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Sefydliad y Gwyddorau Biolegol, Amgylcheddol a Gwledig
IBERS ABERYSTWYTH
Institute of Biological, Environmental and Rural Sciences

Methane production from animal agriculture

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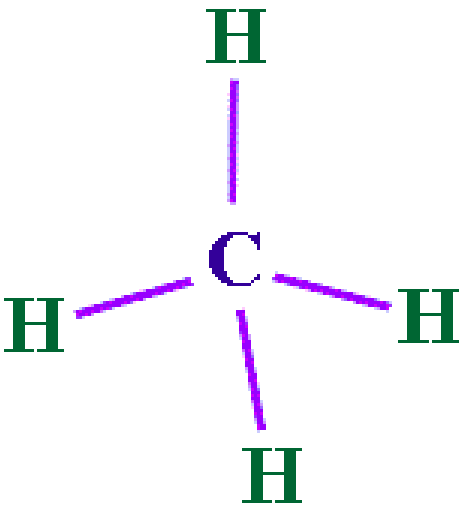
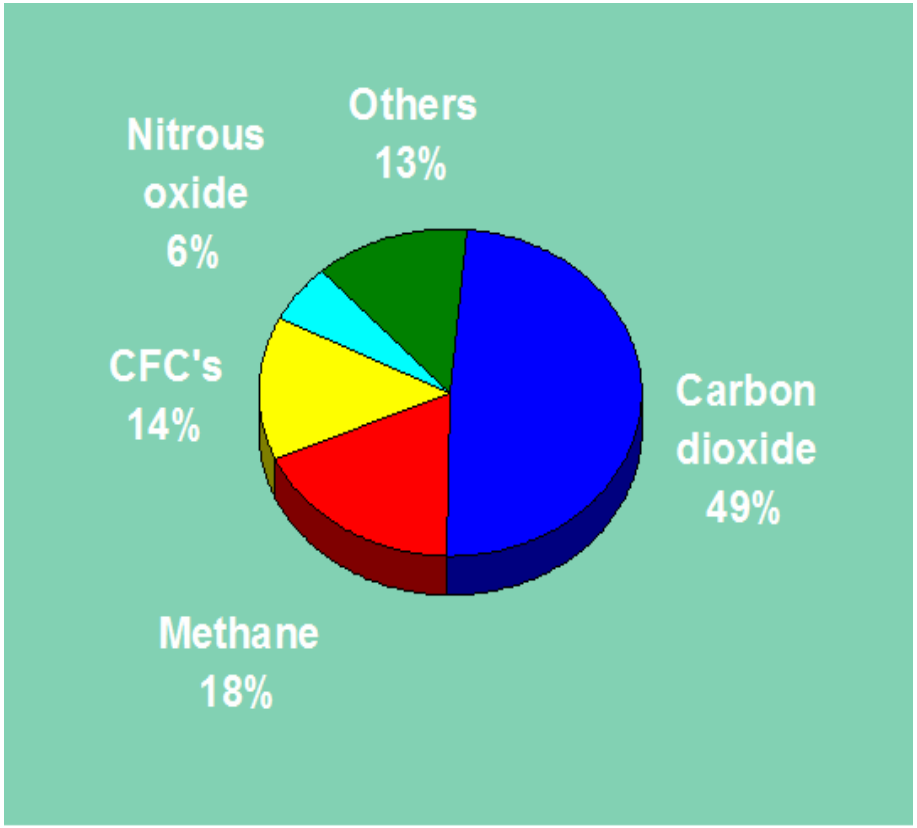
Good or Evil ?



Methane

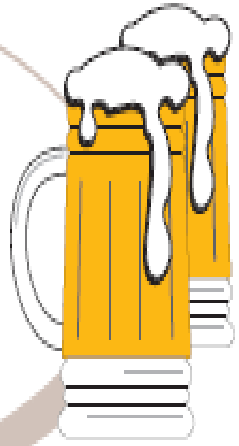
Relative contribution of gases to global warming



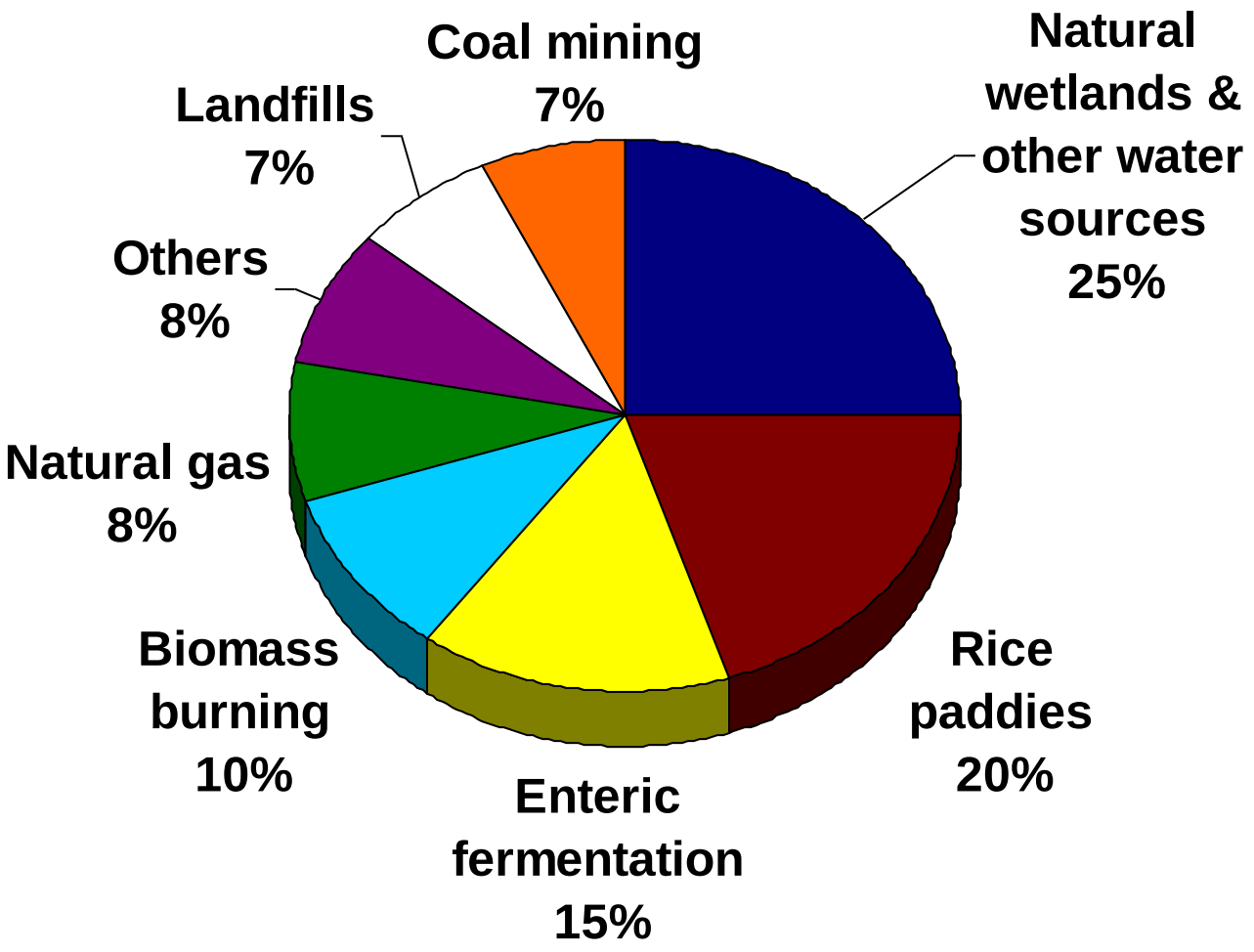
- Average human output 500- 1500 ml/ d
- Only 50% of people produce methane
- From 10 to 50 % methane
- 50 – 750 ml of methane per day

