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CARBON FOOTPRINT OF TYPICAL BEEF PRODUCTION SYSTEMS IN DENMARK AND SWEDEN

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AIM

› To evaluate the effects of typical beef production systems used in Denmark (DK) and Sweden (SE) on GHG emissions in a life cycle perspective (LCA)

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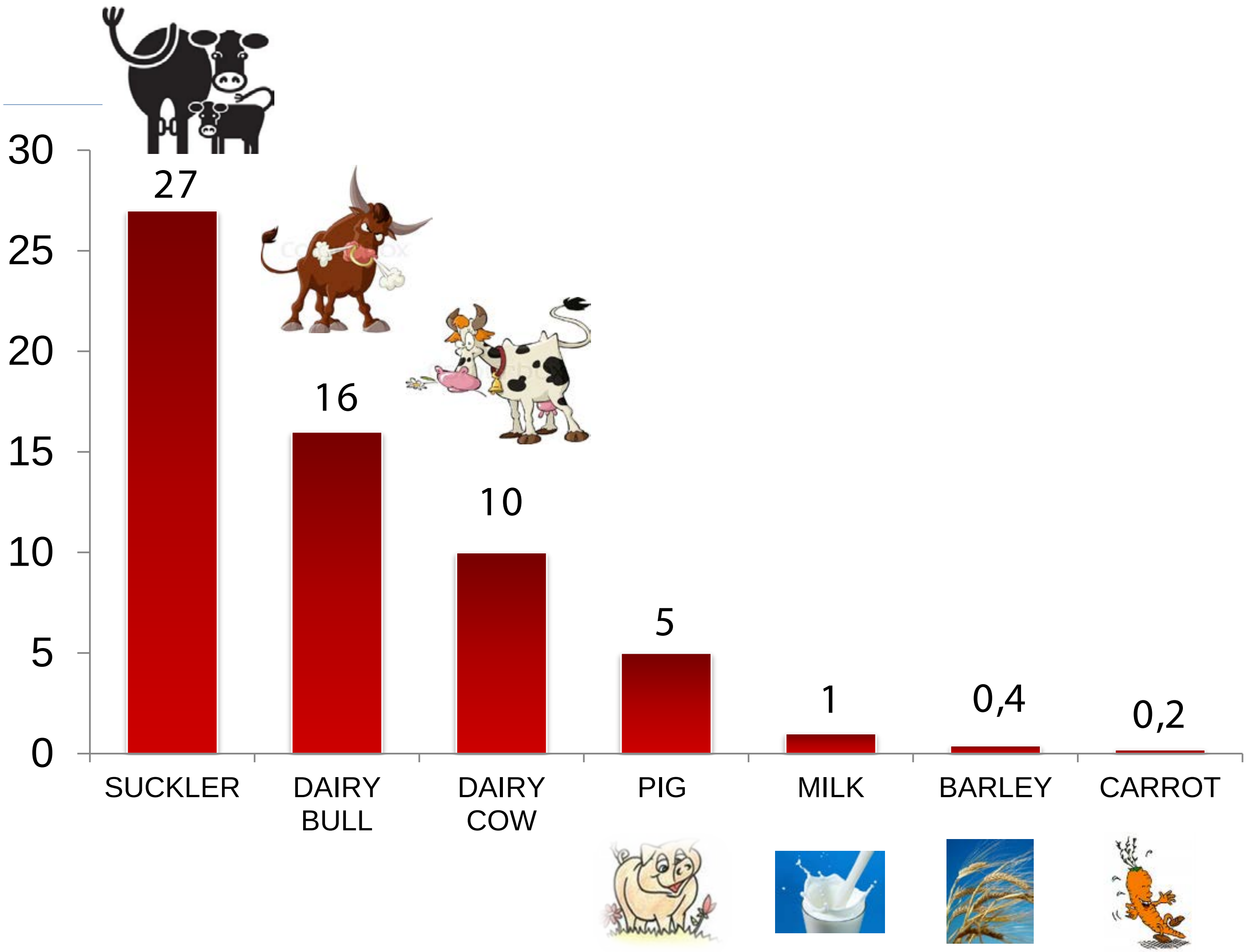
CARBON FOOTPRINT, KG CO_2/KG



MATERIAL AND METHODS

- Existing types of differentiated beef production systems in DK and SE was identified and defined:
- The 6 most differentiated system (5 DK, 1 SE systems)
- Data was collected that represent average productivity of each system:
  - feed rations
  - daily gain
  - feed conversion
  - carcass yield

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BEEF PRODUCTION

SUCKLER SYSTEMS:

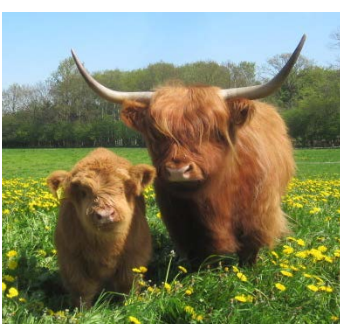
- Extensive (High Land Cattle) (DK)
- Intensive (Limousine) (DK)

DAIRY SYSTEMS – BULL CALVES, mainly DANISH HOLSTEIN

- Steers (24 m., 570 kg LW, typically organic) (DK)
- Bulls (19 m., 630 kg LW) (SE)
- Young bulls (11.3 m., 450 kg LW) (DK)
- Calves (9.3 m., 380 kg LW) (DK)

EXTENSIVE SUCKLER SYSTEM (DK)

- High Land Cattle
- 180 days grazing at fields with low production:
  - Permanent pasture (2300 kg DM/ha) and nature (600 kg DM/ha)
- Winter: housed at deep litter
- Maximum roughage (mainly silage) to stimulate growth during summer
- 0.9 calves/cow/year (20% replacement)
- Heifers: first calving at 36 months
- Bull calves slaughtered at 22 months (430 kg LW)

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INTENSIVE SUCKLER SYSTEM (DK)

