

Productivity, efficiency and environmental load from cattle production since 1920 – in Denmark

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Agenda

Background data and information

Typical farm (1920, 1950, 1980 and 2010)

- Production
- Efficiency
- N load
- GHG emission

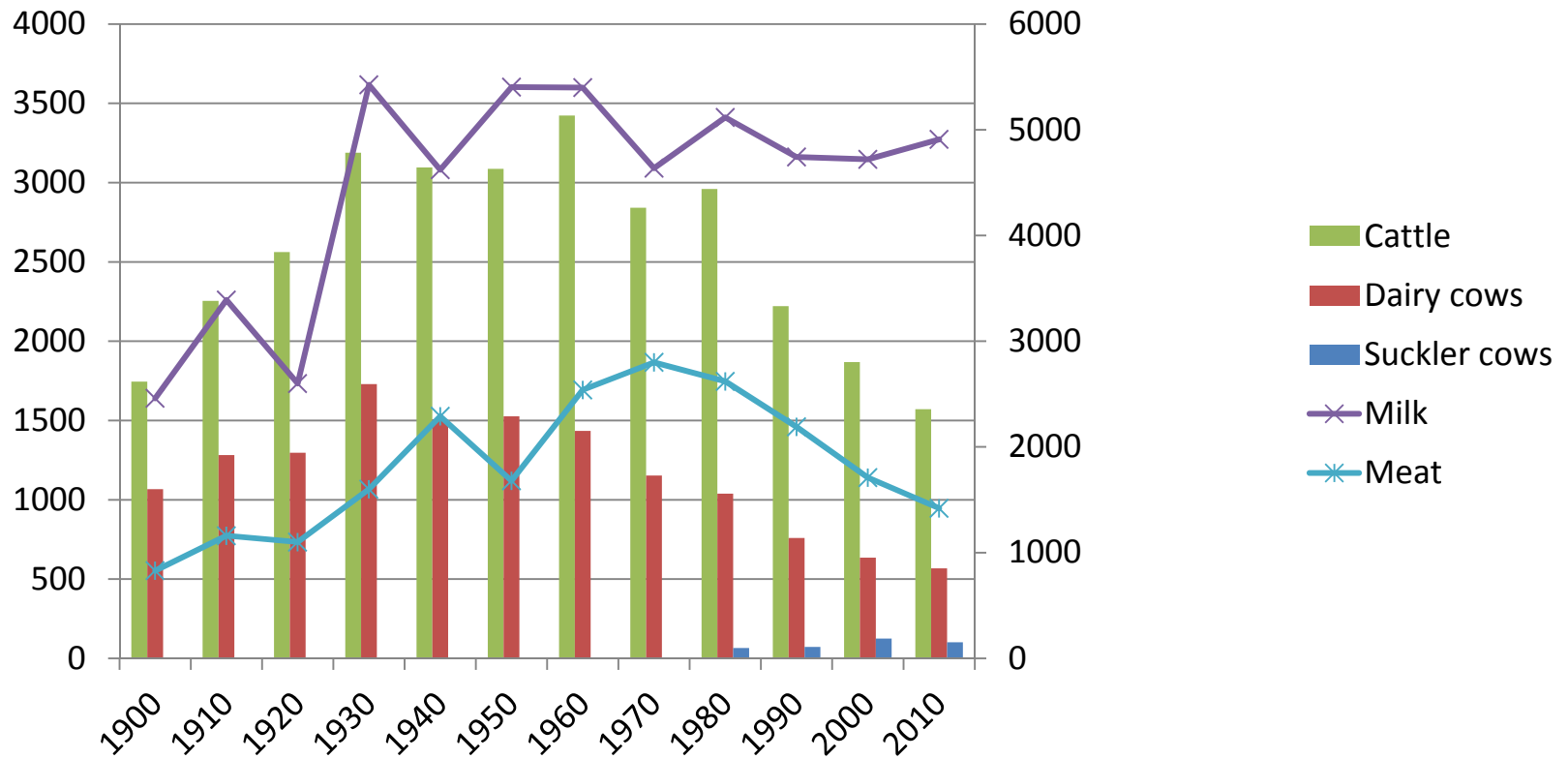
Future trends



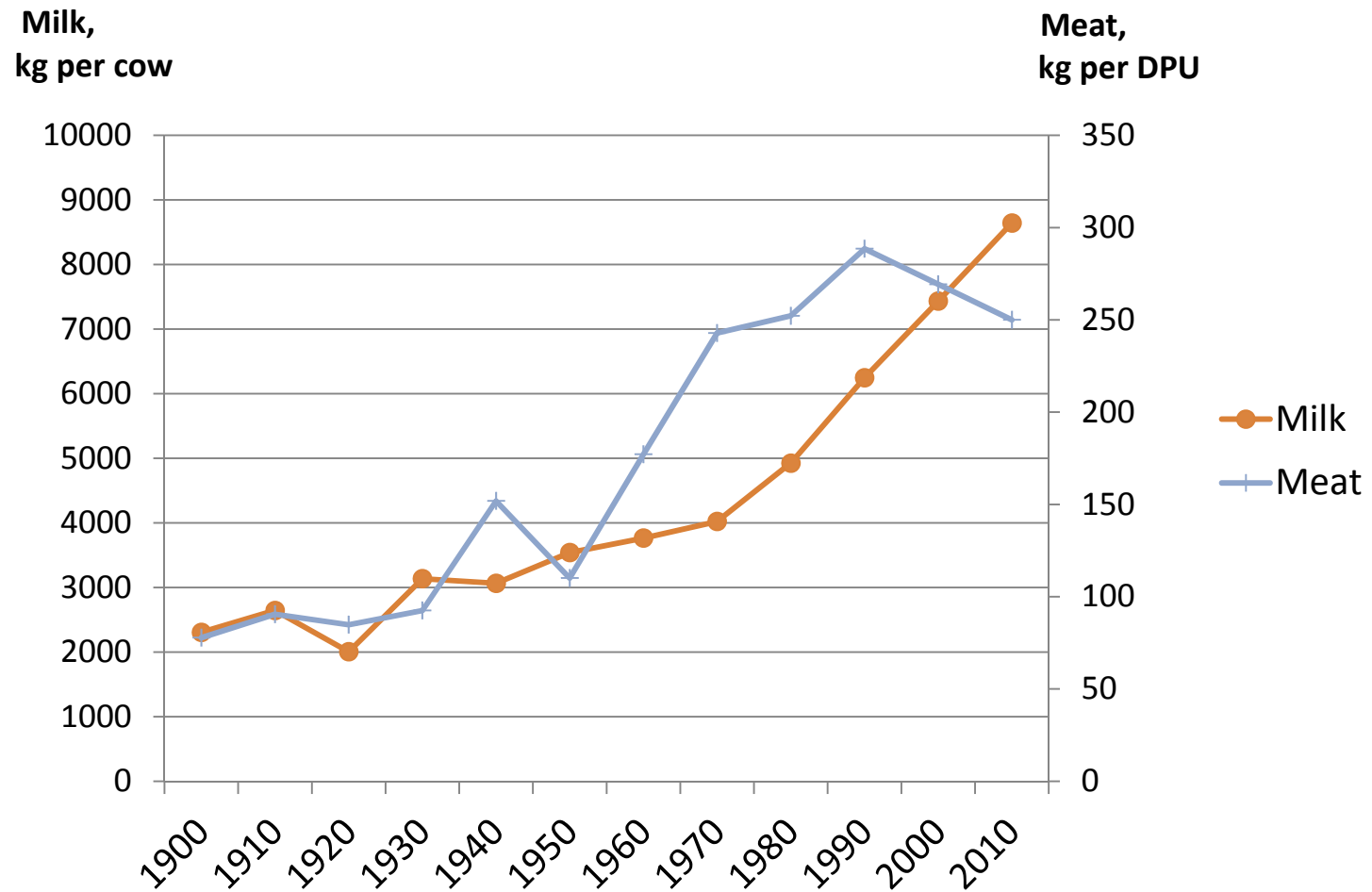
Number of cattle and annual production of milk and meat – Denmark 1900 to 2010

