Sustainable dairy – farm perspective

Troels Kristensen, Aarhus University, Department of Agroecology
Mail:troels.kristensen@agro.au.dk

A: Sustainable – turn over at farm level (resources, money, nitrogen and emission)

B: Emission (CF) feed production

C: Dairy systems effect on product impact

D: Dairy farming past, present and future


Environmentally sound
Sustainable livestock
Economically viable
Socially responsible

BÆREDYGTIG PRODUKTION BETYDER FOR OS

- God ledelse, attraktive arbejdspladser og god økonomi
- Vi passer på dyrene. Vores dyr har høj dyrevelfærd, og vi har et af de laveste antibiotikaforbrug i verden. Vores dyr går løse i åbne stalde med masser af plads og luft
- Vi passer på naturen. Vi laver naturpleje og fremmer biodiversitet
- Vi passer på klima og miljø ved at producere ressourceeffektivt og optimalt. Det bevirker, at vi minimerer tab til omgivelserne og skaber både en bedre økonomisk og miljømæssig bundlinje
- Vi producerer mælk og kød, som er byggesten i en sund ernæring

Most relevant impact categories for dairy product

- Climate change
- Water resource depletion
- Freshwater eutrophication
- Marine eutrophication
- Terrestrial eutrophication
- Freshwater ecotoxicity
- Land use
- Acidification