- Limousine
- 150 days grazing at fields with higher production:
  - Grass-clover (7100 kg DM/ha) and permanent pasture (2300 kg DM/ha)
- Winter: housed at deep litter, maximum roughage (mainly silage) – though bull calves more concentrate
- 1.0 calves/cow/year (25% replacement)
- Heifers: first calving at 30 months
- Bull calves slaughtered at 14 months (590 kg LW)

STEERS (DK)

- Dairy calf of 55 kg LW (30 days)
- Typically Danish Holstein
- Extensive system based on grazing and roughage (typically organic)
- Slaughtered at 24 months (570 kg LW)
- Grazing 160 days/year, pasture with 7100 kg DM/ha, 730 g daily gain
- Winter: housed at deep litter, 640 g daily gain, restricted conc. feed
- Fattening: 45 days, 1100 g daily gain



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BULLS 19 MONTHS (SE)

- Dairy calf of 80 kg LW (63 days)
- Slaughtered at 19 months (630 kg LW)
- Housed at deep litter until 200 kg, then slatted floor (25 : 75)
- 3200 kg DM/produced bull, 40% roughage (grass silage)

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BULLS 11.3 MONTHS (DK)

- Dairy calf of 55 kg LW (30 days)
- Slaughtered at 11.3 months (450 kg LW)
- Housed at deep litter until 200 kg, then slatted floor (25 : 75)
- 1900 kg DM feed/produced bull, 9% roughage (straw, grass silage)


BULLS 9.3 MONTHS (DK)

- Dairy calf of 55 kg LW (30 days)
- Slaughtered at 9.3 months (380 kg LW)
- Produced on contract 'Danish veal'
- Requested: Deep litter until 6 months, 8-10 months, 180-240 kg carcass
- 1400 kg DM/produced bull, 10% roughage (straw, grass silage)

DAILY GAIN AND FEED USE

	Suckler system		Dairy system			
	Extensive	Intensive	Steer	Bull 19 m	Bull 11 m	Bull 9 m
Daily gain, g/day	600 1)	1300 1)	750	1100	1280	1320
Feed use, Kg DM/kg gain	15.8 2)	11.5 2)	7.3	5.8	4.7	4.3
Roughage, %	97	85	88	40	9	10

1) Numbers for bull calves in the suckler system
2) Herd

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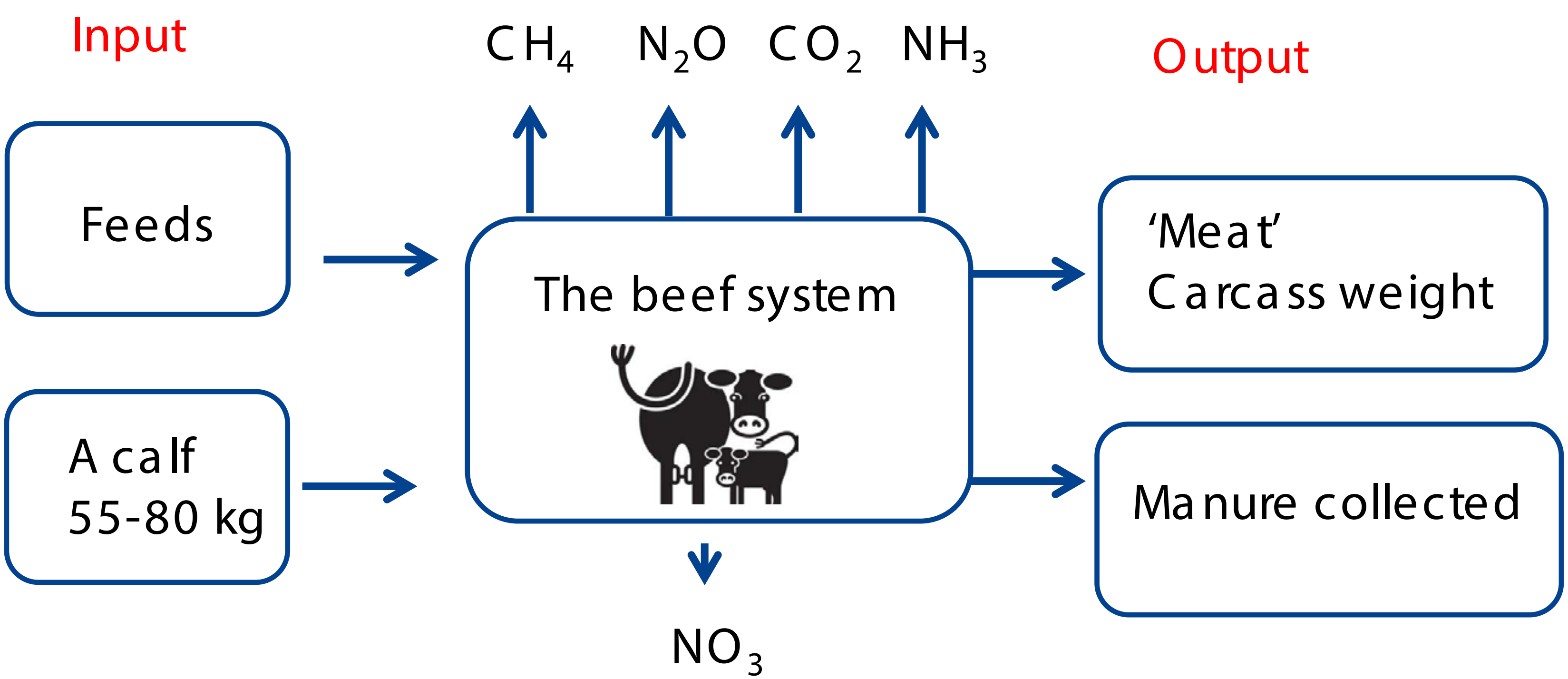
CARBON FOOTPRINT OF BEEF BY LCA

- Calculated over a year and expressed per kg carcass weight (FU).