One cow can produce between 500 and 600 litres of methane per day

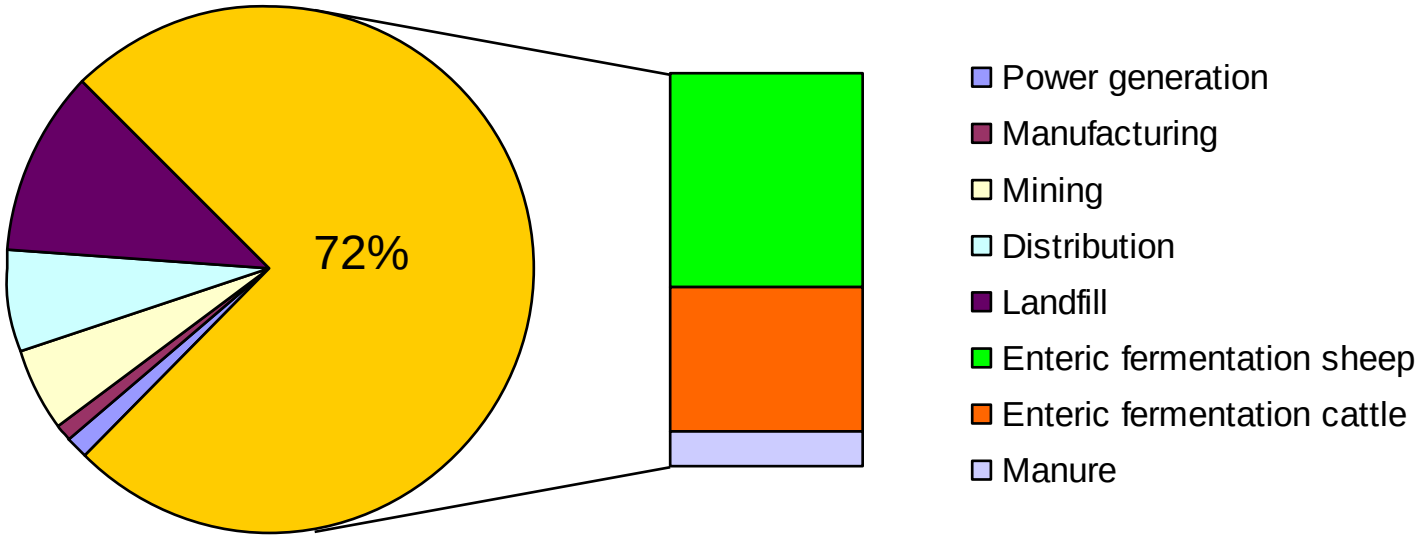
The equivalent to almost 1000 pints of beer