Product Environmental Footprint Category Rules

for

Dairy Products

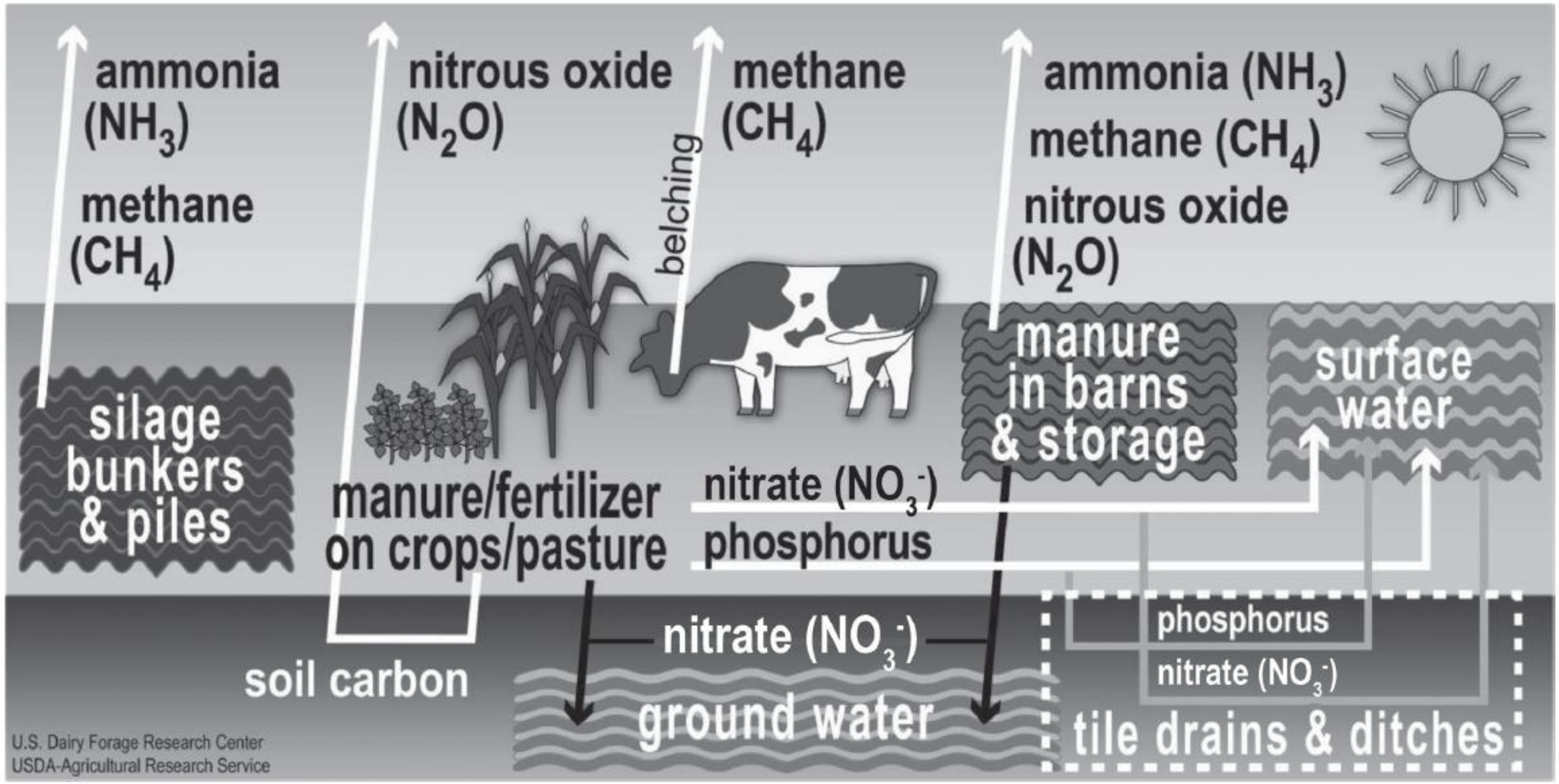


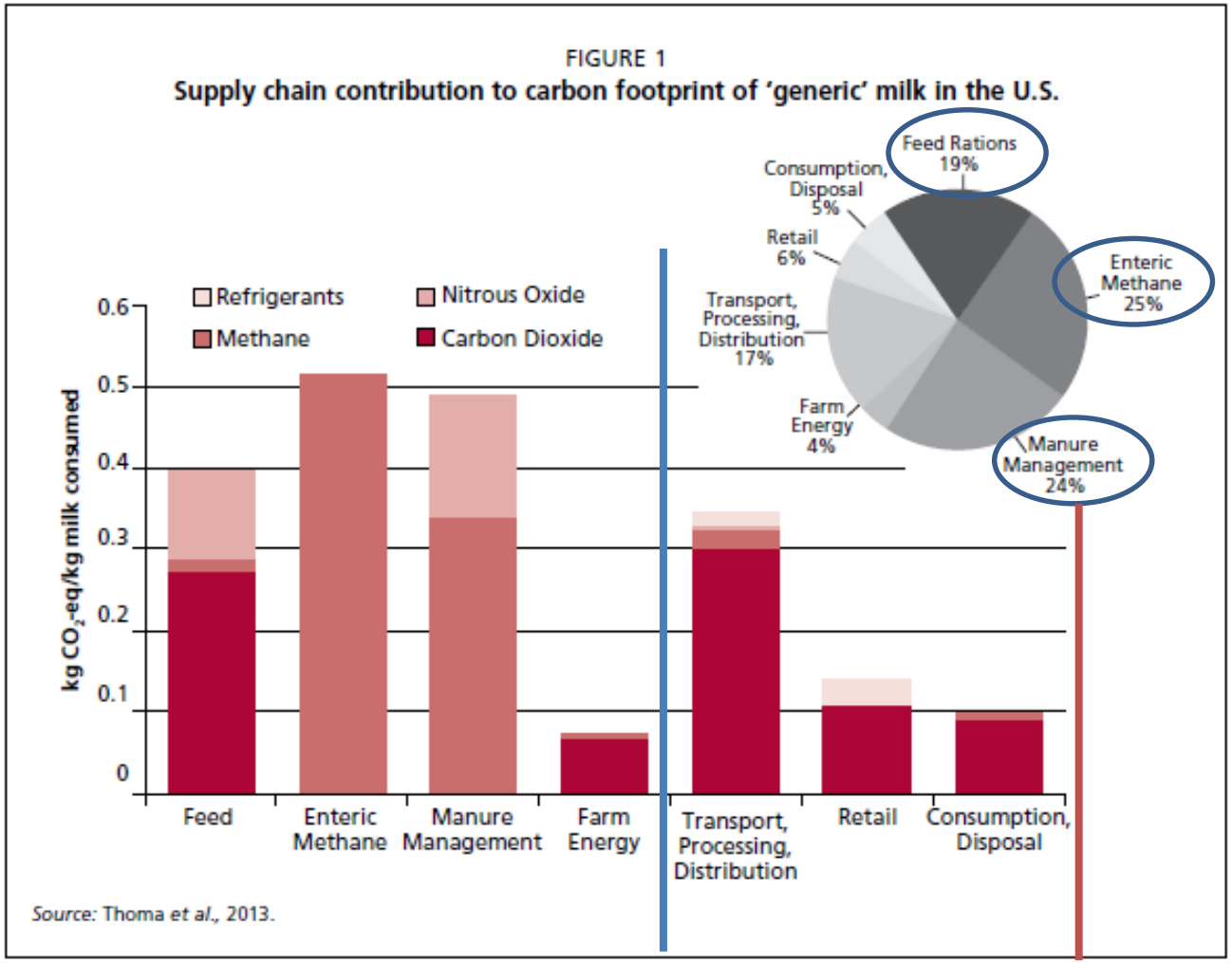
Figure 5. How N, P, and C enter the atmosphere, surface water, and ground water (adapted with permission from US Dairy Forage Research Center, USDA-ARS, Madison, WI).