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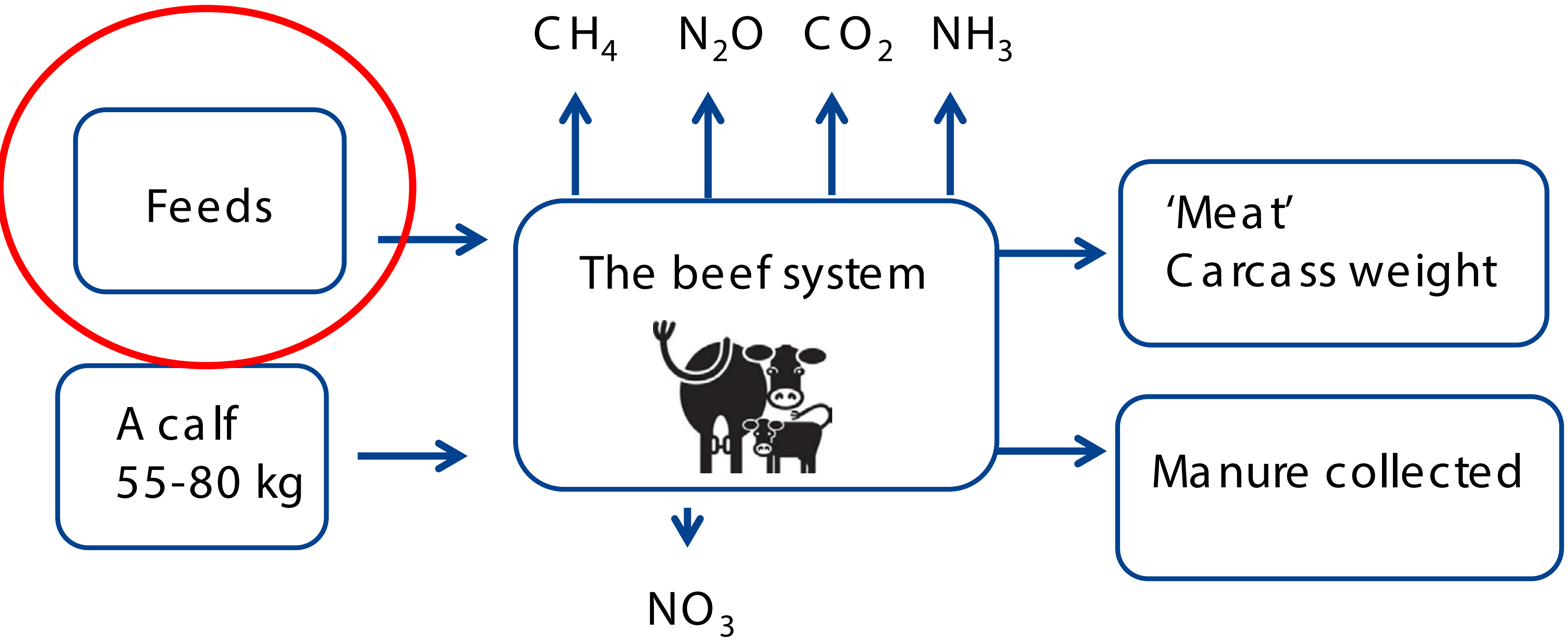
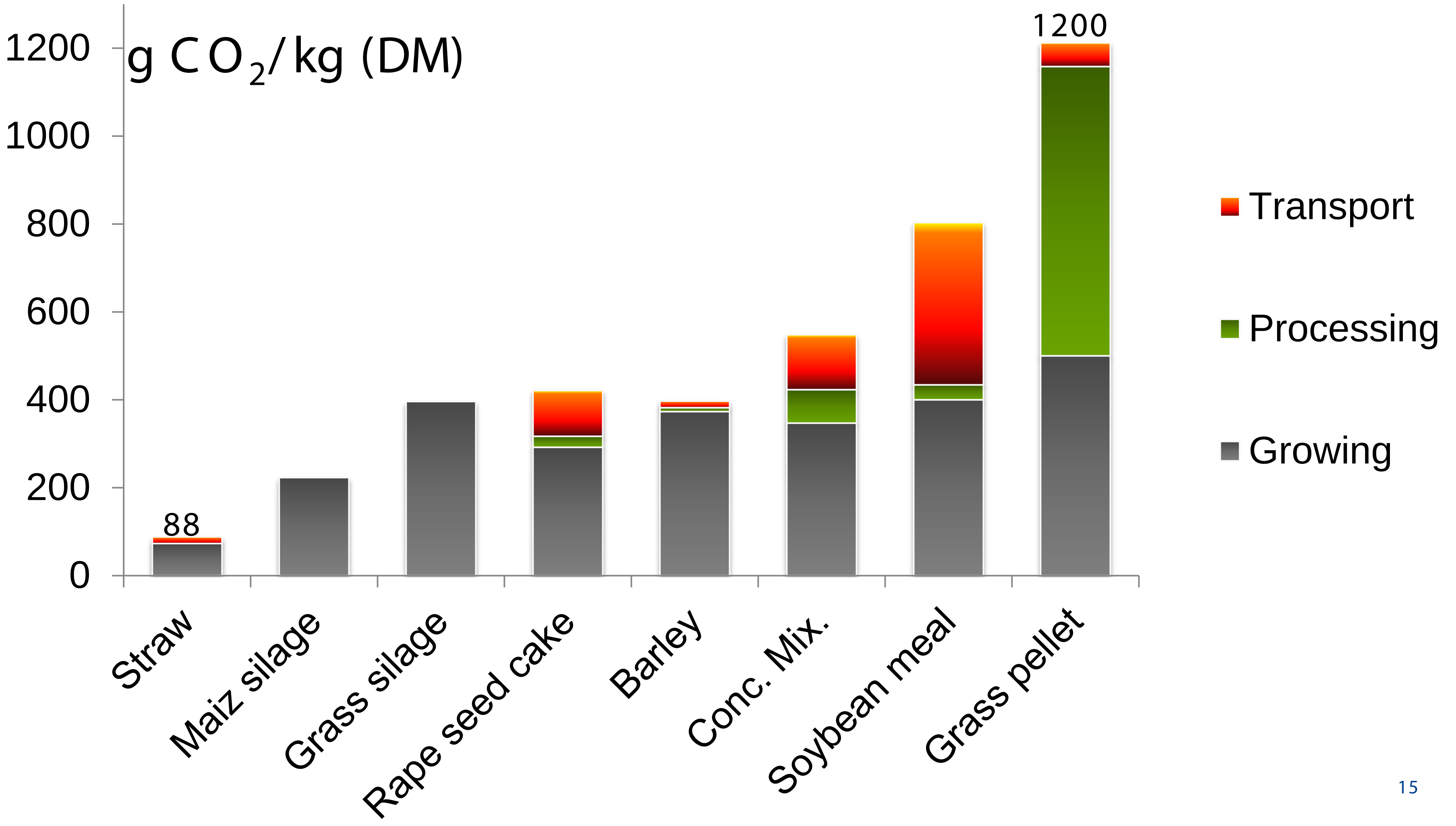
CARBON FOOTPRINT OF ANIMAL FEED