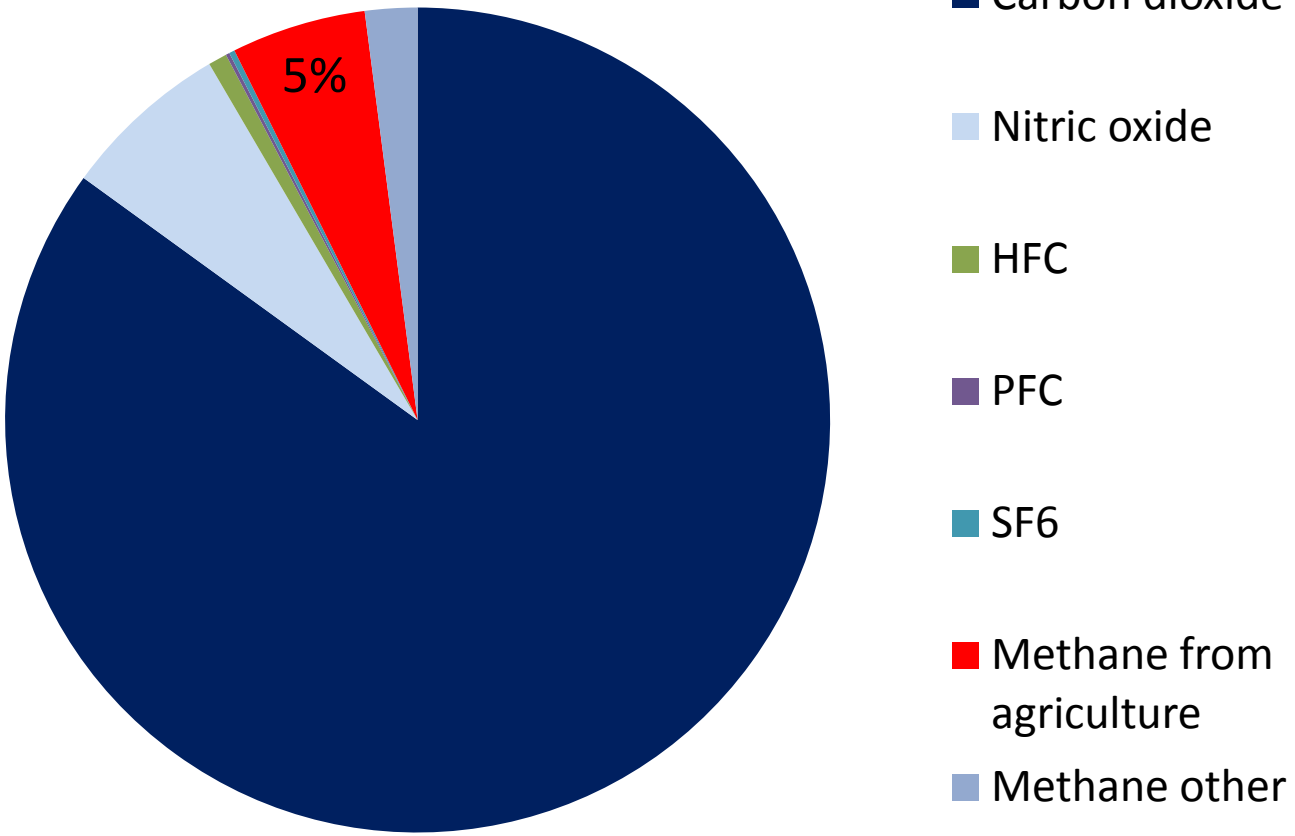
Sources of methane



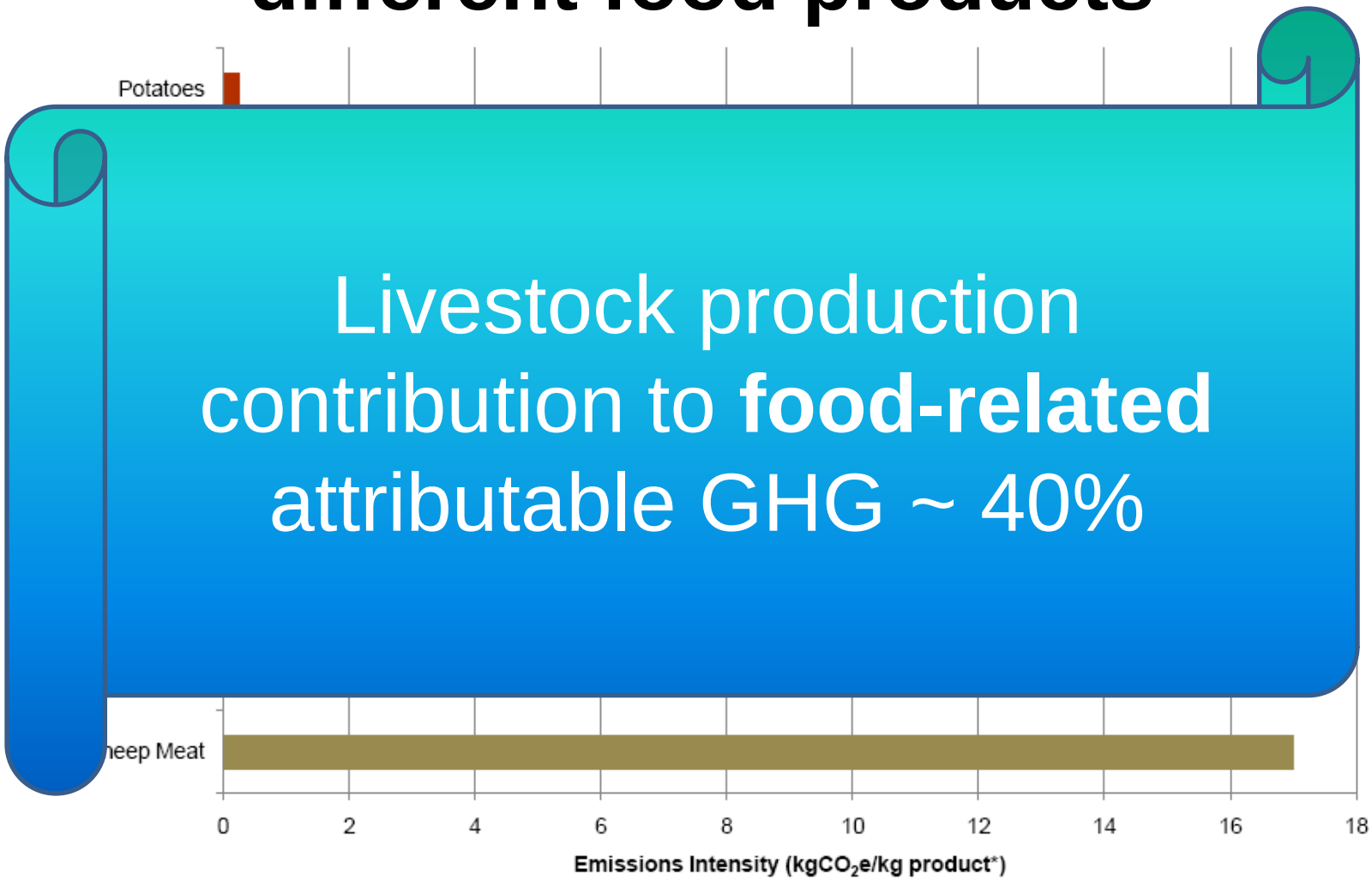
Sources of methane in Wales



Contribution to greenhouse gas emissions (GWP-equivalents)



Estimated emissions intensities for different food products



Livestock production contribution to **food-related** attributable GHG ~ 40%

(Williams et al. 2006)

The acceptable form of food production

- Production of food which meets needs of present without compromising the ability of future generations to meet their needs…. **This requires a fundamental shift in thinking to our production systems**

- What may future animal production systems ?

Major challenges for Animal Systems

- more resilient production systems
- reduce dependency of the food chain on fossil fuels
- enhance ecosystem services (i.e soil and water)
- radically reduce greenhouse gas emissions produced by food system (80% by 2050)
- feed resources *v* food

Monogastrics production systems

- Pig
  - Intensive
  - Relying on mainly grain, **soya bean meal**
  - Competitive with human on grains **BUT** high usage of by-products
  - High feed conversion efficiency

- Poultry
  - Intensive
  - Relying on mainly grain (i.e. the UK poultry industry is the biggest user of British wheat, consuming almost one fifth of the total UK wheat crop each year), **soya bean meal**
  - Competitive with human on grain
  - High feed conversion efficiency

Dutch pig production system

Pigs are seen in front of a biogas plant in Sterksel, south Netherlands. The biogas plant makes enough electricity from their waste to run the farm.