Number, x 10³

Milk, x 10⁶ kg
Meat, x 10⁵ kg

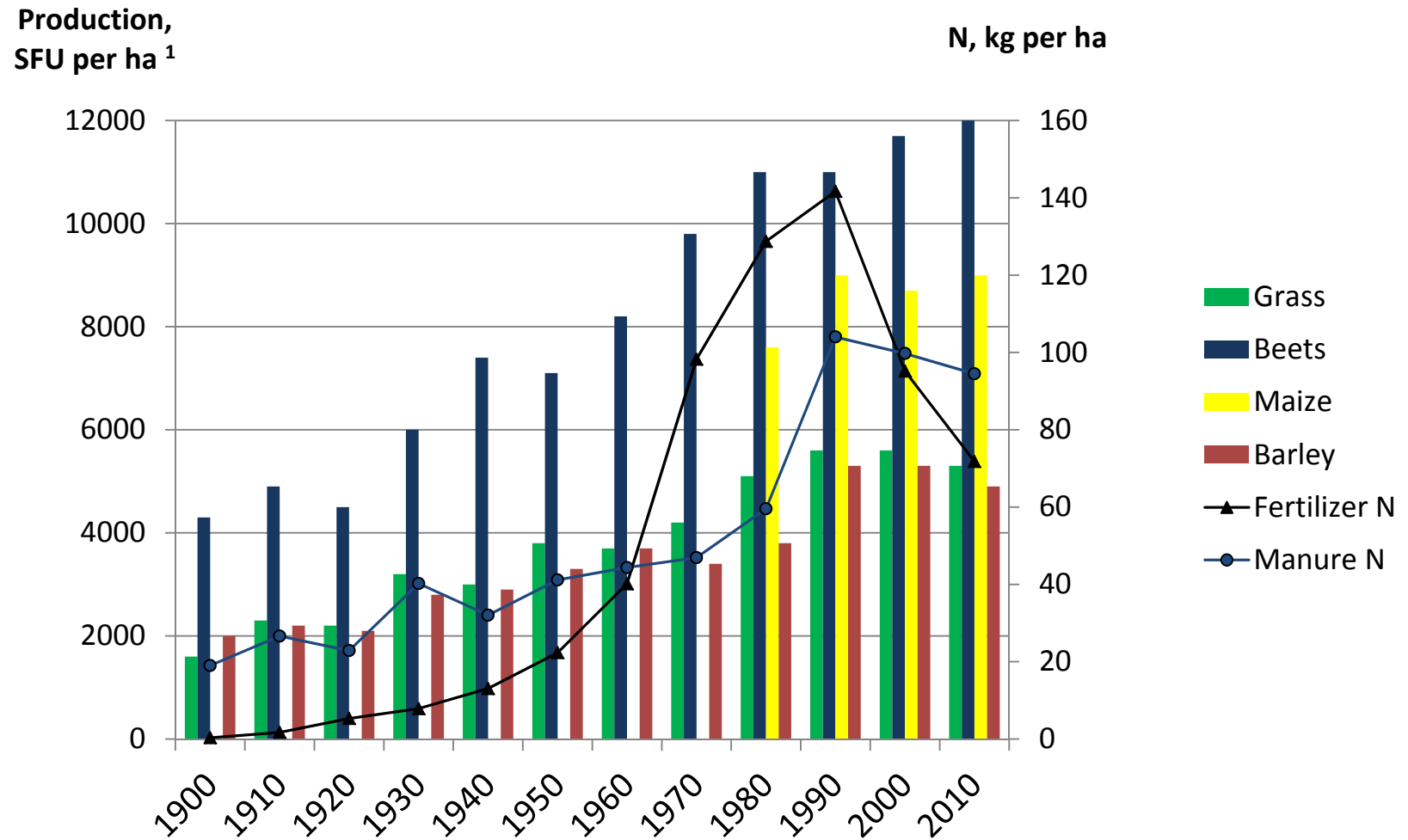


Production of milk and meat, kg annually **per dairy cow** – Denmark 1990 to 2010



1: DPU: dairy production unit – one dairy cow including young stock

Production of main crops and use of nitrogen in average per ha of arable land - Denmark



1: One SFU = 7,8 MJ Net Energy

Development in technology 1920 - 2010

From hand milking to robot milking (AMS)