CARBON FOOTPRINT OF ANIMAL FEED



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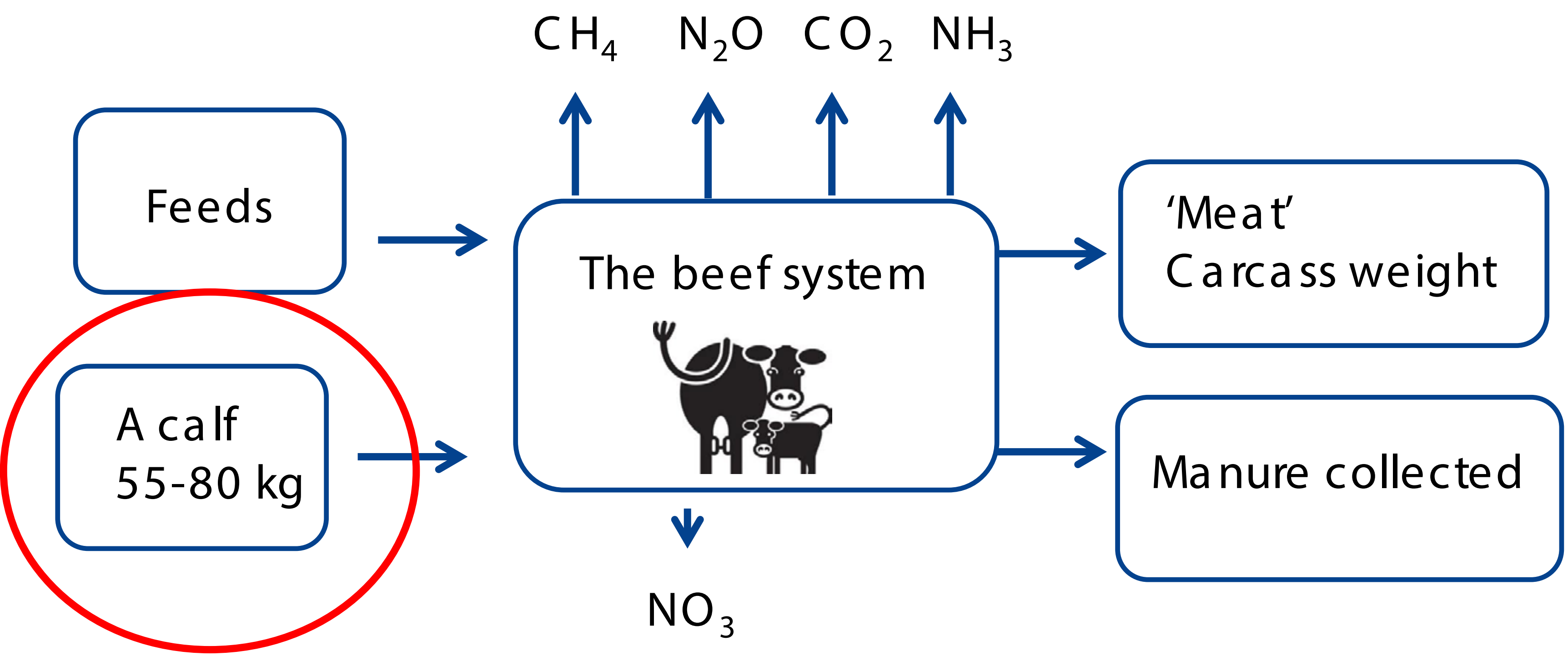