Waste Manag Res OnlineFirst, published on September 1, 2009 as doi:10.1177/0734242X09338728

Los Angeles, London, New Delhi
and Singapore
http://www.sagepub.com

wm&r

ISSN 0734–242X
Waste Management & Research
2009: 00: 1–12
DOI: 10.1177/0734242X09338728

Energy production, nutrient recovery and greenhouse gas emission potentials from integrated pig manure management systems

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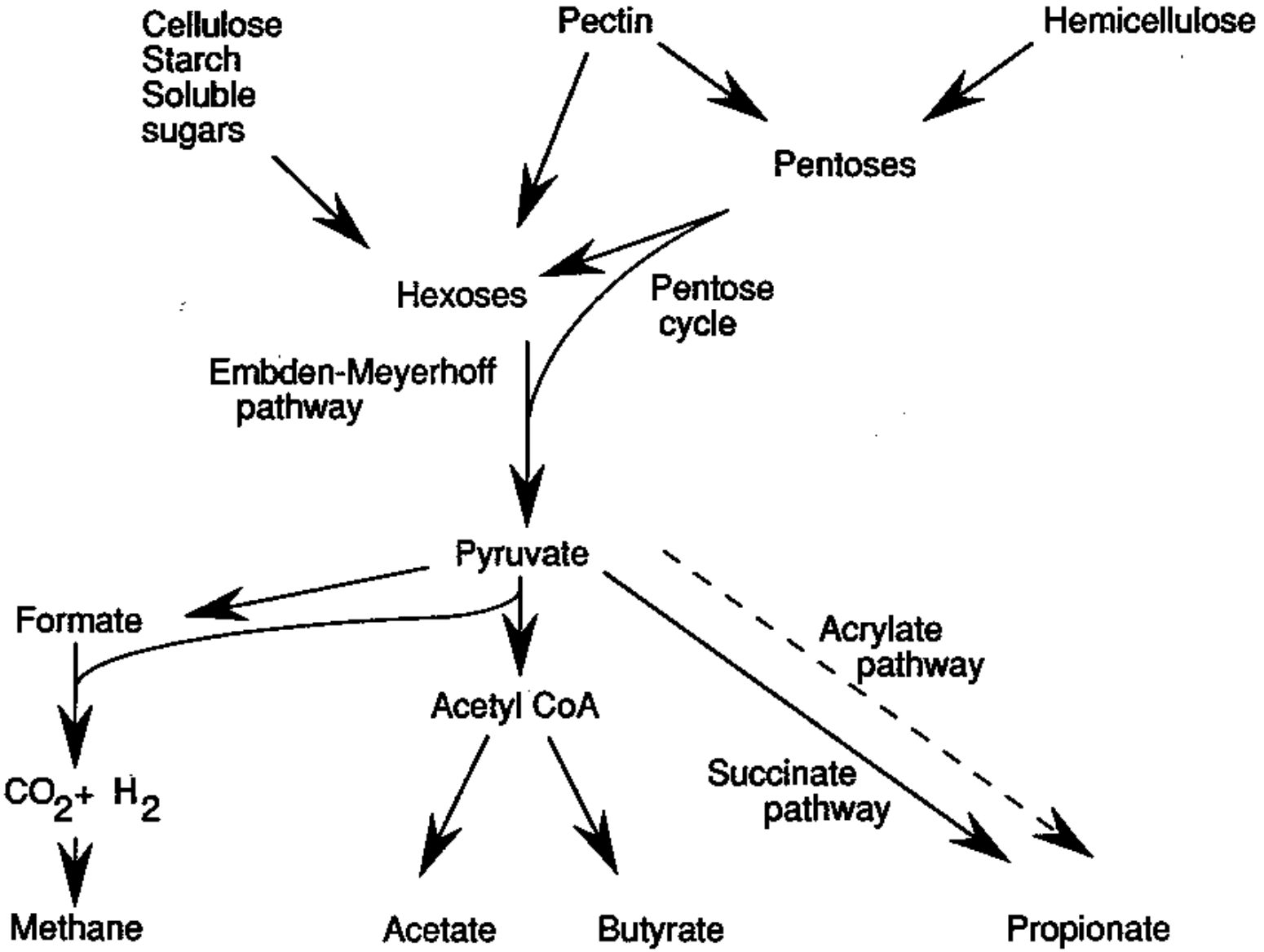
Ruminant production systems

Ruminants – ability to utilise lignocellulose and convert non-protein nitrogen into meat and milk

Ruminant production systems

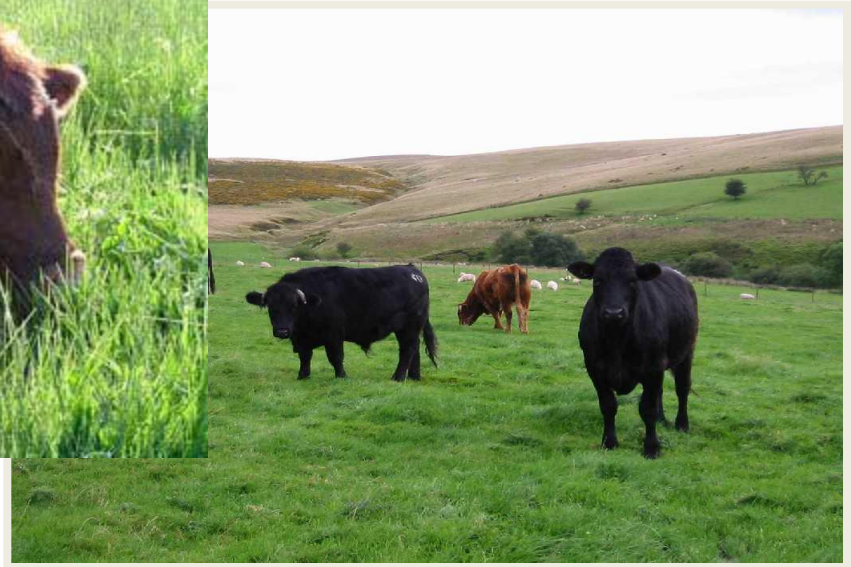
- Intensive
  - dairy, some beef
  - reduced energy use
  - constant feed supply
  - cheaper products
  - maximum efficiency