Turn over Danish dairy herd – 10.000 kg milk + 160 kg meat (1 cow + 1 heifer)

Typical figures, one year.

	Feed, kg DM	ha	Economic, dkr		Nutrient, kg N ab animal		Emission, kg CO_2 eq.	
Silage	5.300	0,60	4.800		106		1.800	
Grain	1.200	0,20	1.300		20		600	
Concentrate	2.500	0,75	7.000		124	250	1.500	
Mineral ec.			900					
Other cost			2.000	16.000				
Man power			4.000					
Investment			7.000	11.000				
Sum Input	9.000	1,55		27.000				3.900
Milk			25.000		53			
Meat			3.000		4	57		
Manure			(1.500)	29.500				
Emission							6.100	6.100
”Surplus”				2.500		153		10.000

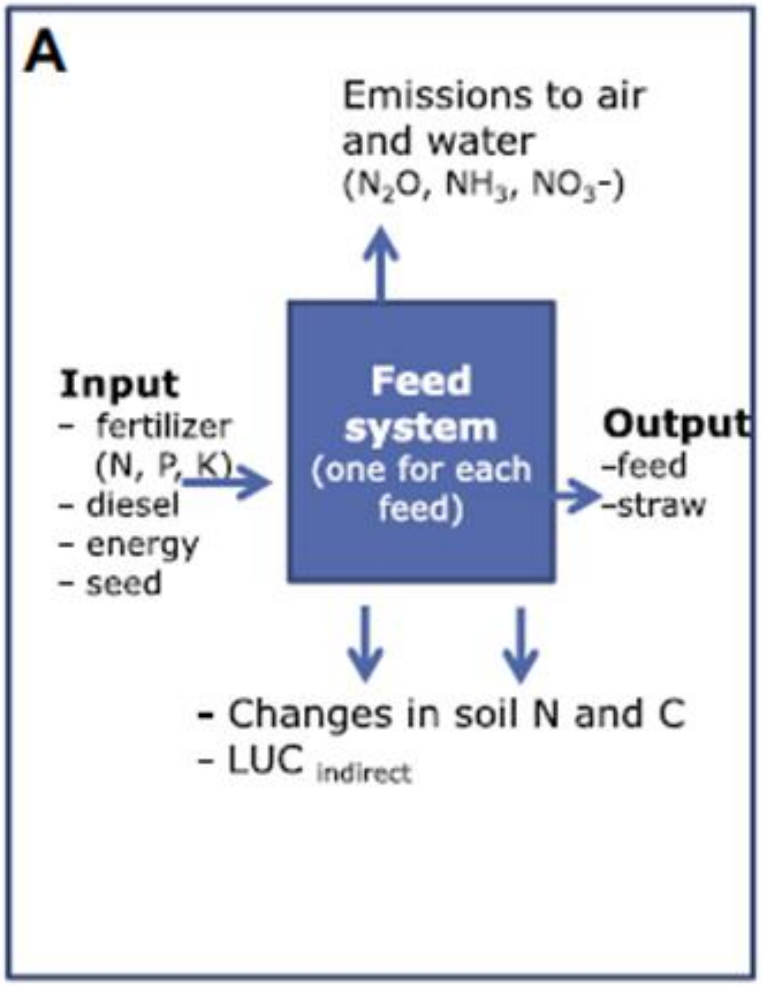
Hot spots through the production chain of USA dairy products – climate change



