Farm management
– how can we reduce emission per kg milk?

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Structure of the presentation

1) Emission at farm scale

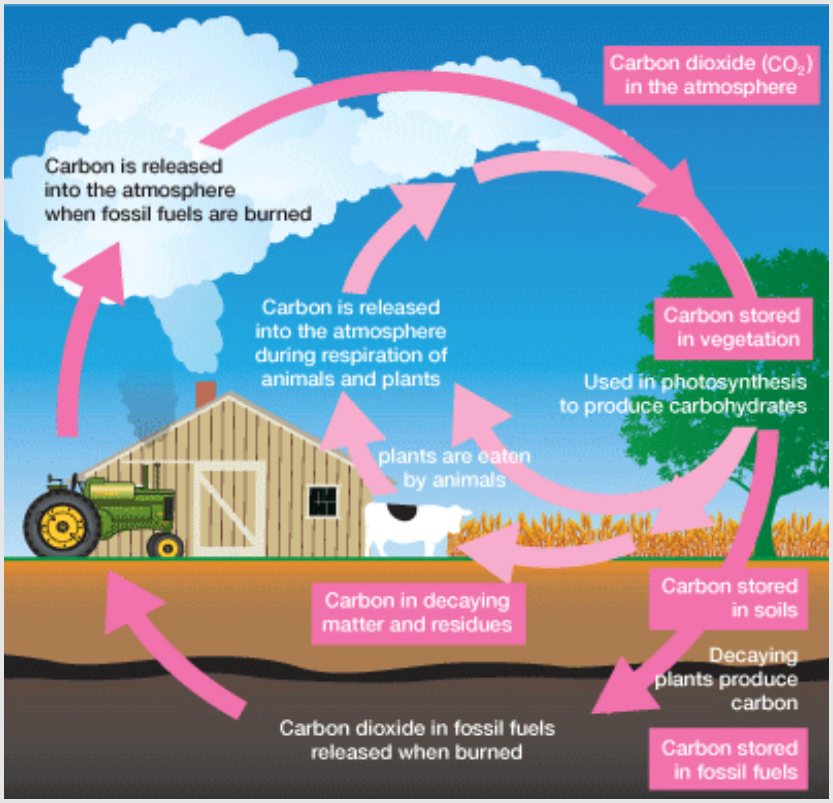
2) The Life Cycle Assessment - method

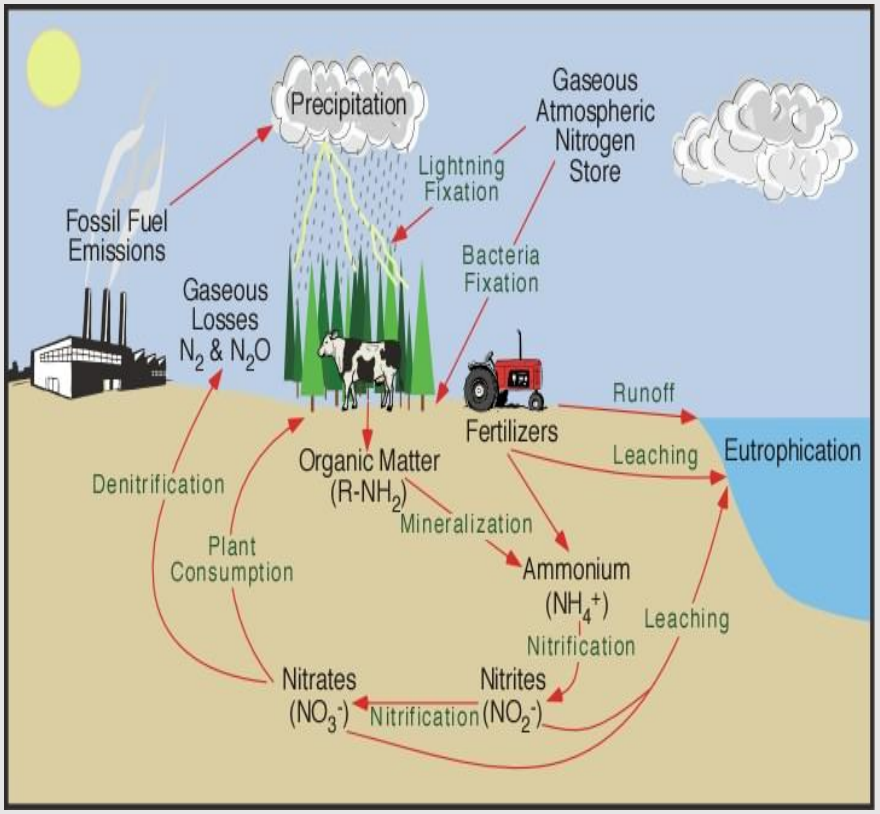