- Extensive
  - dairy, beef, sheep, goat
  - lower output
  - reduced labour
  - low input, high management
  - consumer friendly


Cellulose
Starch
Soluble
sugars
Pectin
Hemicellulose
Pentoses
Hexoses
Pentose
cycle
Embden-Meyerhoff
pathway
Pyruvate
Formate
Acrylate
pathway
Acetyl CoA
Succinate
pathway
CO_2+ H_2
Methane
Acetate
Butyrate
Propionate

Extensive production systems

grassland carbon sequestration has the potential to play a significant role in mitigating the GHG balance of ruminant production systems



(Soussana et al. 2009)

Sources of feed for animal production

Human - inedible materials:

- Forages from land not able to grow crops
- Crop residues
- Food and fiber processing by-products

Returns from Animal Production

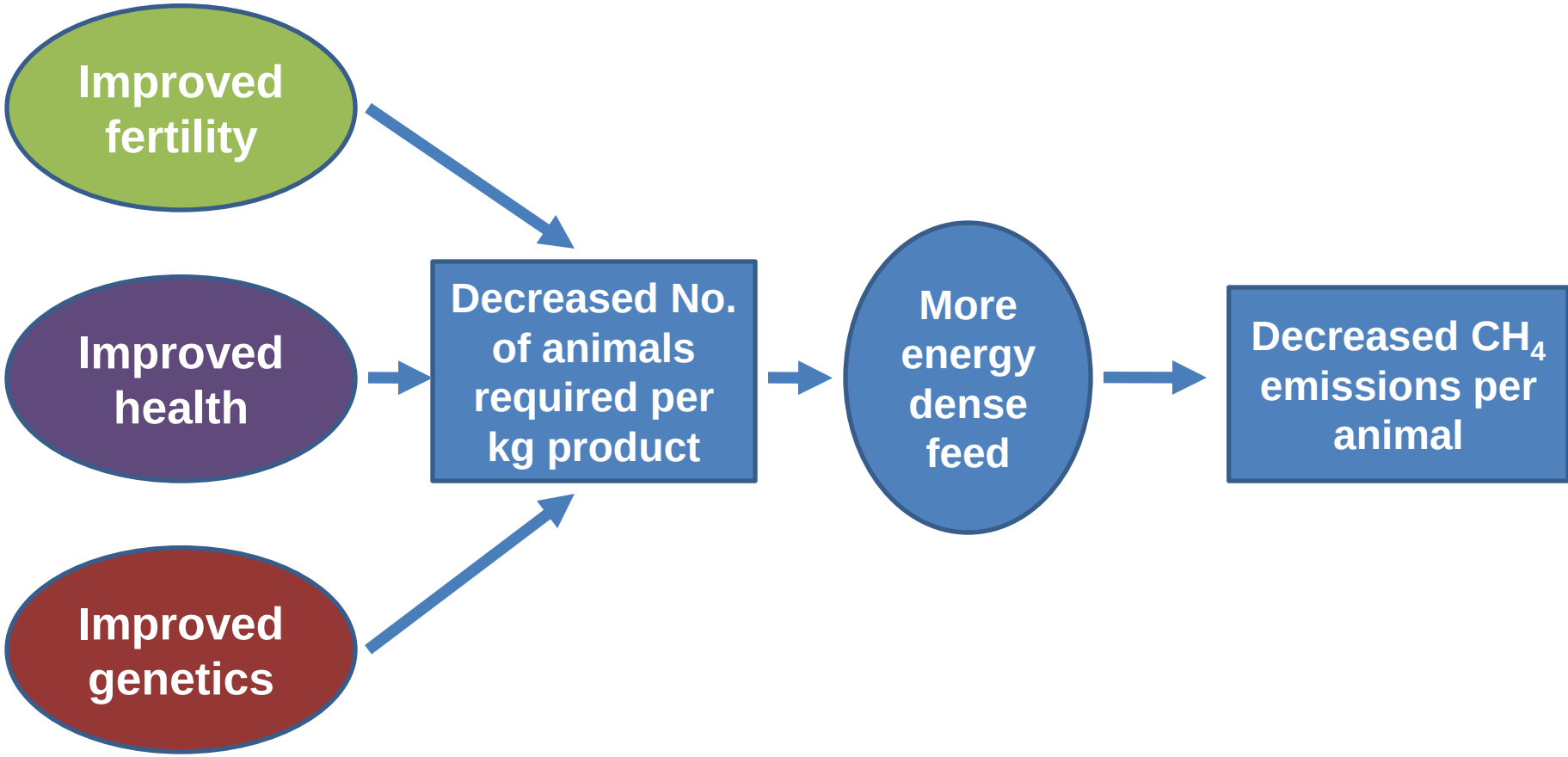
(Energy in Human Food / Energy in Feed)

	Feed Inputs			
	Total		Human Edible	
Product	USA	Other	USA	Other
Beef	0.07	0.04	0.65	7.60
Pork	0.21	0.16	0.31	0.40
Poultry meat	0.19	0.19	0.28	0.50
Eggs	0.17	0.13	0.24	0.30
Milk	0.25	0.15	1.07	3.05

