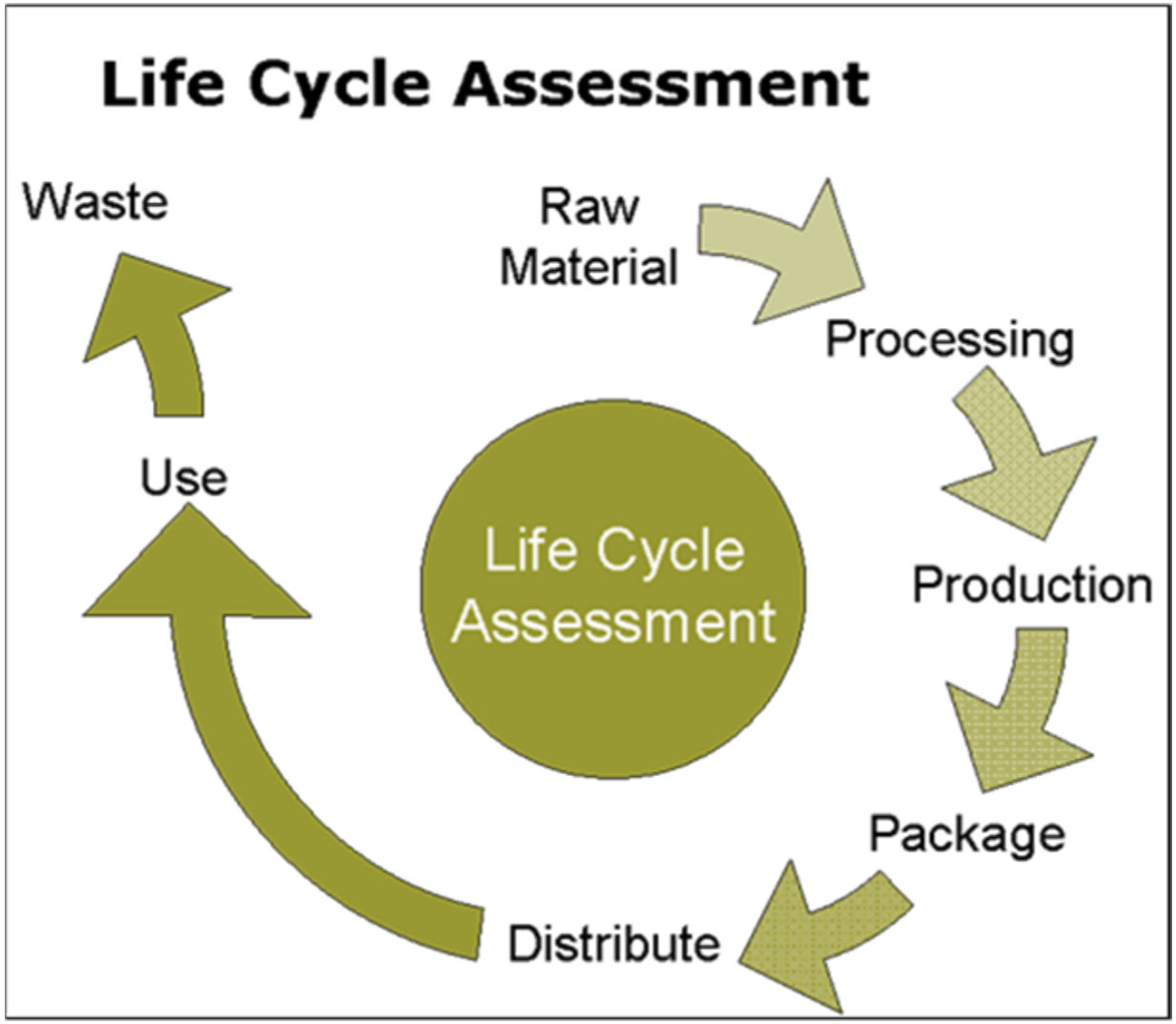


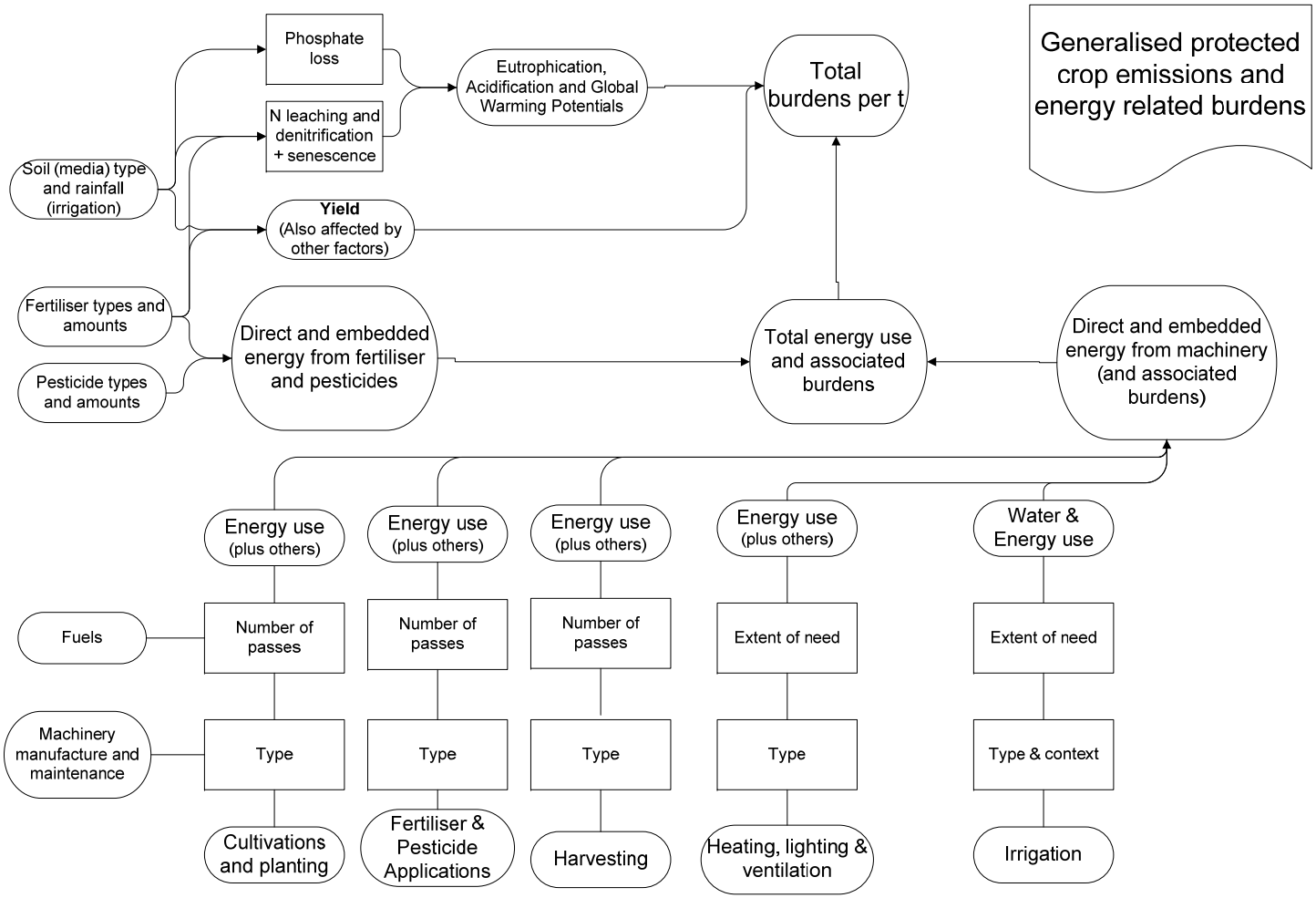
Fig. 5 – The change in Scotland's agricultural emissions (Mt CO_{2eq}) from different emission sources: 1990–2010. (NC: National Communications; SG: Scottish Government).