The 3 big ones

Farm level

Consumer level

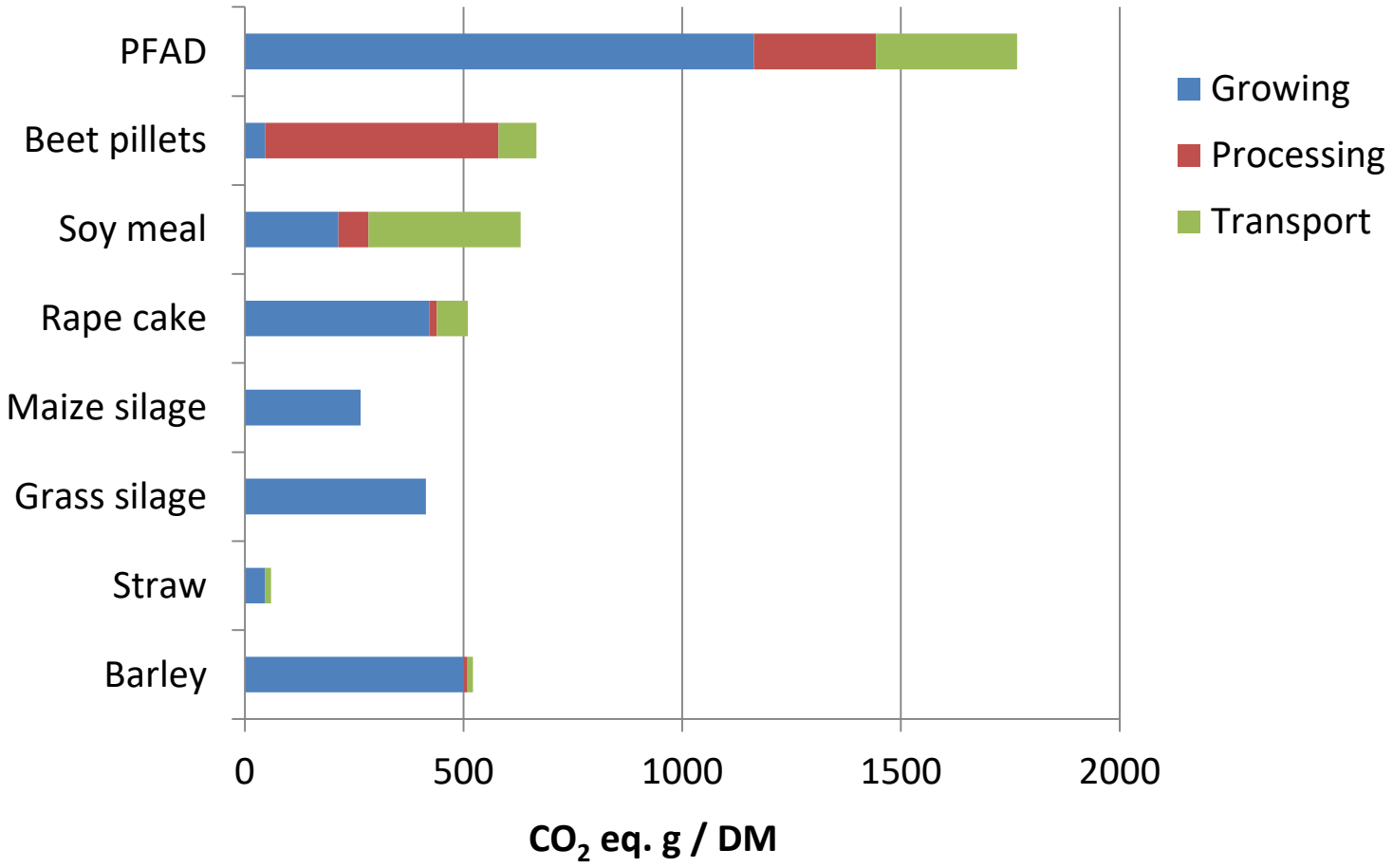


Feed production important areas

- Yield
- Fertiliser
- Energy
- Transport

- Country

Emission of GHG from a range of typical dairy feed stuff

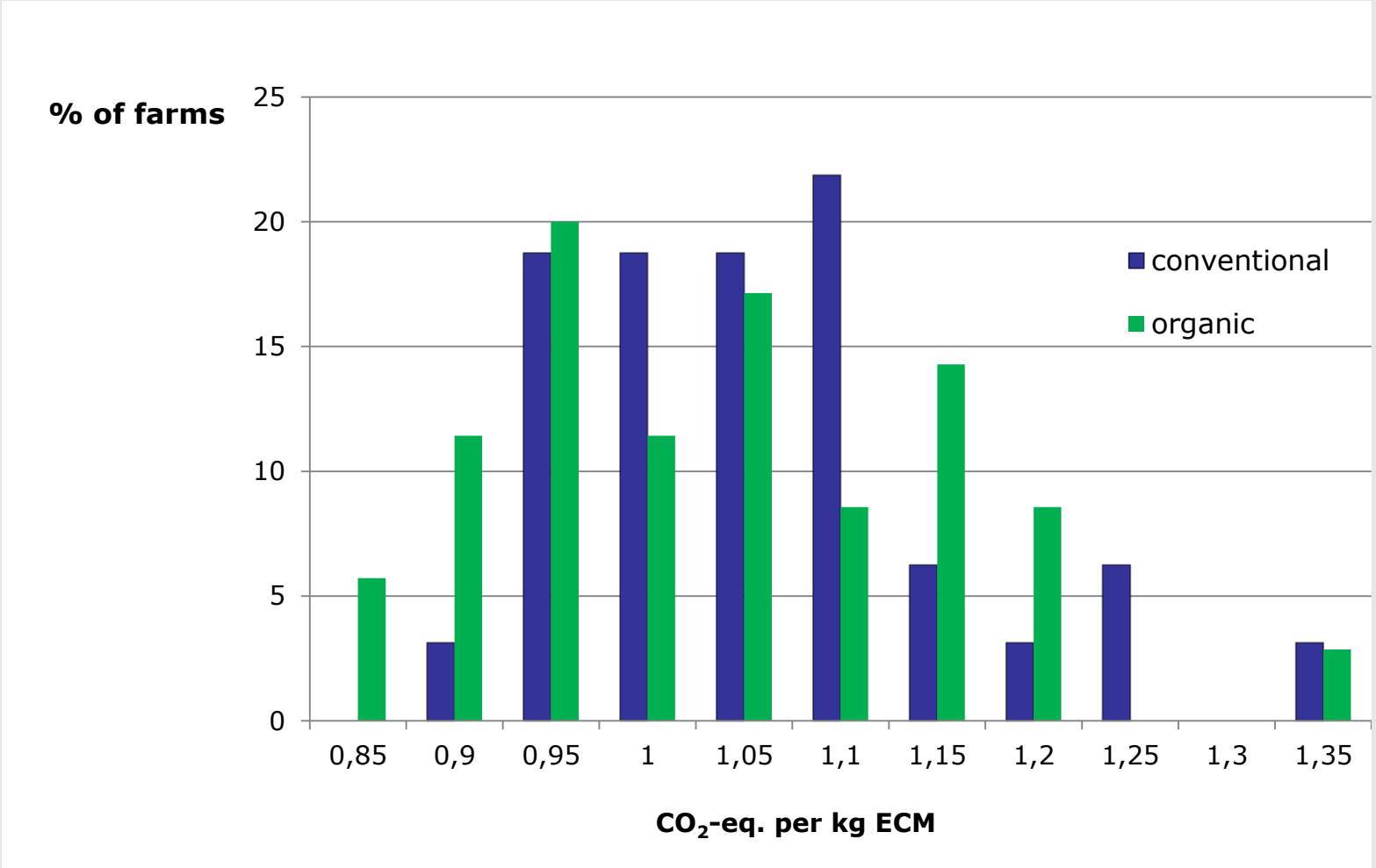


Conclusion: Feed production

- Roughage lower emission than concentrates
- Biproducts often low emission
- Dried products high emission
- Local protein lower than soja imported
- Some effect of soil carbon on ranking of typical feed stuff
- Variation low between balanced rations in GHG