3) Farm as part of the total chain

4) Farm emission – how to calculate, results, reduction potential

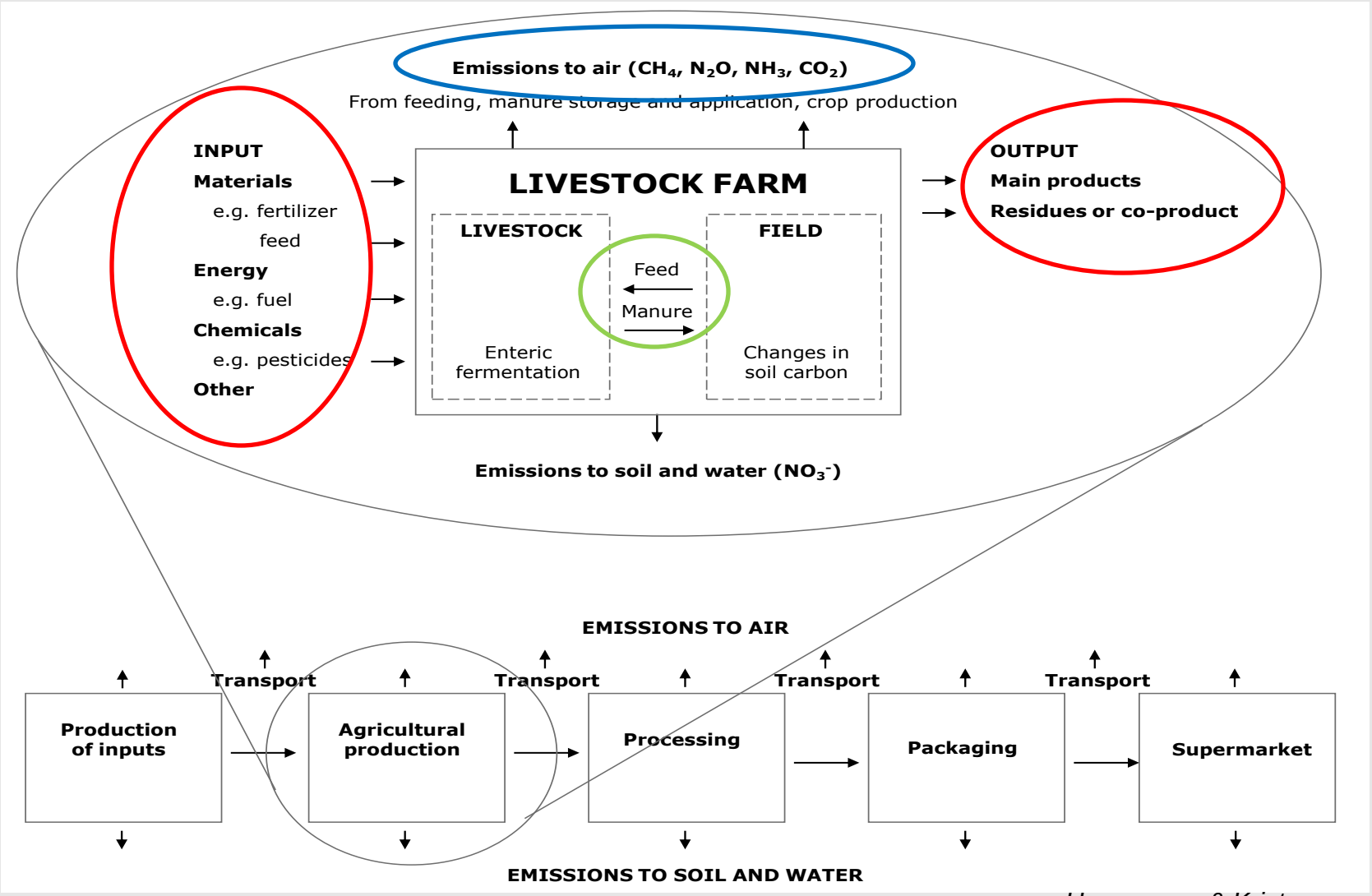
5) Conclusion and perspectives

Emission of GHG from agriculture are part of the global Carbon and Nitrogen cycles