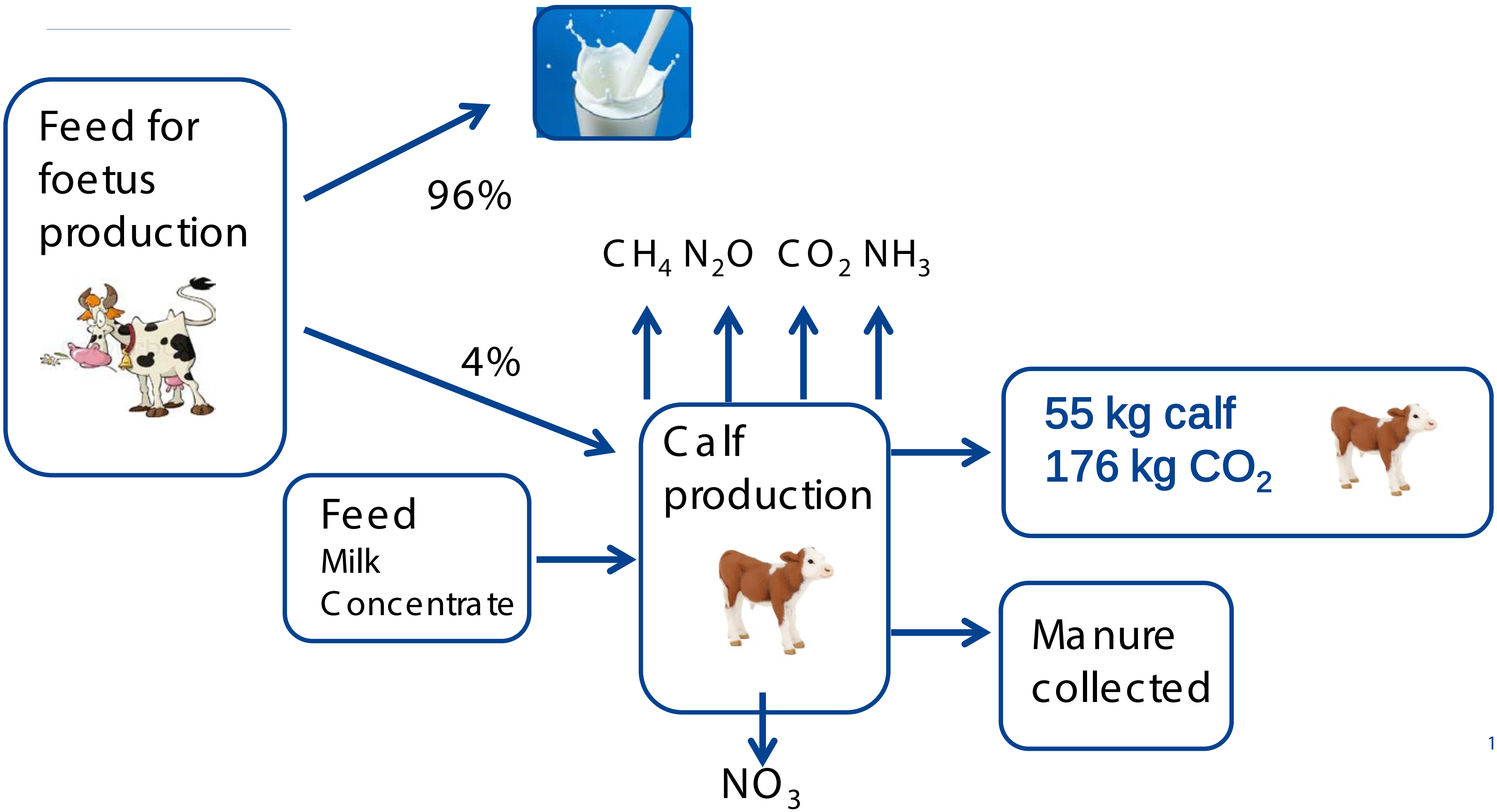
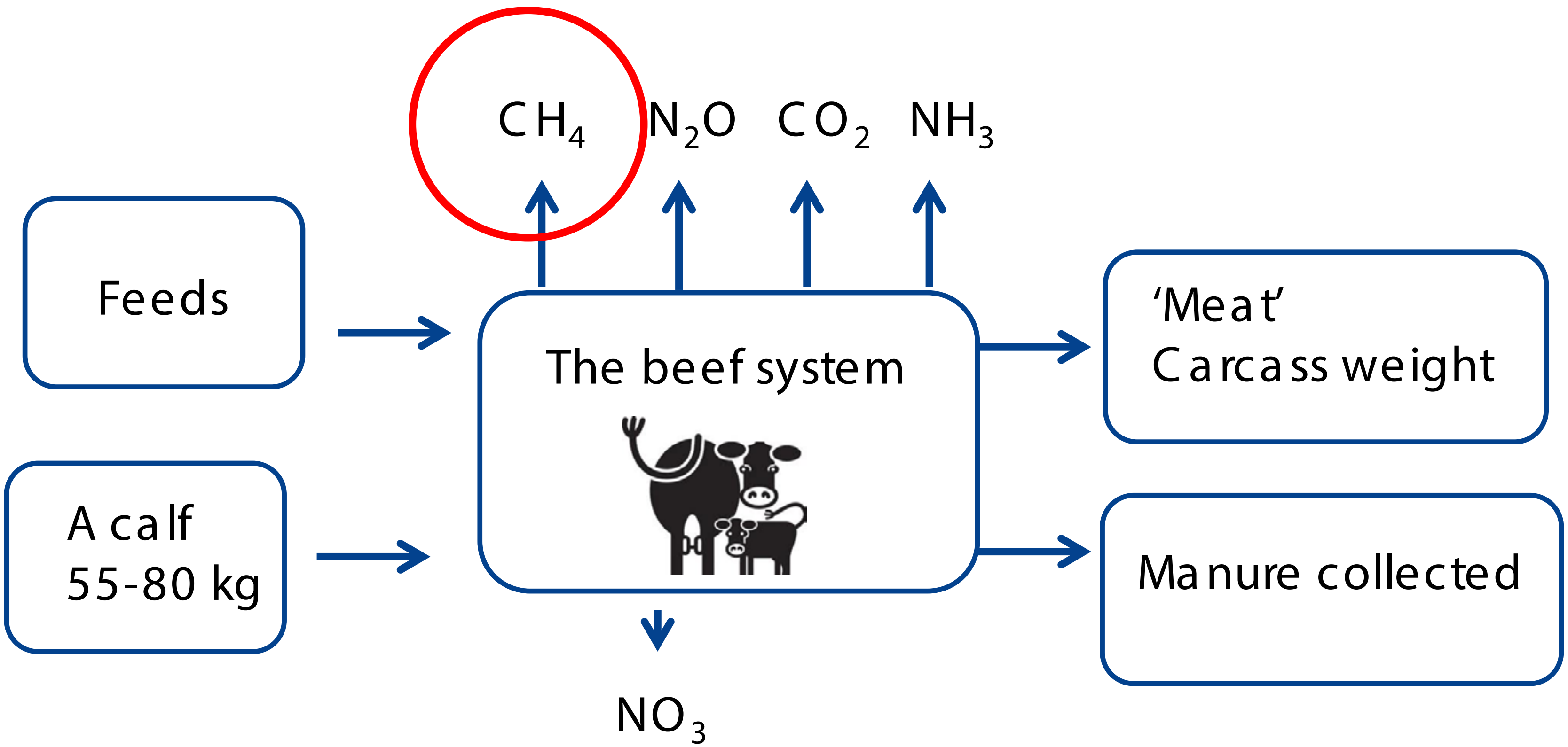
CARBON FOOTPRINT OF A DAIRY CALF