large reduction in emissions from CROPLAND CONVERSION: not included in IPCC agriculture sector

Bell et al, 2013


Life Cycle Assessment
Waste
Raw Material
Processing
Production
Package
Distribute
Use
Life Cycle Assessment

Life cycle assessment



Williams et al 2007

UK vs New Zealand apples

	UK				New Zealand		
	pre-FG	post-FG	Total		pre-FG	post-FG	Total
Primary energy used, GJ	2.1	2.0	4.1		1.2	11.0	12.2
GWP_{100}, t CO_2-eqv.	0.16	0.14	0.30		0.09	0.83	0.92
Eutrophication potential kg PO_4 eqv.	0.3	0.1	0.4		0.1	3.6	3.7
Acidification potential kg SO_2 eqv.	0.6	0.9	1.5		0.3	23.8	24.1
Ozone potential depletion, g CFC-11 eqv.	0.4	ND	0.4		0.2	ND	0.2
Pesticides used, kg A.I.	0.6	NA	0.6		0.3	NA	0.3
Abiotic resource use; kg Sb eqv.	0.8	1.0	1.8		0.5	5.1	5.5
Land ha/t	0.038	NA	0.038		0.017	NA	0.017
Irrigation Water, m^3	10	NA	10		88	NA	88
PM_{10} kg	0.01	0.09	0.11		0.01	0.60	0.60
Photochemical oxidation potential, kg ethylene eqv.	-0.08	0.02	-0.06		-0.04	33.62	33.58
Non-methane Volatile Organic Carbon, kg C Equiv	0.04	0.13	0.17		0.03	1.24	1.26
Proportion of renewable primary energy, %	2	5	4		8	21	19

Apples, comparison of production in UK and New Zealand, total emissions per t product. UK produce fresh, NZ produce stored for 3 months. Williams et al 2007

UK vs Spanish tomatoes

	UK				Spain		
	pre-FG	post-FG	Total		pre-FG	Post-FG	Total
Primary energy used, GJ	34.1	2.1	36.2		4.4	5.2	9.6
GWP_{100}; t CO_2-eqv.	2.11	0.13	2.24		0.27	0.49	0.74
Eutrophication potential, kg PO_4 eqv.	0.1	0.1	0.2		0.1	0.3	0.5
Acidification potential, kg SO_2 eqv.	1.4	1.0	2.4		1.7	2.5	4.1
Ozone potential depletion, g CFC-11 eqv.	0.5	ND	0.5		0.8	ND	0.8
Pesticides used, kg A.I.	0.3	NA	0.3		2.2	NA	2.2
Abiotic resource use, kg Sb eqv.	16.7	1.5	18.2		10.3	3.2	13.5
Land, m^2	18.5	NA	18.5		89.1	NA	89.1
Irrigation Water, m^3	24	NA	24		36	NA	36
PM_{10}, kg	0.03	0.08	0.11		0.89	0.17	1.06
Photo-chemical oxidation potential, kg ethylene eqv.	0.08	0.02	0.10		0.07	0.06	0.13
Non-methane Volatile Organic Carbon, kg C Equiv	0.113	0.136	0.249		0.260	0.413	0.673
Proportion of renewable primary energy, %	1	3	1		6	4	5