1920: First milking machines

1950 : 45% of cows milked by machines

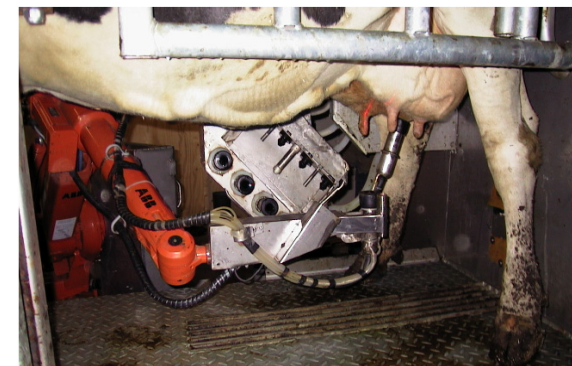
1960: First pipeline milking system

1970: First milking parlors

1980: Automatic teat cup removers

1990: First AMS

2010: 25% of cows milking in AMS



Typical farms

1920 – representing local production and marketing



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



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.

Key figures typical **dairy farms** 1920 – 2010 in Denmark, farm and herd level

Year	1920	1950	1980	2010
Dairy cows	7	8	20	134
Heifers	5	6	22	126
Bulls	2	2	12	55
Yield ¹ , kg ECM / cow / year	1804	3435	5058	8994
Meat, kg / DPU / year	76	100	229	211
Farm land, ha	8,8	8,0	19,4	162,1
Forage, SFU / ha	2118	3841	5176	5551
Energy content, SFU / kg DM	0,74	0,81	0,89	0,93
Protein, g crude protein / kg DM	142	137	180	157
Feed efficiency ² , %	39	49	57	64
Protein efficiency ³ , %	12	19	16	23

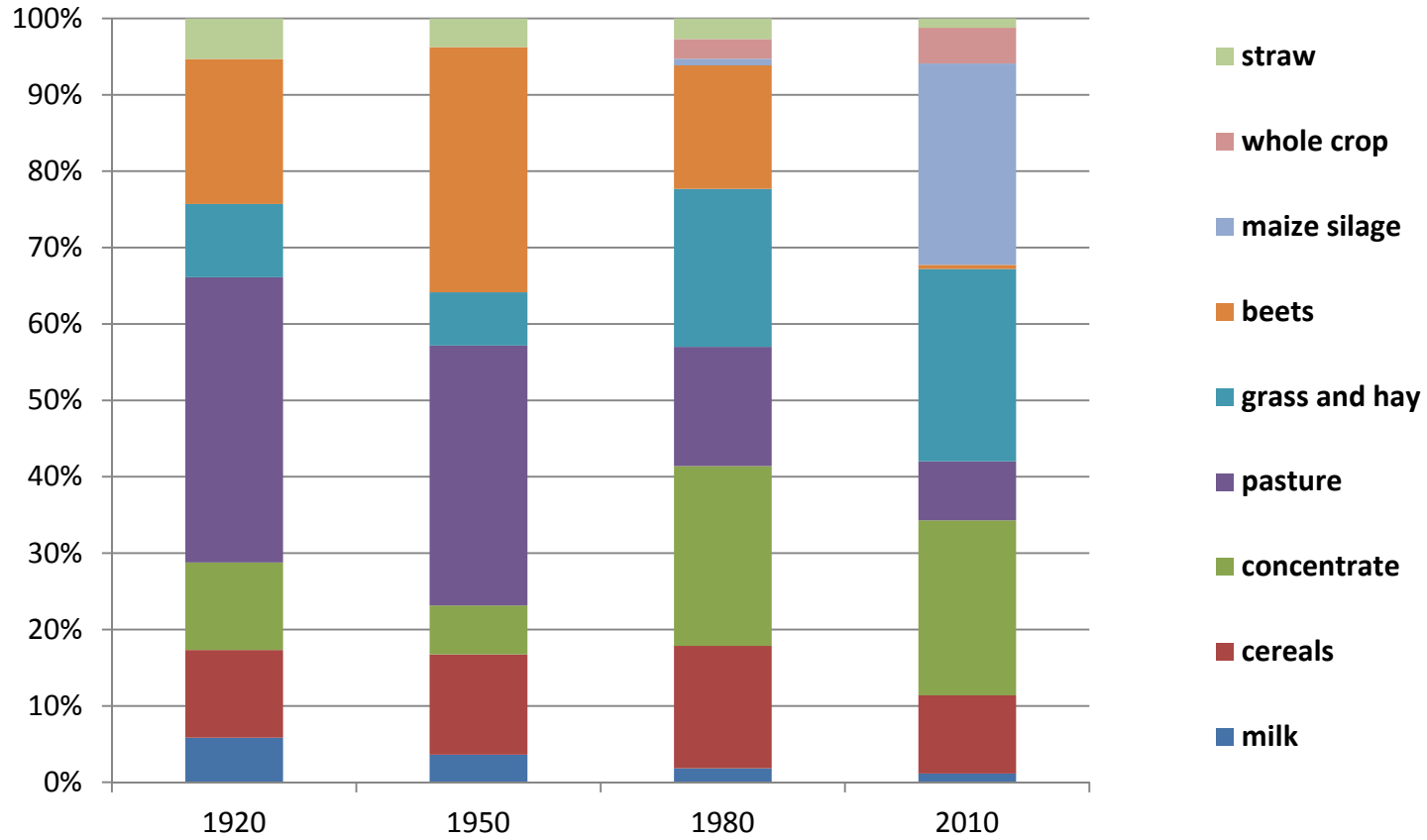
1: Delivered to dairy and used as feed and food on the farm