CARBON FOOTPRINT OF A CALF



METHANE FROM ENTERIC FERMENTATION



METHANE FROM ENTERIC FERMENTATION

Suckler cow:

$$CH_4\ (MJ/d) = 2,87 + 1,23 * DMI - 0,1164 * FA$$

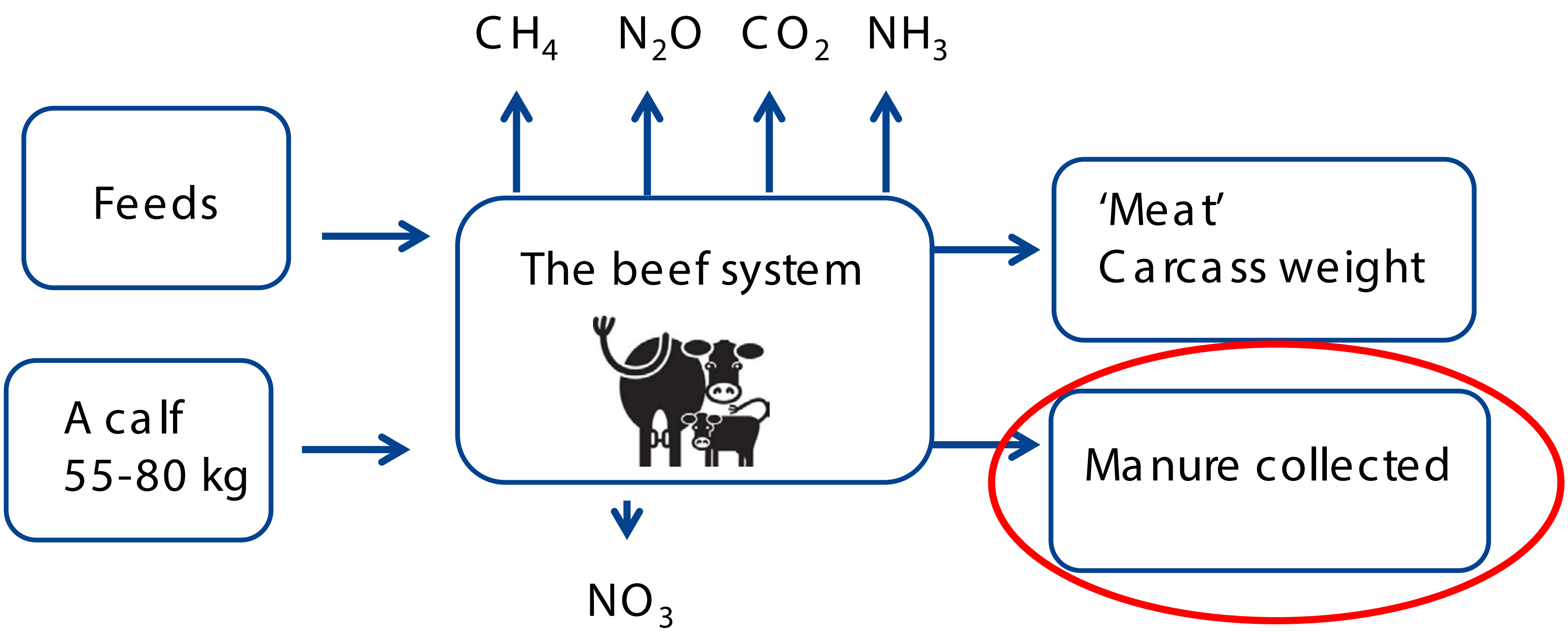
Heifers, bull calves:

$$CH_4\ (MJ/d) = (-0,046 * CONC + 7,1379)/100 * GE$$

DMI : kg DM/day
FA: Fatty acids (g/kg DM)
CONC: Concentrated feed, %
GE: Gross energy (MJ/day)

(Nielsen et al., 2013)