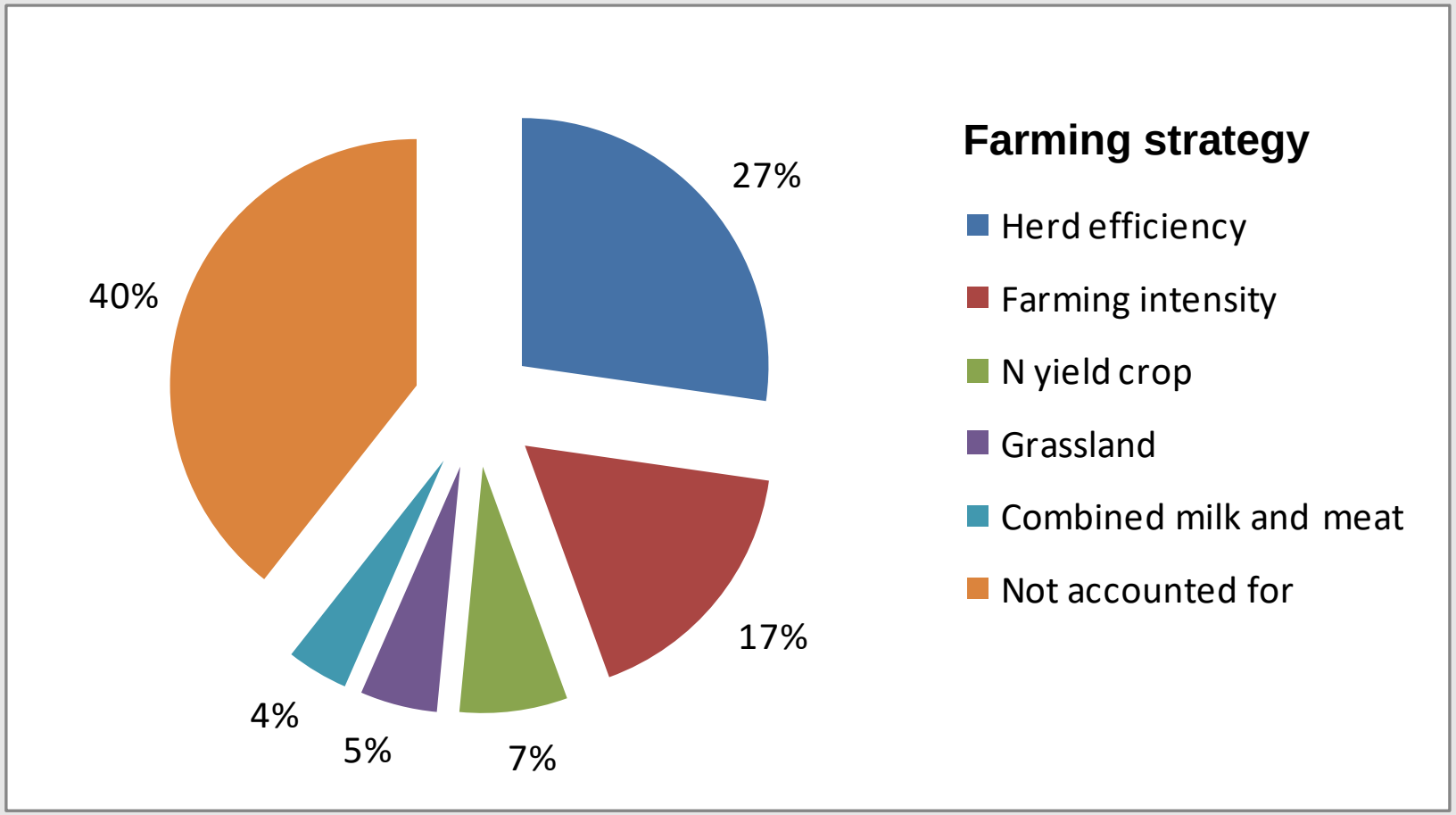
Variation between intensive Danish dairy farms (n=67)

Variation in CF of milk between danish dairy farms



Kristensen et al, 2011

Variation in CF of milk explained by different farming strategies



Kristensen et al, 2011

Historic perspective
Typical Danish dairy farms

1920 – representing local production and marketing

1950 – representing the period with emerging mechanization and introduction of new technologies and a more global marked

1980 – representing a period with heavily use of external resources like fertilizer and protein

2010 – today with focus on balancing production and risk of environmental damage.