2: NE for milk and meat in percent of NE intake

3: Protein in milk and meat in percent of protein intake

Composition of the feed ration – herd level

Net energy

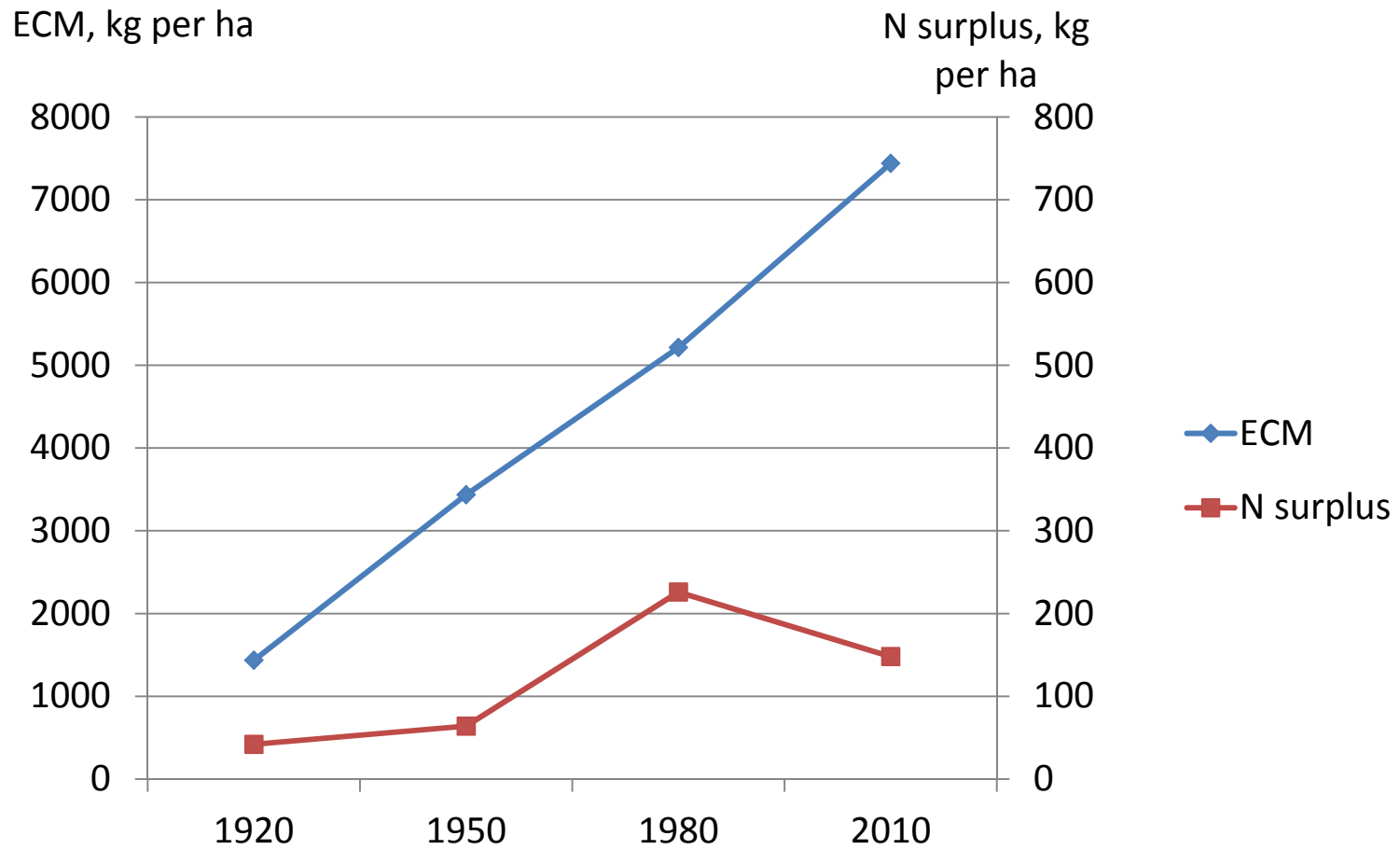


N balance at farm level for typical **dairy farms** – Denmark 1920 -2010

Year	unit	1920 ¹⁾	1950 ¹⁾	1980	2010
Fertilizer	Kg N per ha farm land	5	22	129	74