Farm production and emissions in a system approach



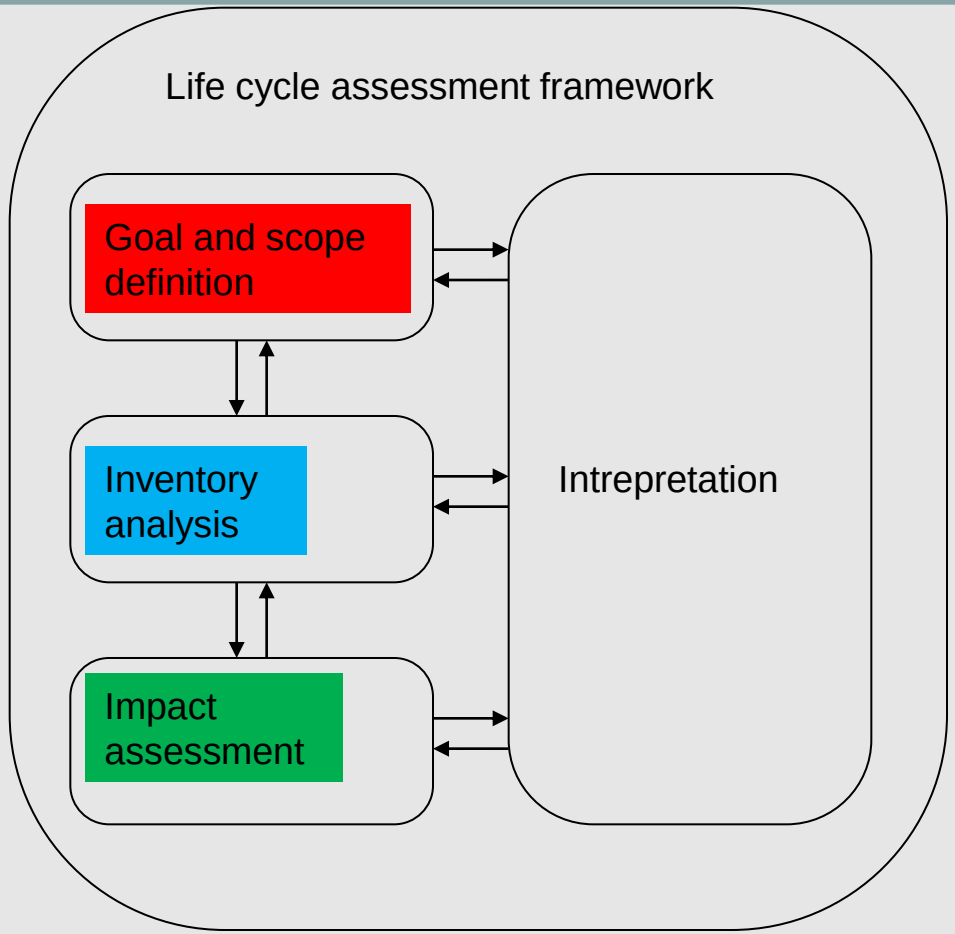
Hermansen & Kristensen, 2011

Green house gasses – commen unit CO_2 eq.

- **1 kg Carbondioxid (CO_2)** **= 1 kg CO_2 eq.**
  - Fossile energy
  - Soil carbon change
- **1 kg Methane (CH_4)** **= 25 kg CO_2 eq.**
  - Enteric fermentation
  - Manure
- **1 kg Nitrousoxide (N_2O)** **= 298 kg CO_2 eq.**
  - Manure handling and crop production

(100-årig tidshorisont, IPCC 2007)

How to use an LCA approach?



- **Functional unit**
- **System boundaries**

- **Model of the system**
- **Produktion data**
- **Emissions factors**

- **Emissions converted and aggregated**
- **Allocation between products**

Production data - DK dairy farms

	Unit	Year
		2010
Farm area	ha	251
- permanent grass	ha	13
Crop yield	SFU pr ha	7599
- sold	SFU pr ha	932
N applied to fields	Kg gros N pr ha	209
-Manure	Kg gros N pr ha	157
Herd size	LSU	419
Cows	n	244
Milk production (sold)	Kg ECM pr cow	9271
Heifers	n	201
Feed intake	SFU pr LSU	5281
Live weight gain - herd	Kg pr LSU	164

Total GHG emission from the dairy production and contribution from different sources

		Year
		2010
Total emission	CO_2 eq (ton)	2595
-Per area (ha farm land)	CO_2 eq (kg)	10931
-Per LSU	CO_2 eq (kg)	6272
Contribution from different sources	%	
-methane		54
-nitrousoxide		19
-fossil energy (incl. contracter)		12
-feed import		12
-fertilizer import		2

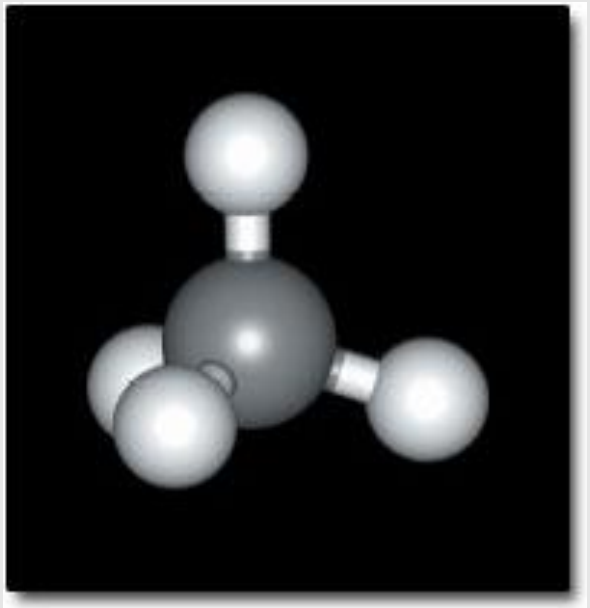
GHG emission from DK milk production – land use perspective

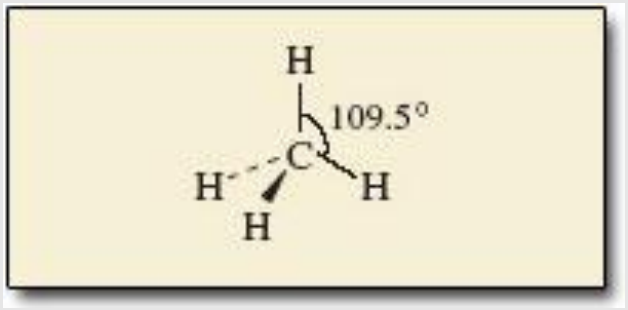
Production of milk	10900 kg CO_2 eq per ha
-Emission at the farm	8000 kg CO_2 eq per ha
-Fossil energy use	1300 kg CO_2 eq per ha
Production of bioenergy crop (willow)	- 12000 kg CO_2 eq per ha
Production of biogas (manure from 1.7 LSU)	- 1500 kg CO_2 eq per ha
Private transport annually (20.000 km)	7000 kg CO_2 eq
Diet annually one adult	900 - 1200 kg CO_2 eq