Kristensen et al. 2015 / Livest. Sci. (178) 306-312

Dairy - historical development

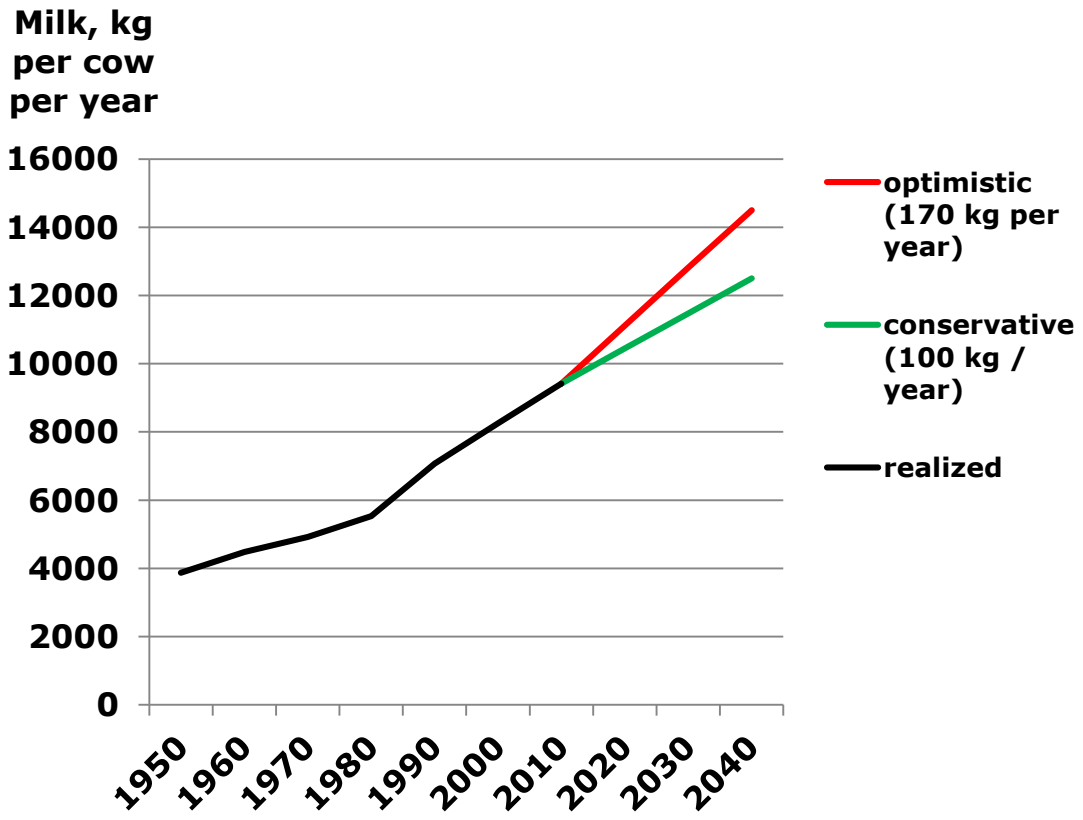
Key figures typical dairy farms 1920 – 2010 in Denmark

Year	1920	1950	1980	2010
Yield, kg ECM / cow / year	1804	3435	5058	8994
Meat, kg / 1000 kg ECM	42	29	46	23
Fertilizer, kg N / ha	5	22	129	74
Protein, g crude protein / kg DMI	142	137	180	157
Feed efficiency, kg ECM / kg DMI (herd level)	0.39	0.62	0.62	0.90
Total emission, kg CO_2 eq.				
Per cow	4392	5088	9830	10761
Allocation				
Per kg ECM	1.27	0.92	1.02	0.81
Per kg meat	25	18	20	16

Kristensen et al., 2015

Herd production in 2040 ????

Milk recording Holstein in Denmark 1950-2010



Optimistic = reality??

- Genomic selection
- Feed ration evaluation
- Cow specific information
- Housing facilities
- Health management