Fixation		29	48	33	42
Feed		15	15	103	80
Total input		49	85	266	196
Milk		6	15	27	39
Meat		3	5	12	9
Total output		9	20	39	48
Farm balance		40	65	226	148
Efficiency	%	18	23	15	24
NH ₃ -N losses		10	16	41	26
Hot spot losses		6	6	9	0

1) Including 2 horses

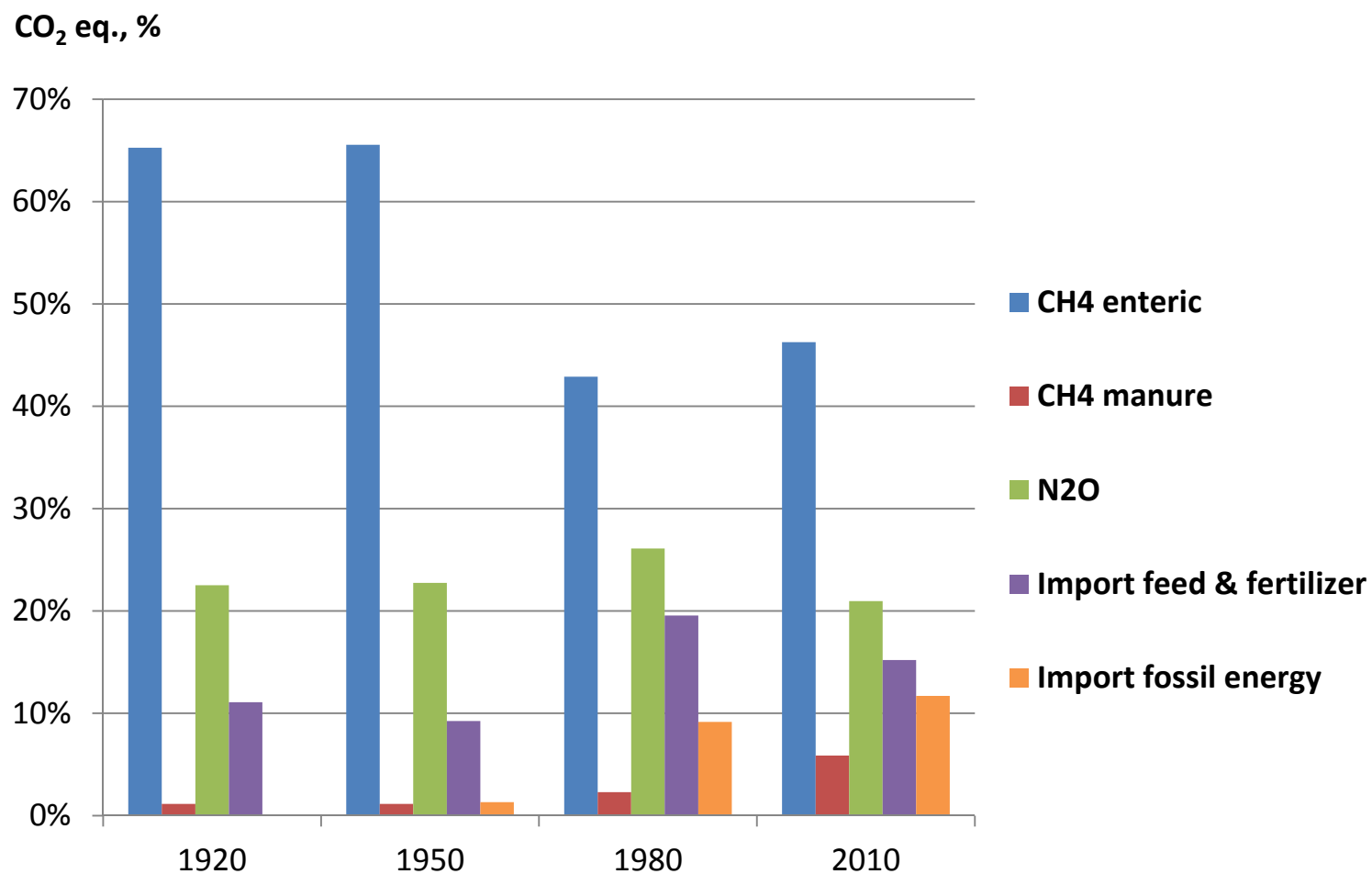
Development in milk production per ha and surplus of N, kg per ha farm land