Allocation of total emission to different products (IDF method)

		Year
		2010
Proportion to the products	%	
- milk, kg ECM sold		78
- meat, kg live weight		17
- cach crops, SFU		5
Emission per kg product	CO_2 eq. (kg)	
- milk, kg ECM sold		0,90
- meat, kg live weight		6,31
- cach crops, SFU		0,53

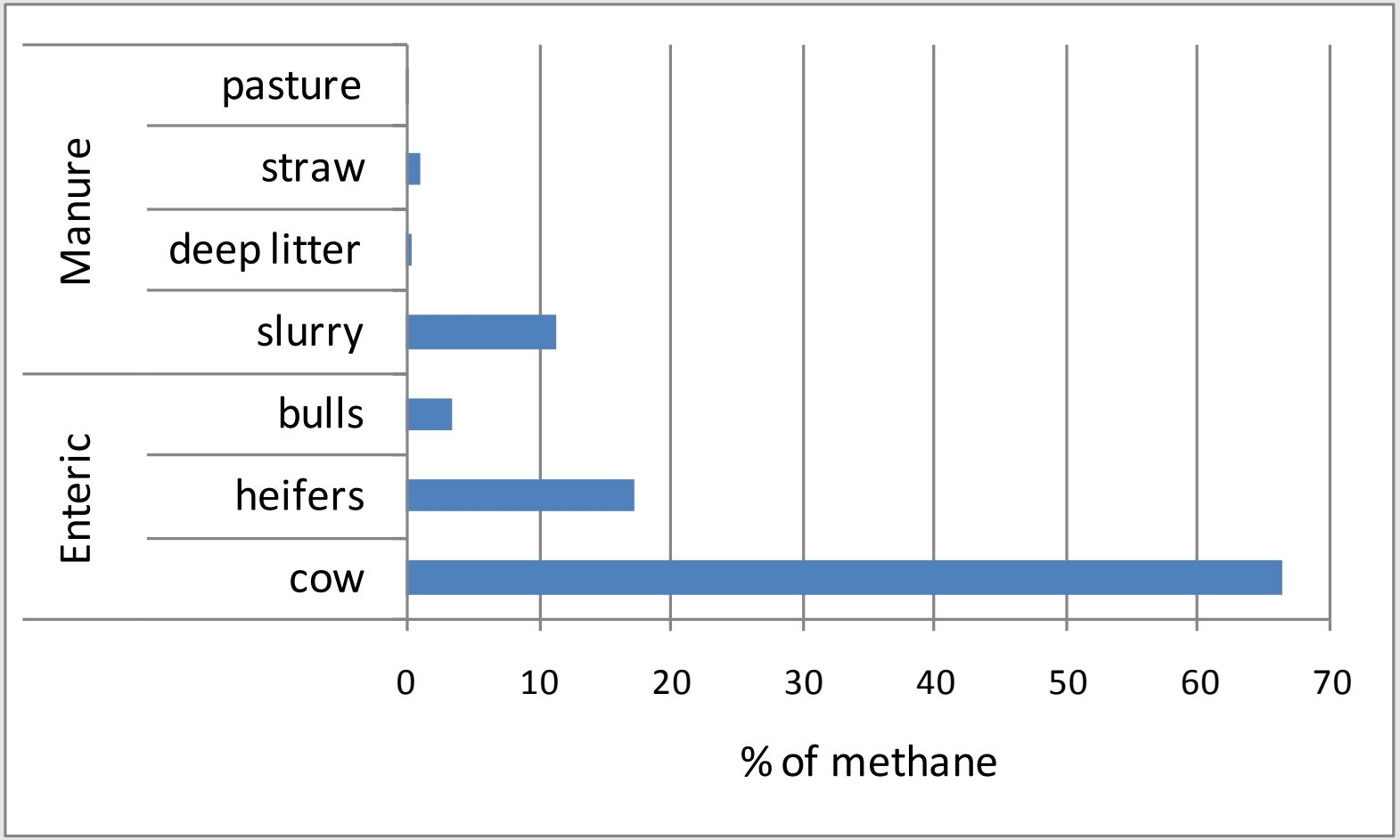
Methane (CH_4)





LCA of Danish milk production

Methane – where do the emission occurs ?