Potential for mitigation of GHG emissions from livestock

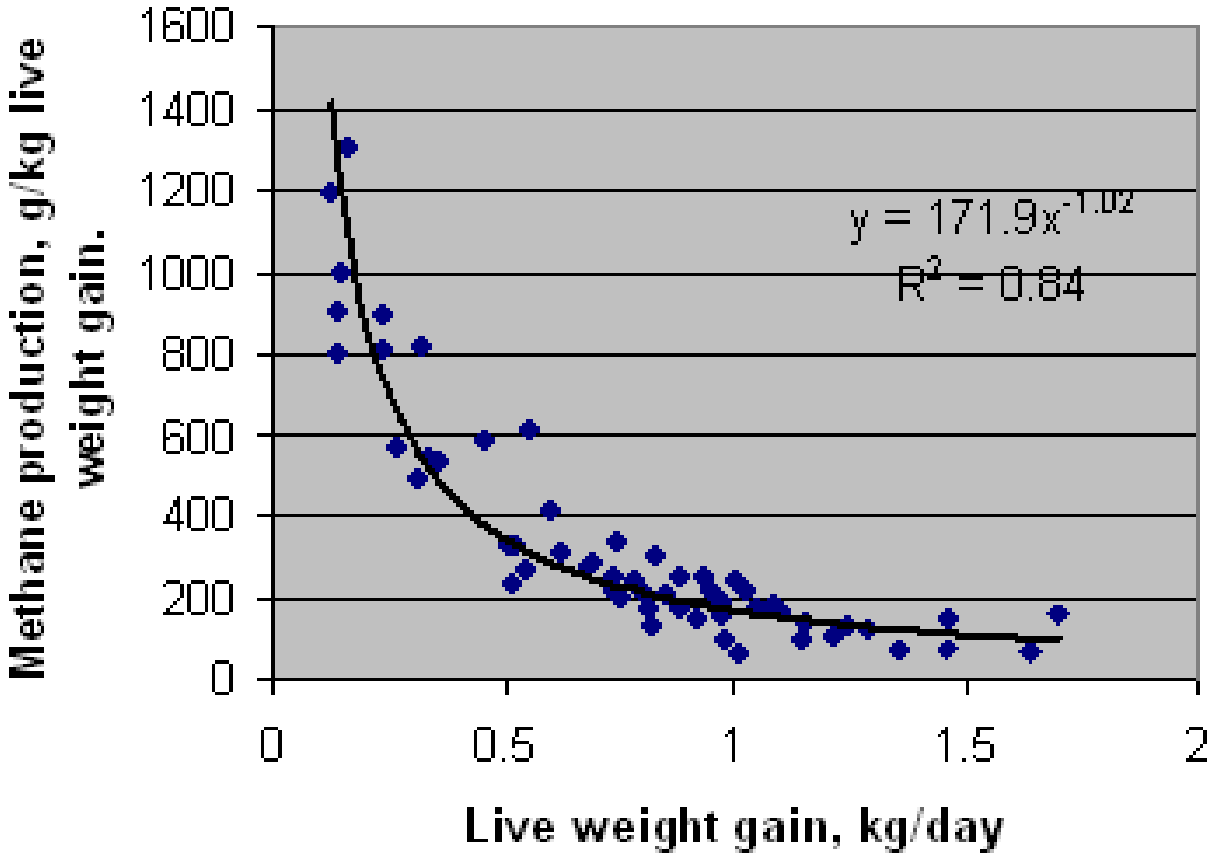
- ✓ Lifestyle change (i.e. less reliance on products with a high carbon cost associated with their production and reducing food waste)
- ✓ Changing farming practice
- ✓ Using new technologies

(Gill et al. 2009. *Mitigating climate change: the role of domestic livestock*. **Animal** doi:10.1017/S1751109004662)



Routes for impact of management and technology interventions designed to improve productivity on GHG emissions from livestock (Gill et al. 2009)

The relationship between live weight gain (LWG) of cattle and methane production per kg of gain



(Kurihara et al 1997, Klieve. and Ouwerkerk 2007, Howden and Reyenga 1999)