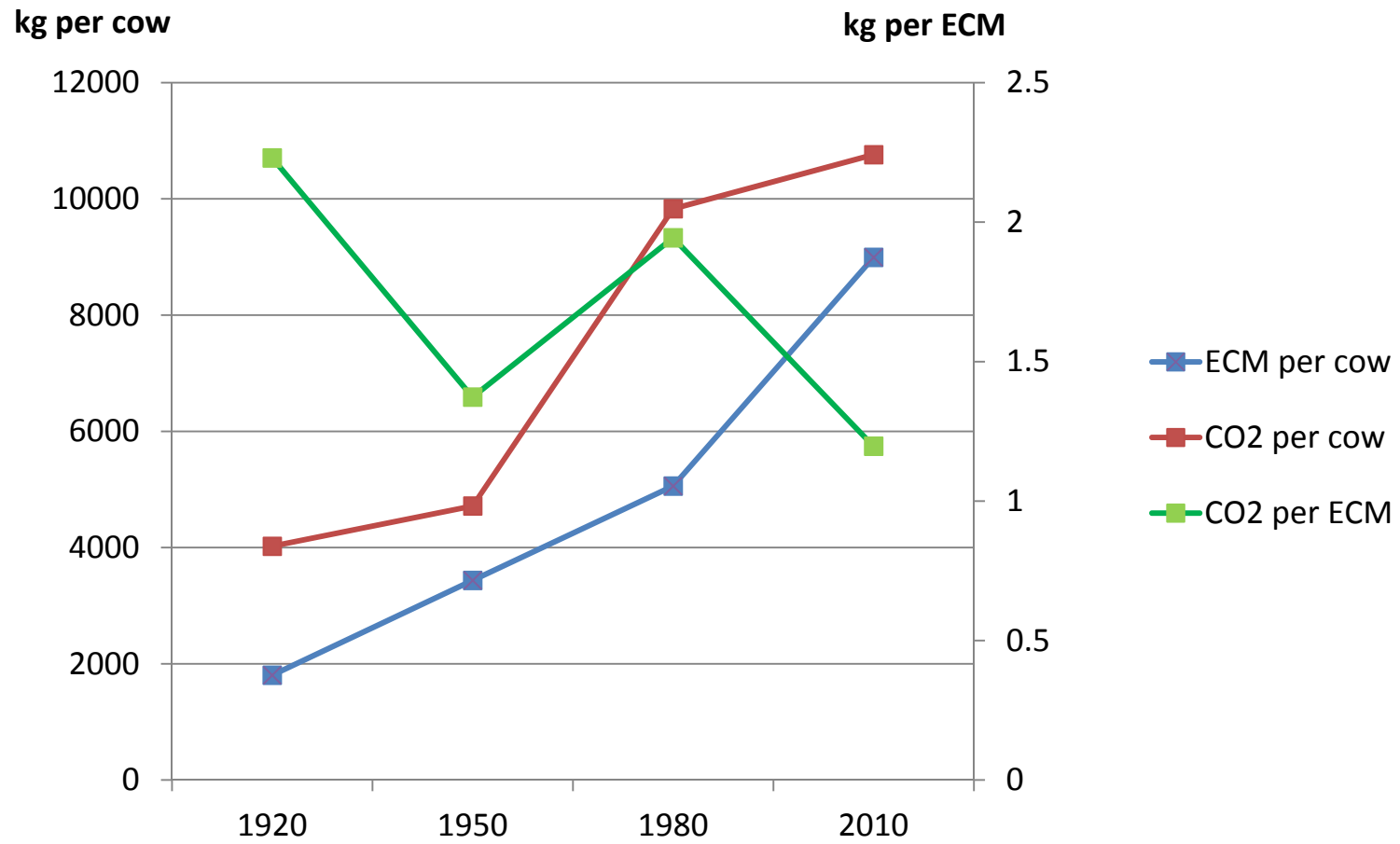
Emission of green house gasses at farm gate for typical **dairy farms** – Denmark 1920 -2010