Reduction of methane emission per kg of milk in intensive systems

Mitigations options

Feeding

Herd structure

Breeding

Farm management

Trade offs

Effect on emission of other GHG

Pollution swapping

Product quality and food security

Animal health

Social acceptable

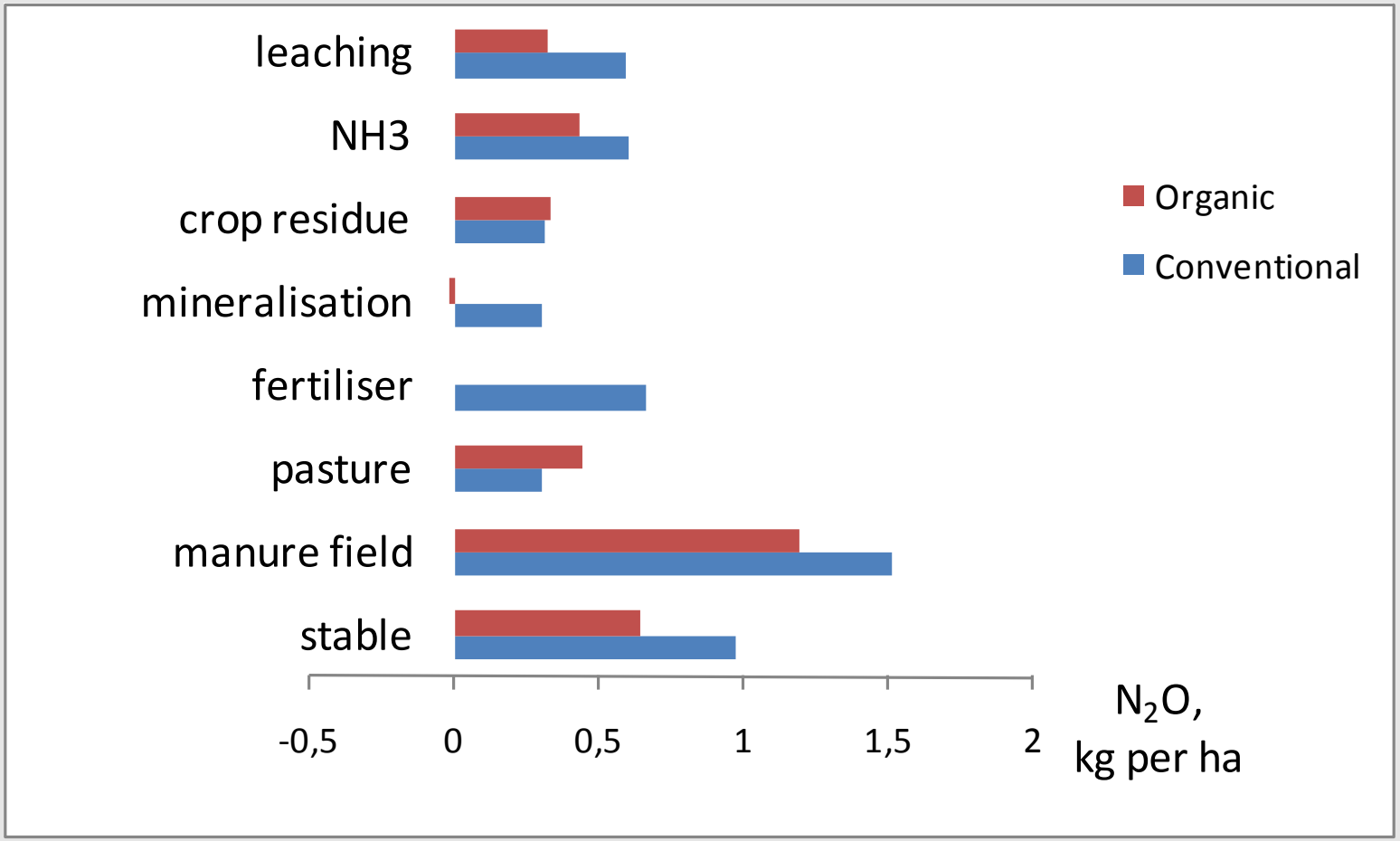
Illustration of partial reduction in GHG emission and potential trade offs

	Concentrate / forage ratio		Change, %
	32 / 68	53 / 47	
Enteric Methane [1)]			
- g CH_4	18,0	14,4	
- g CO_2 eq	450	360	- 20
Feed supply, g CO_2 eq			
- concentrate	83	141	
- forage	113	77	
Total	196	218	+ 11
Enteric + feed supply	646	578	- 11
Landuse, m^2	0,73	0,84	+ 15