Kristensen & Weisbjerg, 2015

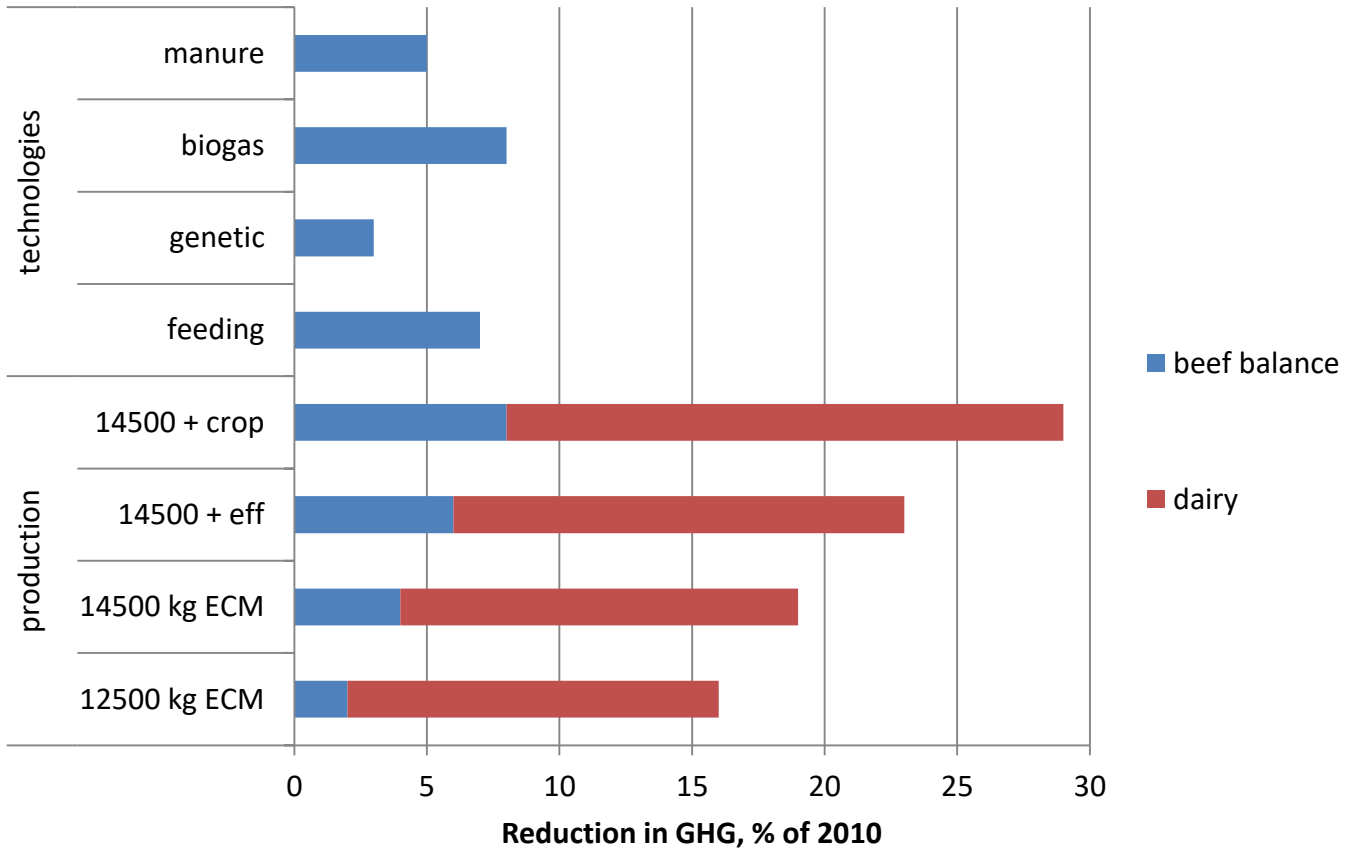
Emission in 2040 – different scenarios

	O: Present (2010)	I: Conser-vative	II: Optimist	III: Optimist + High herd efficiency 1)	IV: III + Increased crop production (20%)
Year	2010	2040			
Yield per cow	9000	12500	14500	14500	14500
Efficiency - ECM / DMI (herd)	0.89	1.09	1.18	1.21	1.21
Stocking rate - ECM / ha (farm)	7372	8781	9494	9705	11630
CO_2 eq. per kg ECM (no allocation)	1.20	1.01	0.94	0.92	0.87

1) 3 %-units

Potential reduction in GHG per kg milk in 2040 compared to 2010

Dairy productivity, beef balance and different technologies



Summary - CF

Environmental impact of dairy products is highly influenced by the farm stage

Impact has to be estimated for the whole system – dairy farm or sector

Danish studies show

Productivity increase emission per animal – but reduce product emission (25-40% effect)

Feed efficiency reduce emission per animal and product (60-80% effect)

Herd structure – more milk per kg DM – reduce product emission (60-70% effect)

Additional – be aware

National Kyoto emission might rank systems different than LCA product emission!!!

Thank you for your attention

When assessing the mitigation potential of various practices, users must consider the combined effects of interactions among animal-manure-soil-crop processes related to whole-farm profitability, effectiveness in the field (vs experimental results) and the likely adoption rate.

Hristov et al. 2013