MANURE AS AN OUTPUT

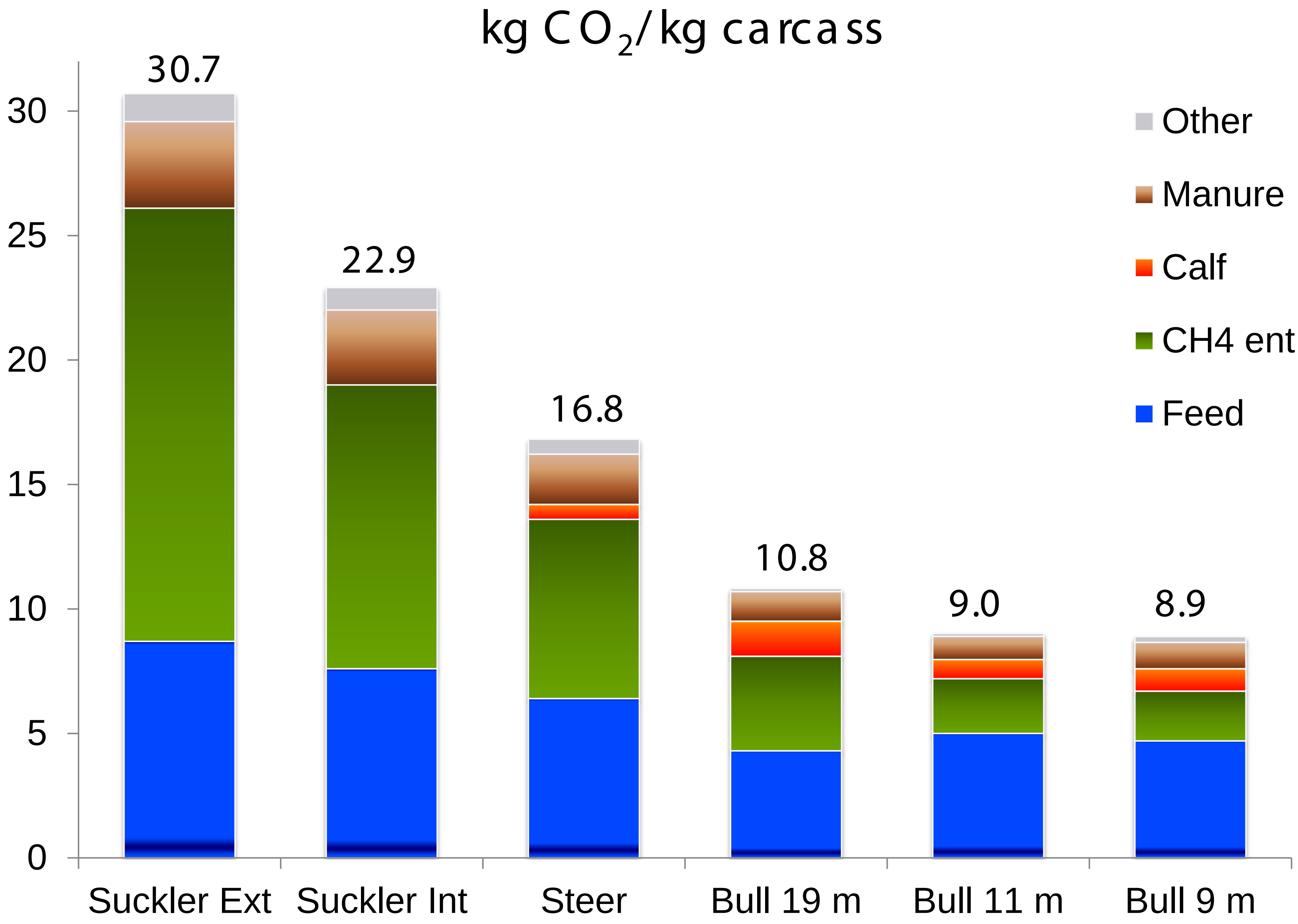


MANURE AS AN OUTPUT

- The beef system got credit for this corresponding to the fertilizer value of the manure
- The beef system pays for emissions in stable, storage and where emissions from manure application exceed those from fertilizer application

1 kg N in manure collected as slurry → Fertilizer equivalent 0.70 kg N, 0.14 kg P, 0.91 kg K → Saved emissions 4.2 kg CO_2-eq/kg N

CARBON FOOTPRINT OF BEEF



PRESENT WORK

- Improve the method used for including soil C
- Mitigation options for the systems

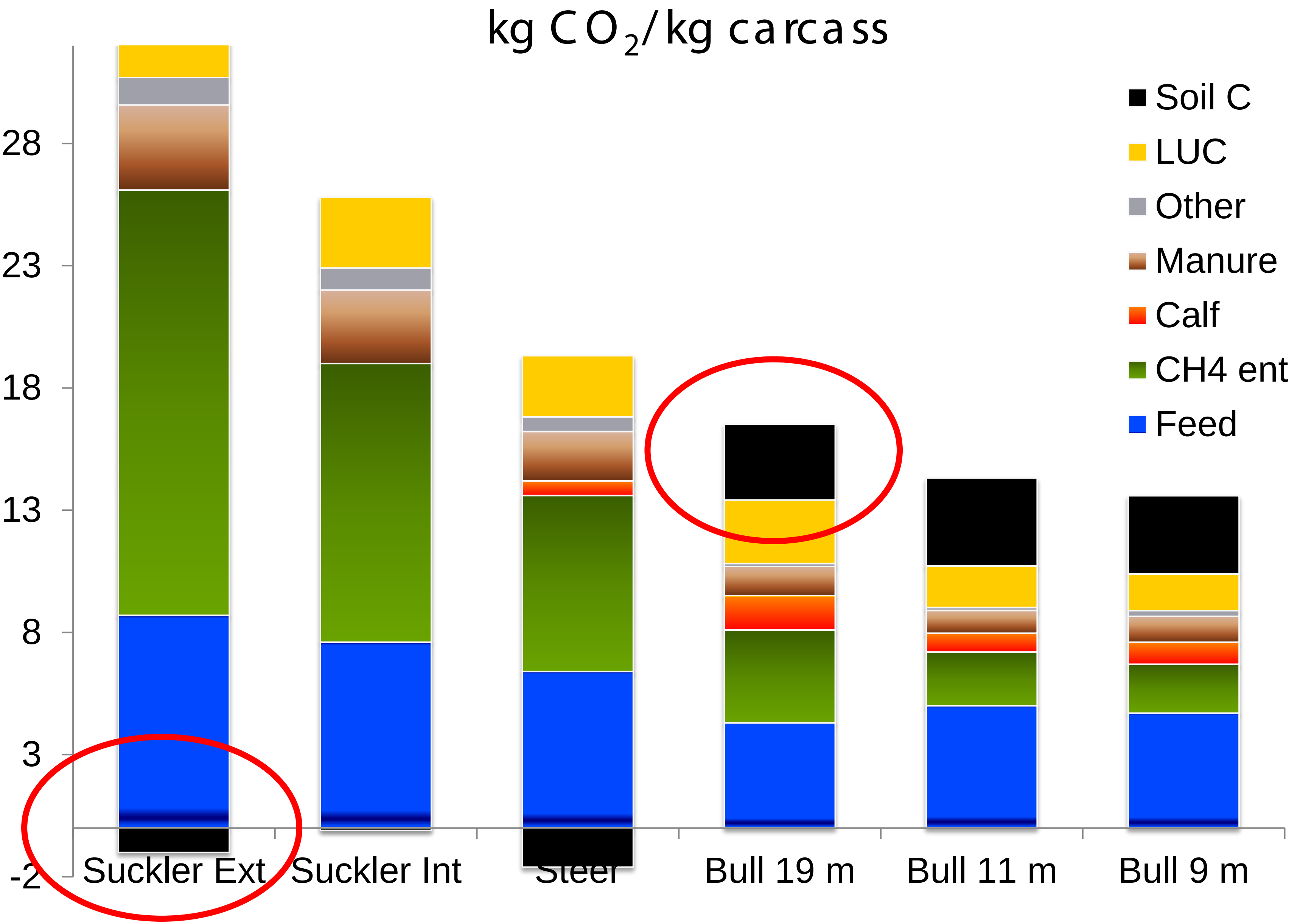



Impact from changes in soil carbon

	C in soil	kg CO_2/ha/y
Grass in rotation	sink	- 1910
Permanent pasture		0
Other crops	release	+ 3080