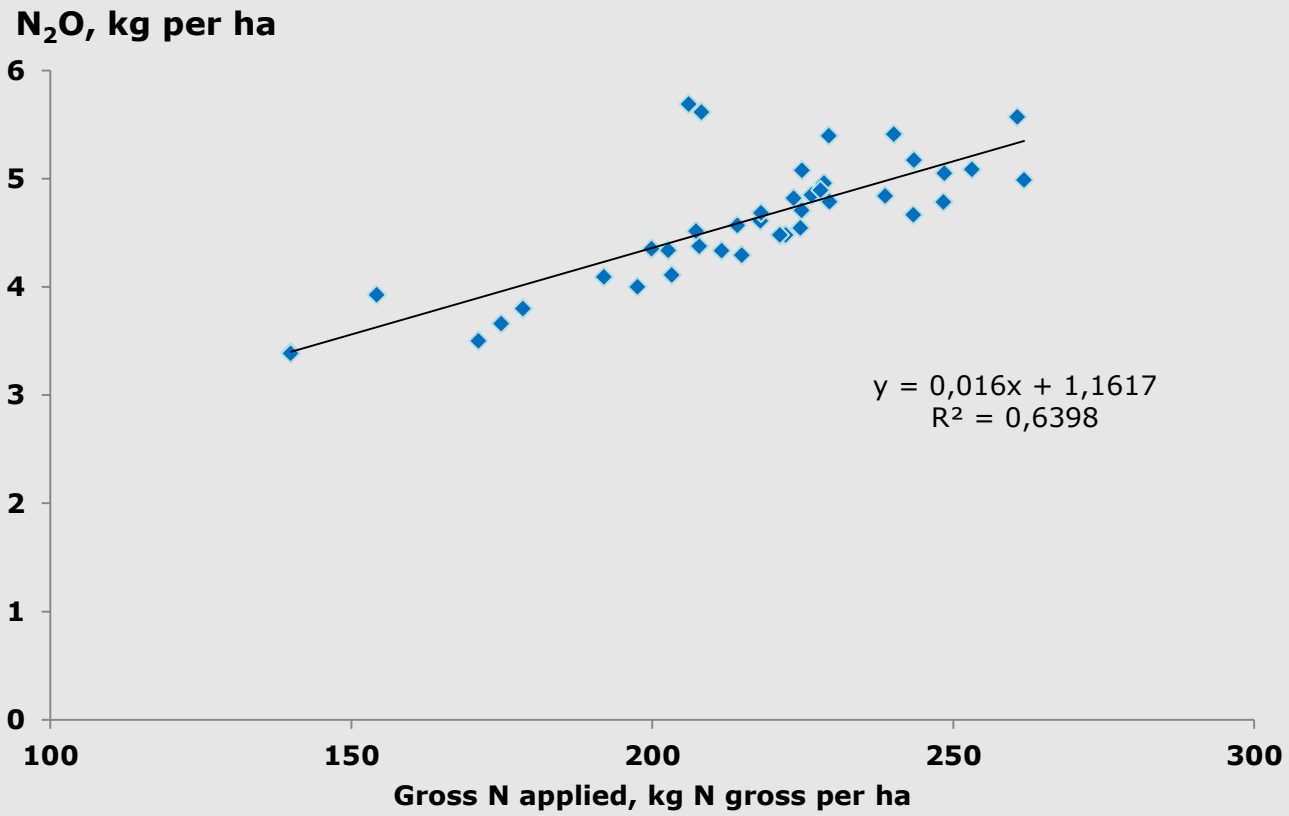
1) Aguerre et al 2011

LCA of Danish milk production

Nitrous oxide – where do the emission occurs ?