Year		1920	1950	1980	2010
CH ₄ enteric	Kg CO ₂ eq. per DPU	2626	3090	4217	4979
CH ₄ manure		46	54	225	631
N ₂ O		755	874	2026	1811
- from NH ₃		60	74	185	137
- from leaching		91	125	354	309
Feed import		392	246	1220	1149
Fertilizer import		54	190	702	487
Fossil energy		0	62	900	1259
Horses		369	373		
Total emission		4392	5088	9830	10761
	Kg CO ₂ eq. per kg ECM	2,43	1,48	1,94	1,20
Allocated to products	Milk, kg CO ₂ eq.	1,27	0,92	1,02	0,81
	Meat, kg CO ₂ eq.	25	18	20	16

Sources to emission in the dairy system ab farm



Development in production of milk and emission of GHG per cow and product



Summary – dairy production 1950 to 2010 in Denmark

Year	Unit	1950	1980	2010
Production				
- Yield	Kg ECM per cow	3435	5058	8994
Efficiency				
- Energy	% of intake use for production (milk & meat)	49	57	64
- Protein	% of intake in product	19	16	23
- Landuse - global	Ha per 1000 kg ECM	0,32	0,27	0,17
Environment				
- N farm balance	Kg N per ha farm land	65	226	148
	Kg N per 1000 kg ECM	22	43	20
- NH ₃ farm emission	Kg N per ha farm land	16	41	26
	Kg N per 1000 kg ECM	5,4	7,9	3,5
- Carbon foot print (LCA)	Kg CO ₂ eq per DPU	5100	9800	10700
	Kg CO ₂ eq per kg ECM	1,48	1,94	1,20

Change from 1950 to 2010 – due to livestock- or crop production improvement?

Estimated emission, N surplus and land use from cattle production in Denmark

	GHG	N surplus	Landuse farm
	CO ₂ eq. x 10 ⁹	Kg N x 10 ⁶	Ha x 10 ³
1950	7,76	115	1766
2010 with 1950 crop production	7,63	119	1170
2010 with 1950 livestock production	7,90	102	932
2010	6,94	122	800

Future: Scenarios for 2040 – milk yield 12500 kg ECM per cow

Year	Unit	2010	2040 – 2010 meat production		
			2010 total milk	2010 number of cows	+ 20% forage yield
Dairy cows	n x 10 ³	568	409	568	568
Heifer	n x 10 ³	534	347	483	483
Suckler cows ¹⁾	n x 10 ³	0	108	10	10
Production					
Milk	kg ECM x 10 ⁶	5109	5109	7102	7102
Meat - dairy	Kg meat x 10 ⁶	120	84	117	117
Meat - others	Kg meat x 10 ⁶	0	36	3	3
Resource use					
Feed	SFU x 10 ⁶	5315	5128	6214	6214
Area – Denmark	Ha x 10 ³	689	715	827	689
Area – import	Ha x 10 ³	166	139	189	151
Environment					
N balance	Kg N x 10 ⁶	102	106	119	91
Emission GHG	Kg CO ₂ eq. x 10 ⁹	6,1	6,1	7,2	6,8

Concluding remarks

Cattle production since 1950

- **Constant annually increase in milk yield per cow**
- **Diminishing annually increase in crop yield per ha**
- **Environmental load peaked in 1980, marked decrease since**

Future development

- **Stimulation of productivity**
- **Holistic product - and farm perspective**