(Vleeshouwers & Verhagen, 2002)

CARBON FOOTPRINT – LU LUC



NEW METHOD TO INCLUDE SOIL C

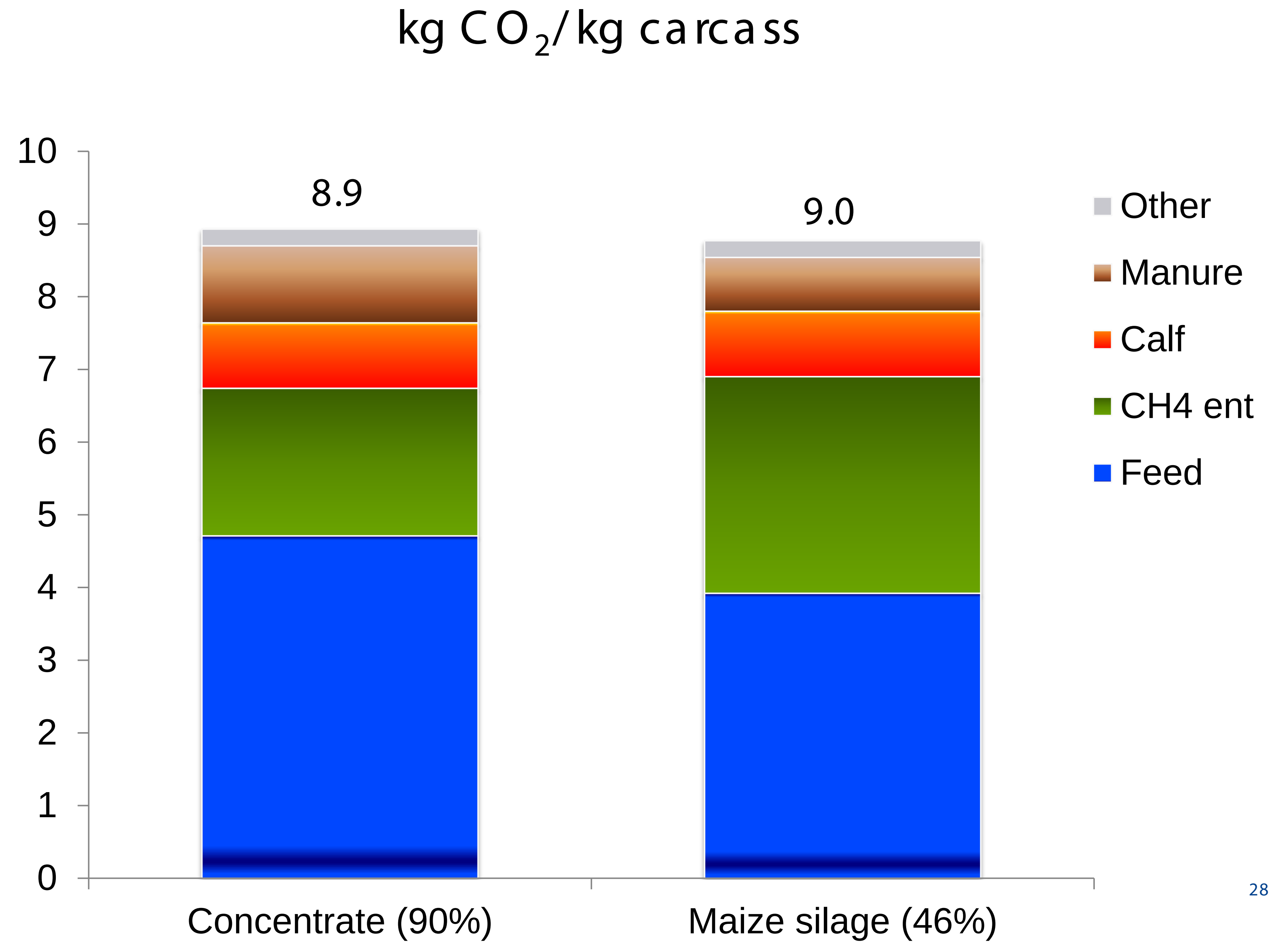
- Based on data on input of C from above and below ground residues
- Soil carbon model (Petersen et al., 2013):
  - 10% of this C input will stay in soil in a 100 year perspective

PRESENT WORK

- Improve the method used for including soil C
- **Mitigation options for the systems**
  - Changed feeding – for example including maize silage with low CF



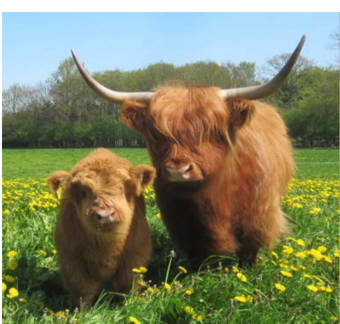

EFFECT OF FEED RATION TO BULL CALVES 9 M



CONCLUSION

Based on data from 6 differentiated beef production systems:

- 600 - 1300 g daily gain
- 4.3 - 15.8 kg DM per kg gain
- 9 - 97 % of DM from roughage
- CF: 8.7 - 30.7 kg CO_2-eq per kg 'meat' (carcass weight)




Thank you for your attention

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Interreg IVA

ÖRESUND – KATTEGAT – SKAGERRAK

CLCA: Indirect LUC

Step 1	Total LUC emissions	8.5 GtCO_2e/year
Step 2	Proportion caused by agriculture	58%
Step 3.	Common LUC emissions factor per hectare of land	1,43 tCO_2e/ha (143 g CO_2/m^2)
Step 4.	Calculate land requirement	
Step 5.	Multiply LUC factor by land	EF * area

(Audsley et al., 2009)