Emission of N_2O per ha in relation to N applied per ha in manure + fertiliser



Reduction of N_2O emission per kg of milk in intensive systems

Mitigations options in relation to livestock

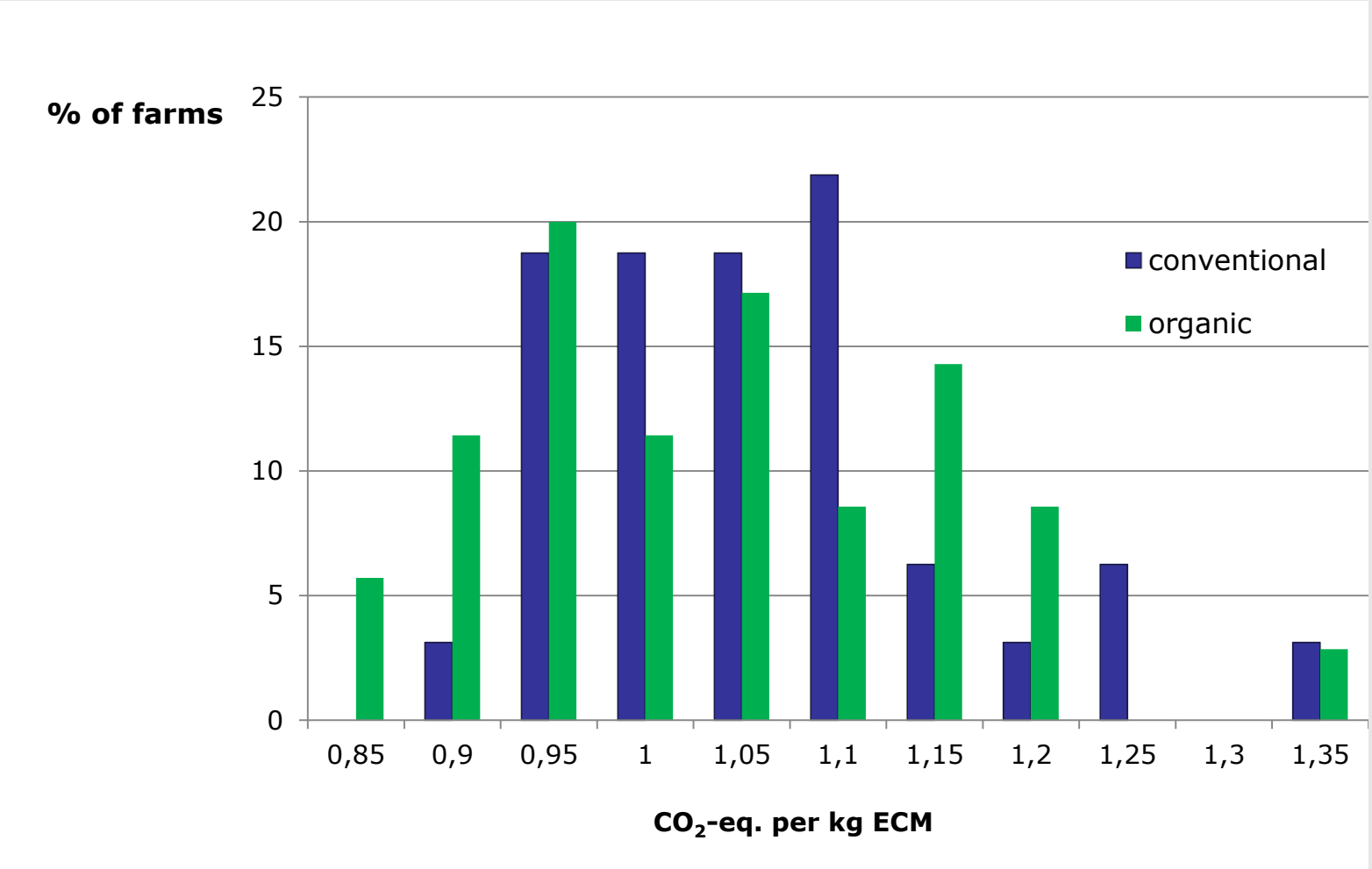
Reduced N intake

Manure management

Utilization of legumes

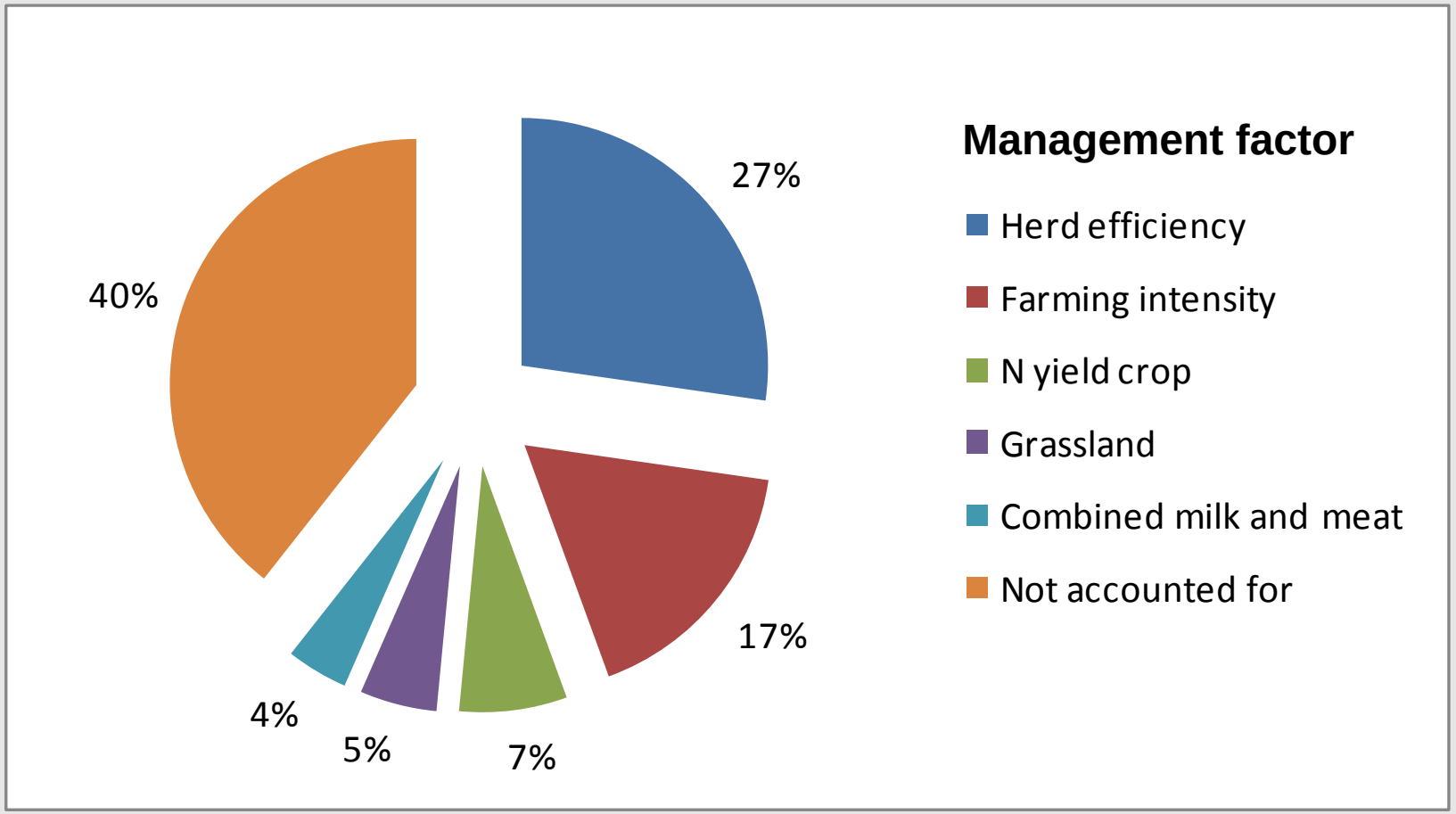
Variation between farms

Variation in CF of milk between farms



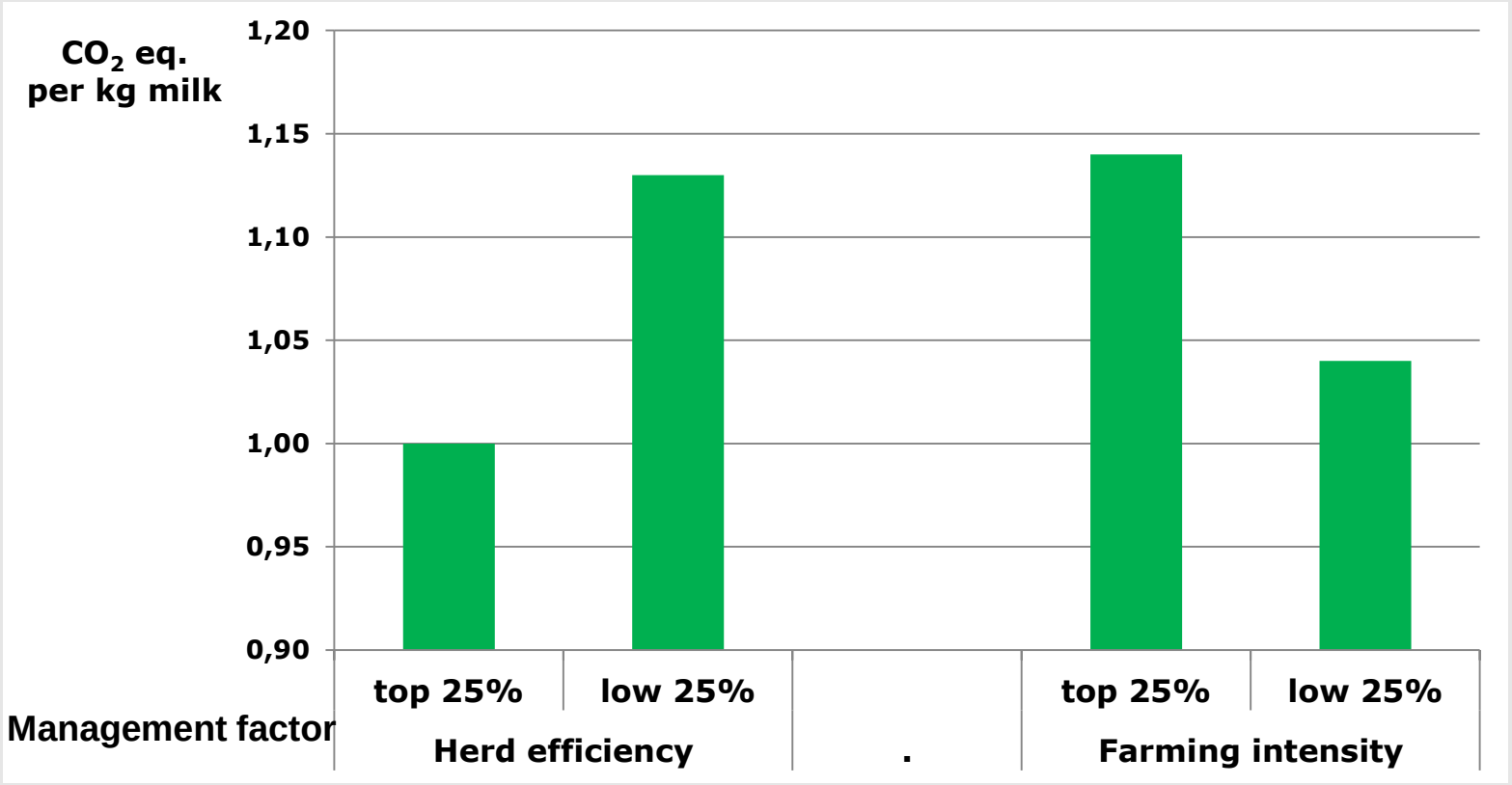
Kristensen et al, 2011

Variation in CF of milk explained by different management factors



Kristensen et al, 2011

CF of milk related to management faktor



ECM per kg DM	1,32	1,06	Feed import, % of NE	39	-4
ECM per cow	8488	6964	Gross N, kg per ha	279	198
			Yield, DM per ha	6260	6333

Kristensen et al, 2011

Farming strategies effect on emission of GHG – USA model

	Basis	Feeding and breeding	Forage increased	Maize silage	Biogas
Yield, kg ECM	9000	10400	9000	9000	9000
% forage	45	45	59	45	45
- part as maize	50	50	50	75	50
CH_4 kg per cow	147	160	179	138	147
N_2O kg per cow	6	6	6	5	4
CO_2 eq. per ECM	0,86	0,83	0,98	0,80	0,63
- Relative to basis		97	114	93	73

Rotz et al. 2010

Conclusions – CF of intensive milk production

Uncertainty relative large compared to reported differences between systems

Large variation between studies due to methodological choices

CF of Danish milk

- Farm emission: 80-90 % of total emission
- Enteric methane largest source (54 % of emission at farm gate)
- Fossil energy only 12 % of emission at farm gate
- High herd efficiency is the most important factor for reducing CF
- Low stocking rate reduces CF

Conclusion regarding method

- LCA one of the best methodologies for GHG balance calculation due to the chain approach
- However, key aspects to be considered with regard to LCA
  - Production data
  - Allocation
  - Land use change (direct, indirect)
  - Soil carbon changes /soil fertility
  - Biodiversity and other environmental issues

Thank you for your attention