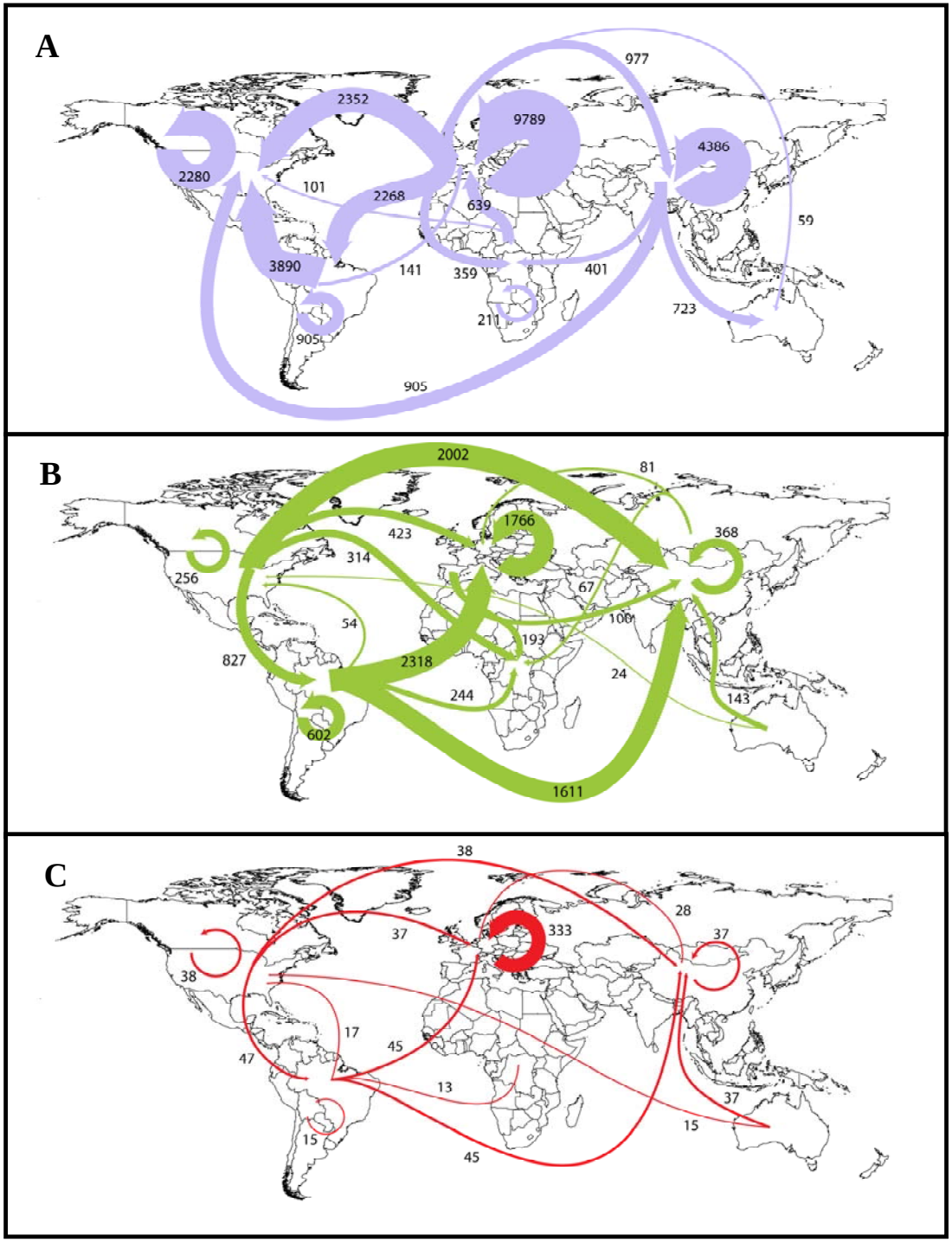
loose tomatoes, comparison of production in UK and Spain, total emissions per t product. Values pre farm gate do not include packing. Williams et al 2007

International trade

Fertilizer (31 Tg)