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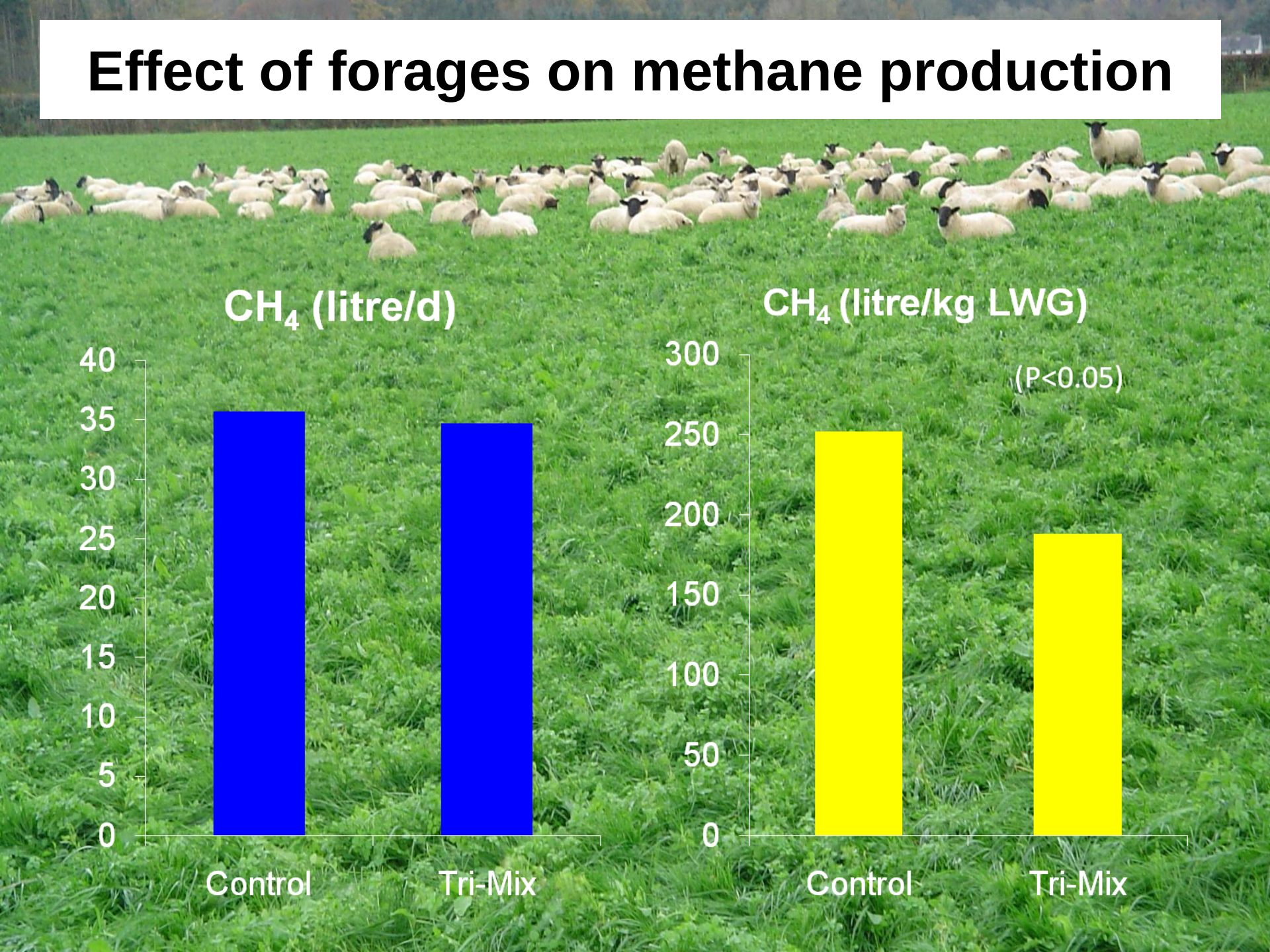
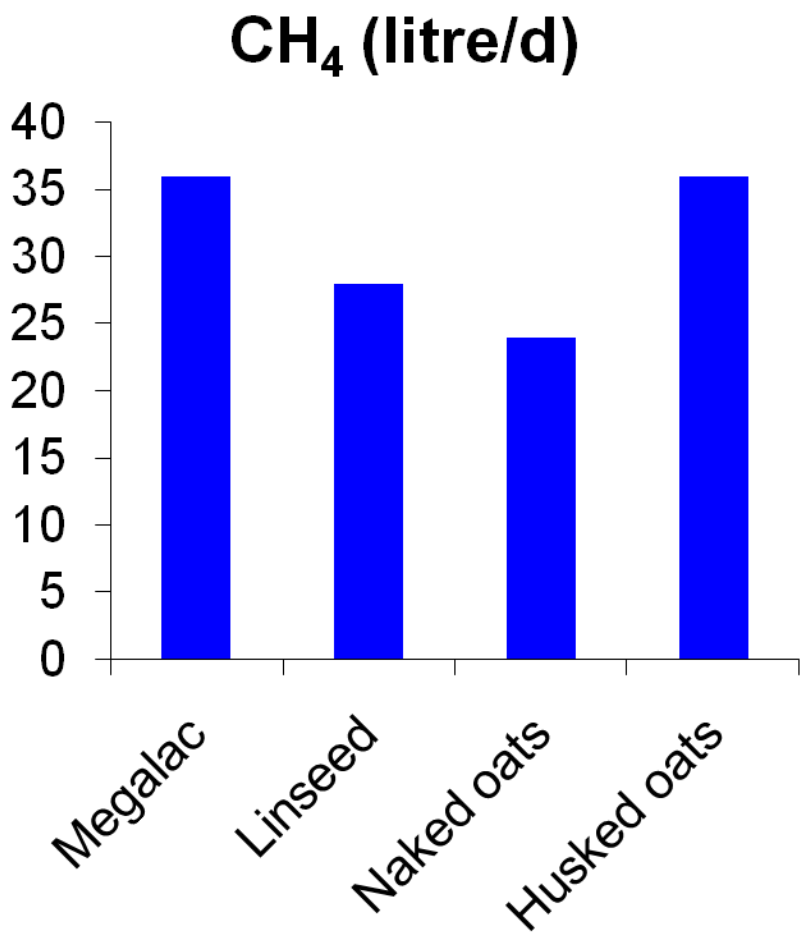
Breeding for production and efficiency

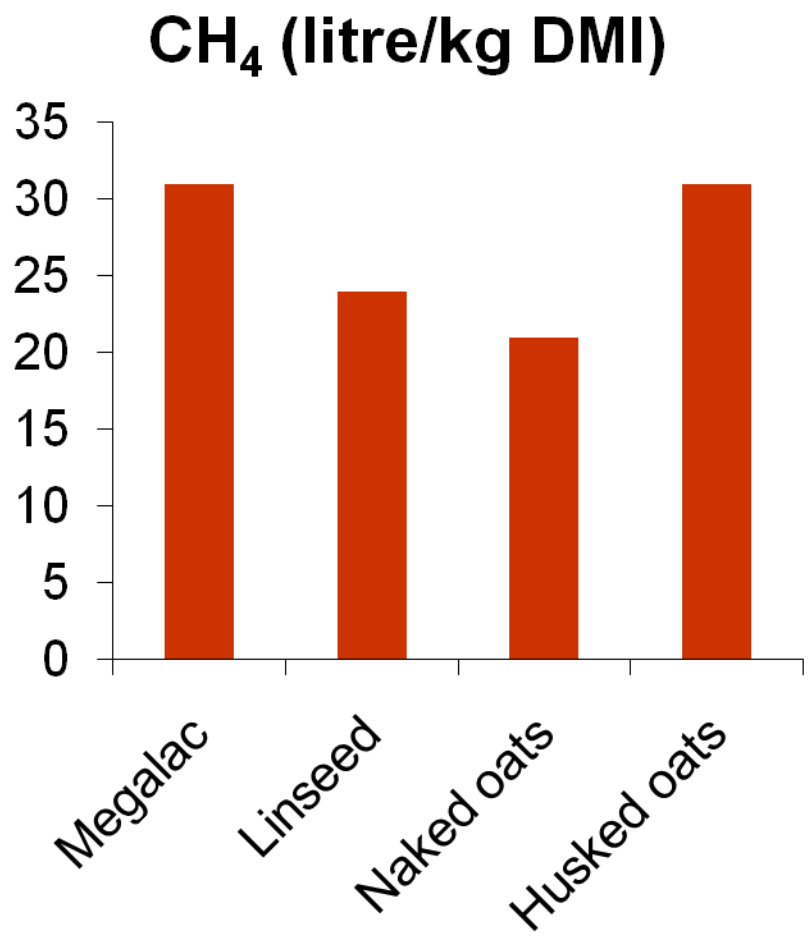
Breeding: combining novel characteristics with an existing set of required traits