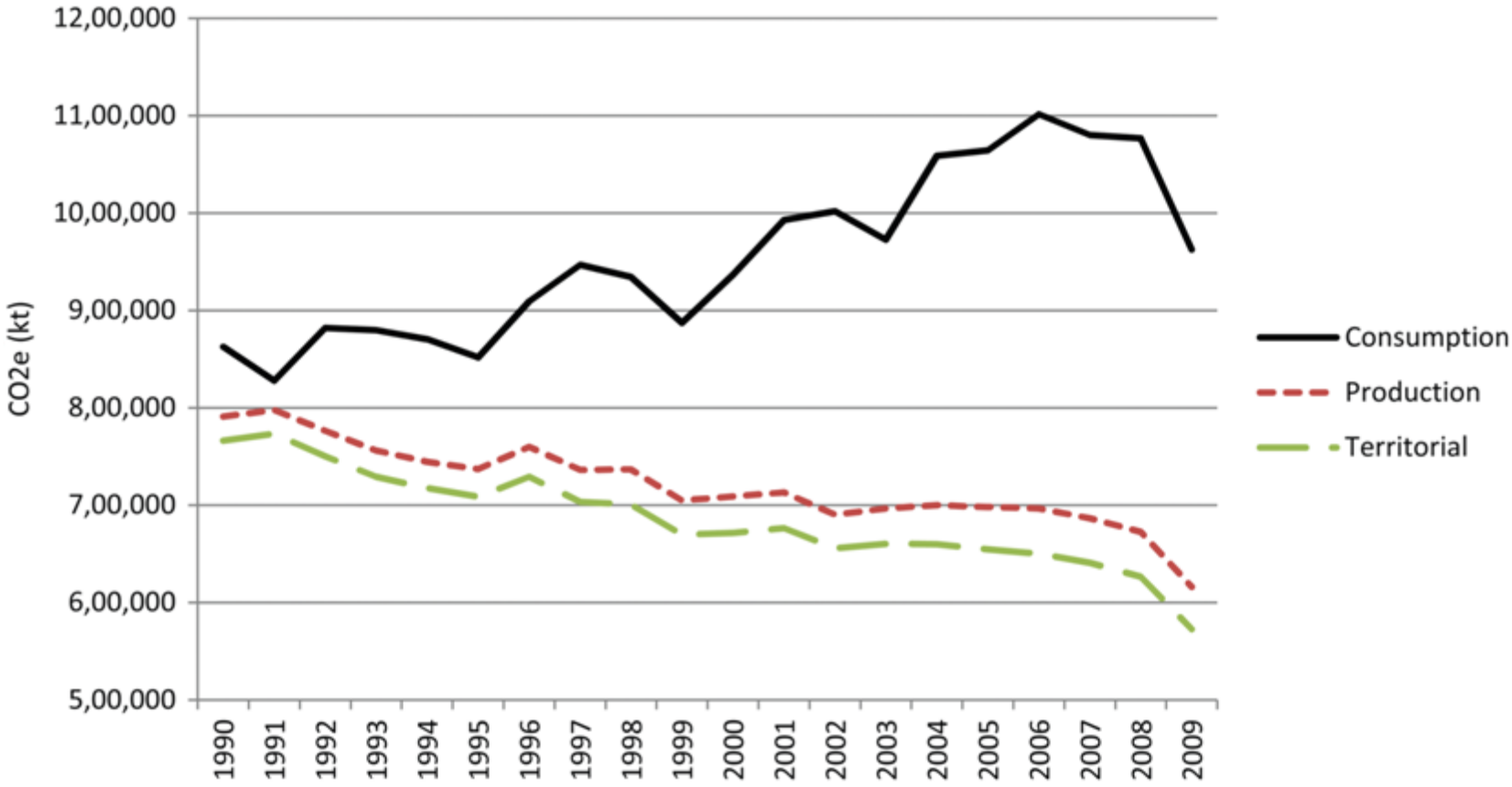
Grain (12 Tg)

Meat (0.8 Tg)