Effect of forages on methane production

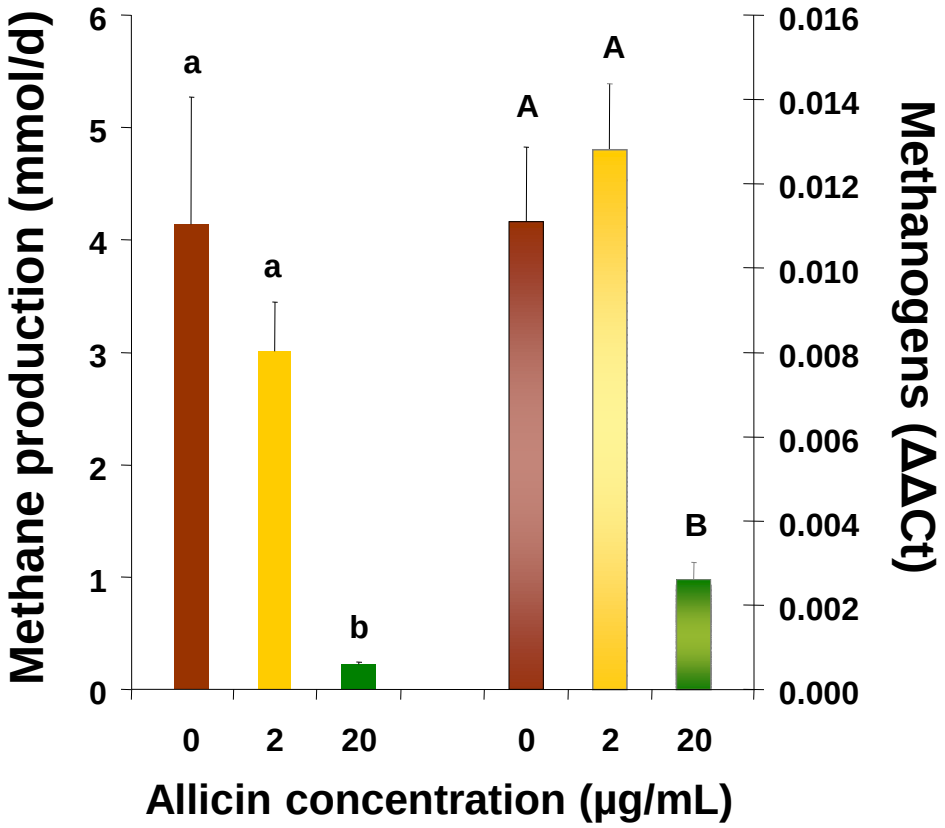


Effect of oil on methane production



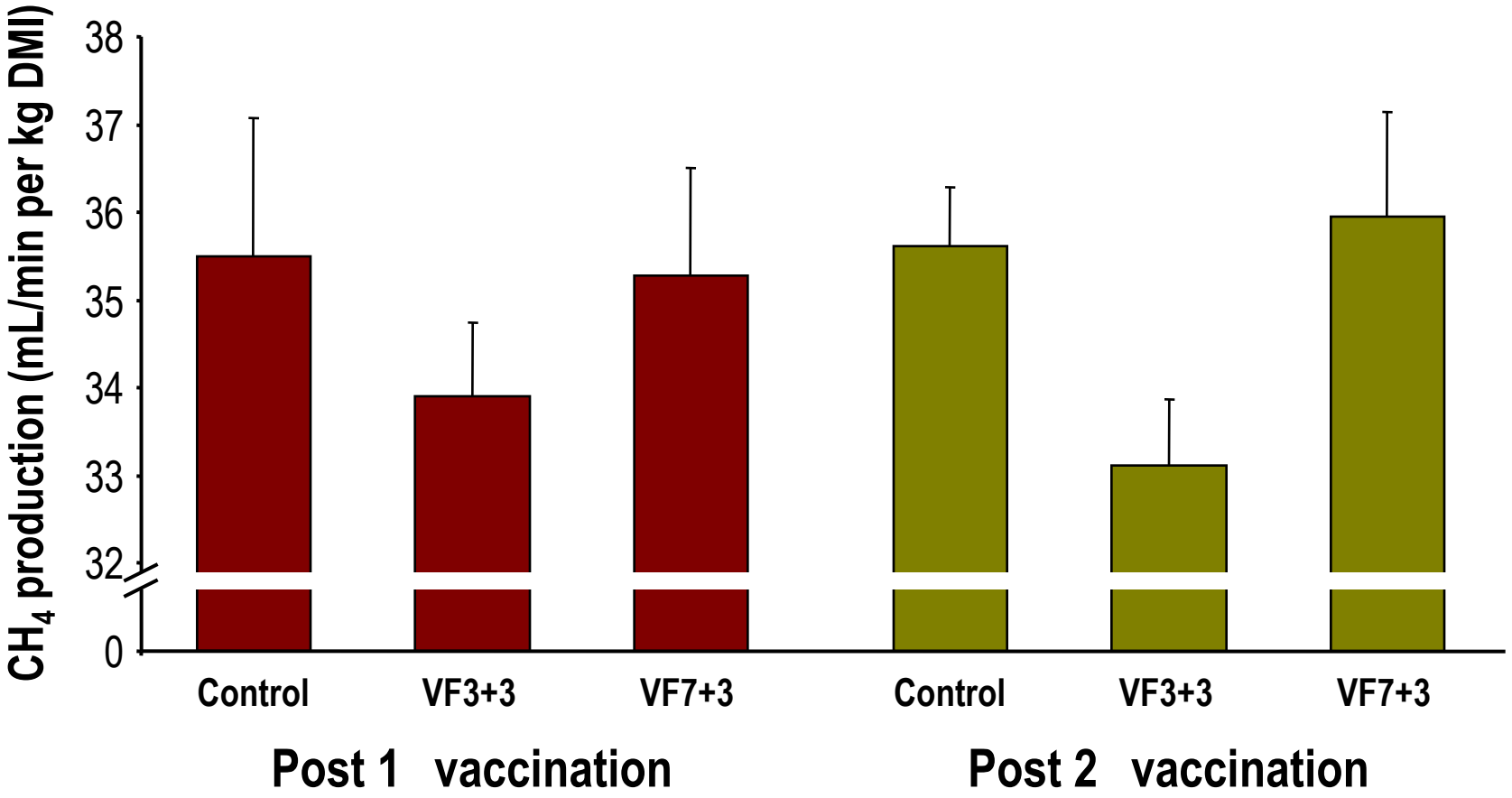


Garlic and methane



a,b or A,B: Means differ at (*P* < 0.05).

Vaccination - methanogens



(Wright et al. 2004)

Ruminant production systems

ruminant agriculture has a key role to play in producing human edible food from substrates not otherwise available to man provided that the challenge of reducing GHG emissions and in particular methane may be achieved