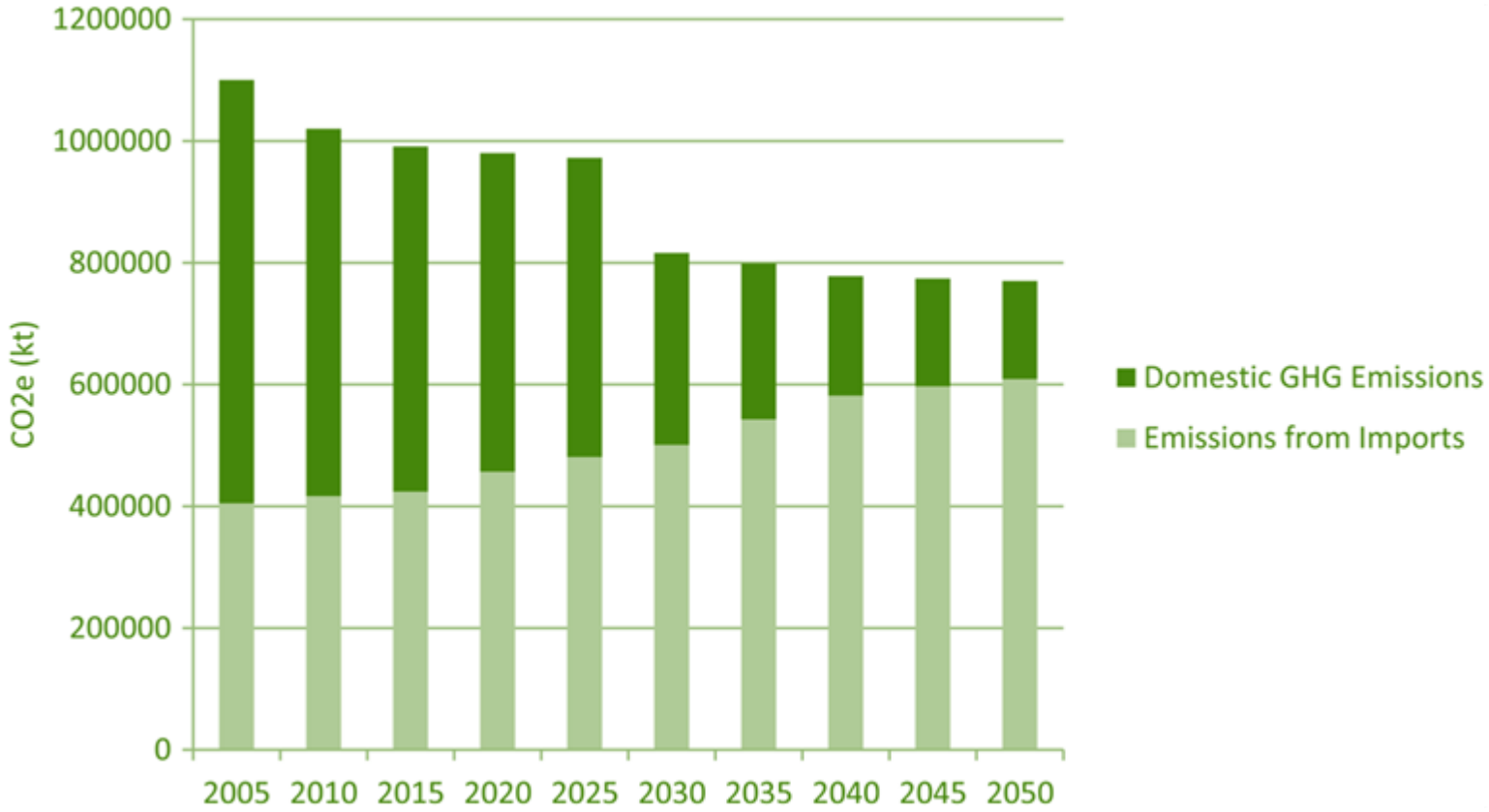
Galloway, Ersiman, Sutton et al. Science (2008)

Consumption based emissions



UK consumption and production of GHG emissions. *Barratt et al 2013*

Projected emissions



Projection of UK consumption-based GHG emissions to 2050. *Barratt et al 2013*

What do the numbers tell us?

- Beware of headlines
- Food contributes significantly to greenhouse gas emissions
- There have been significant reductions in emissions in the past two decades
- More can be done, but mitigation and reporting needs to address both production and consumption