Greenhouse gas emissions from suckler cow production - the new whole farm-system model "HolosNorBeef"

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Background

- The global population is expected to exceed 9 billion by 2050[1]
- Global food production needs to increase by 70%[1]
- Limited arable land reserves
- Natural resources available for food production vary considerably between countries

1) FAO (2009)

Background

- Norway: Increasing population → increasing food production
- Grass production accounts for 2/3 of cultivated area
- Milk/meat from ruminants account for 55% of food production on energy basis
- Increased utilization of domestic grassland

  and pastures
- Reduce greenhouse gas (GHG) emissions 40% by 2030

What are Greenhouse gas emissions?

- CO_2 – transport, electricity
- CH_4 – enteric fermentation, manure management
- N_2O – manure, soil management, fertilizer

- Global warming potential (GWP)[2]
  - CO_2 1
  - CH_4 25
  - N_2O 298

2) IPCC 2007

GHG emissions from beef production

- Ruminants > monogastric
- Dairy beef < suckler beef
- Differences in GHG emissions between continents[1] and between farms within a country[3]
- Need for a flexible emission model adapted to production systems and national resources in Norway

1) FAO (2009)
3) Bonesmo et al.,(2013)

Background – Other studies

- **Holos**, Life cycle assessment from beef cattle in Canada[4]
  - 22 kg CO_2eq/kg carcass

- **HolosNor**, emissions from dairy cattle in Norway[3]
  - 17.3 kg CO_2eq/kg carcass young bulls
  - 1.02 kg CO_2eq/kg FPCM

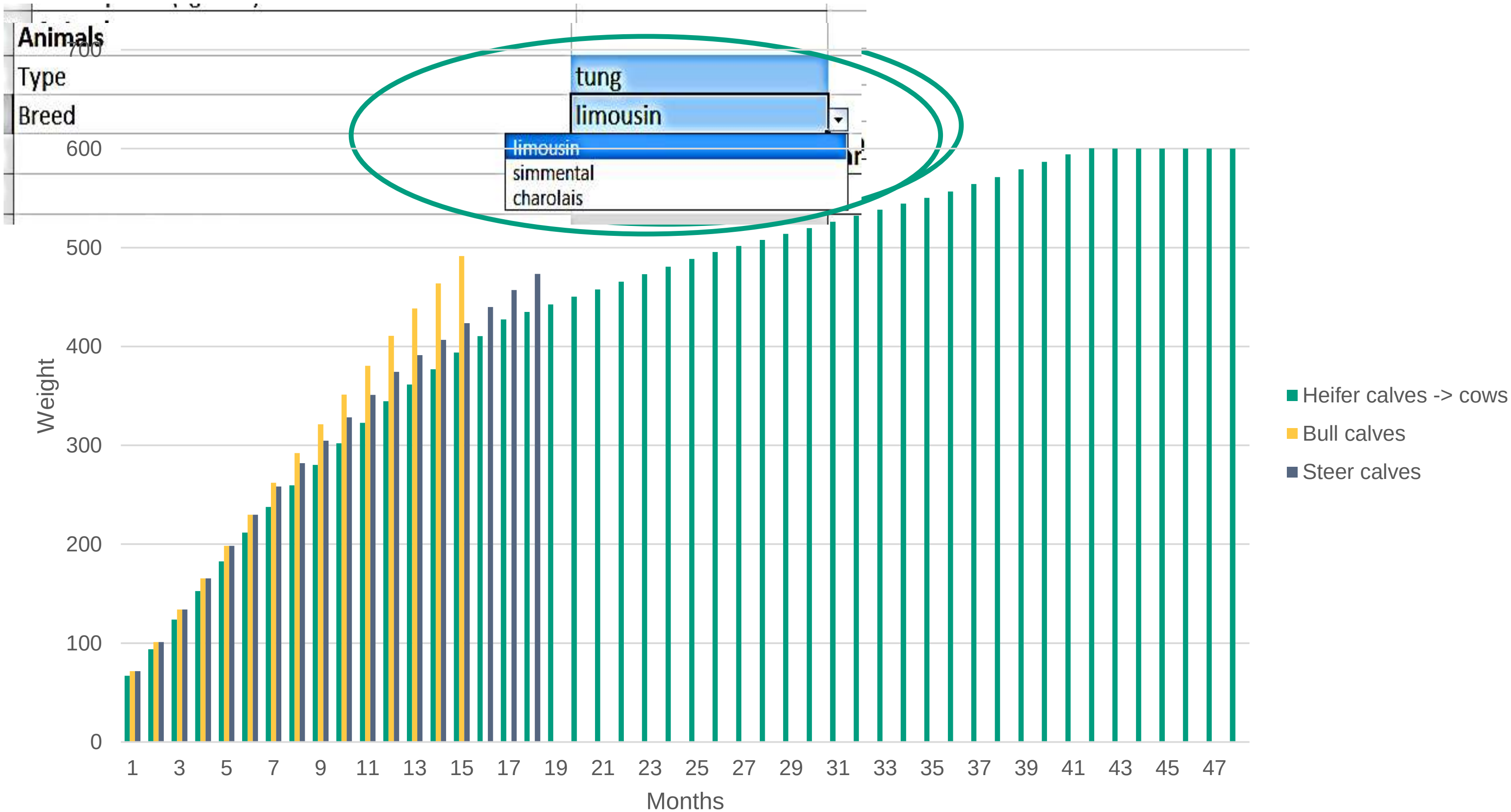
- **BEEFGEM**, Irish farm model[5]
  - 18.9-23.1 kg CO_2eq/kg carcass

3) Bonesmo et al.,(2013)
4) Beauchemin et al., (2010)
5) Foley et al., (2011)

Developing HolosNorBeef

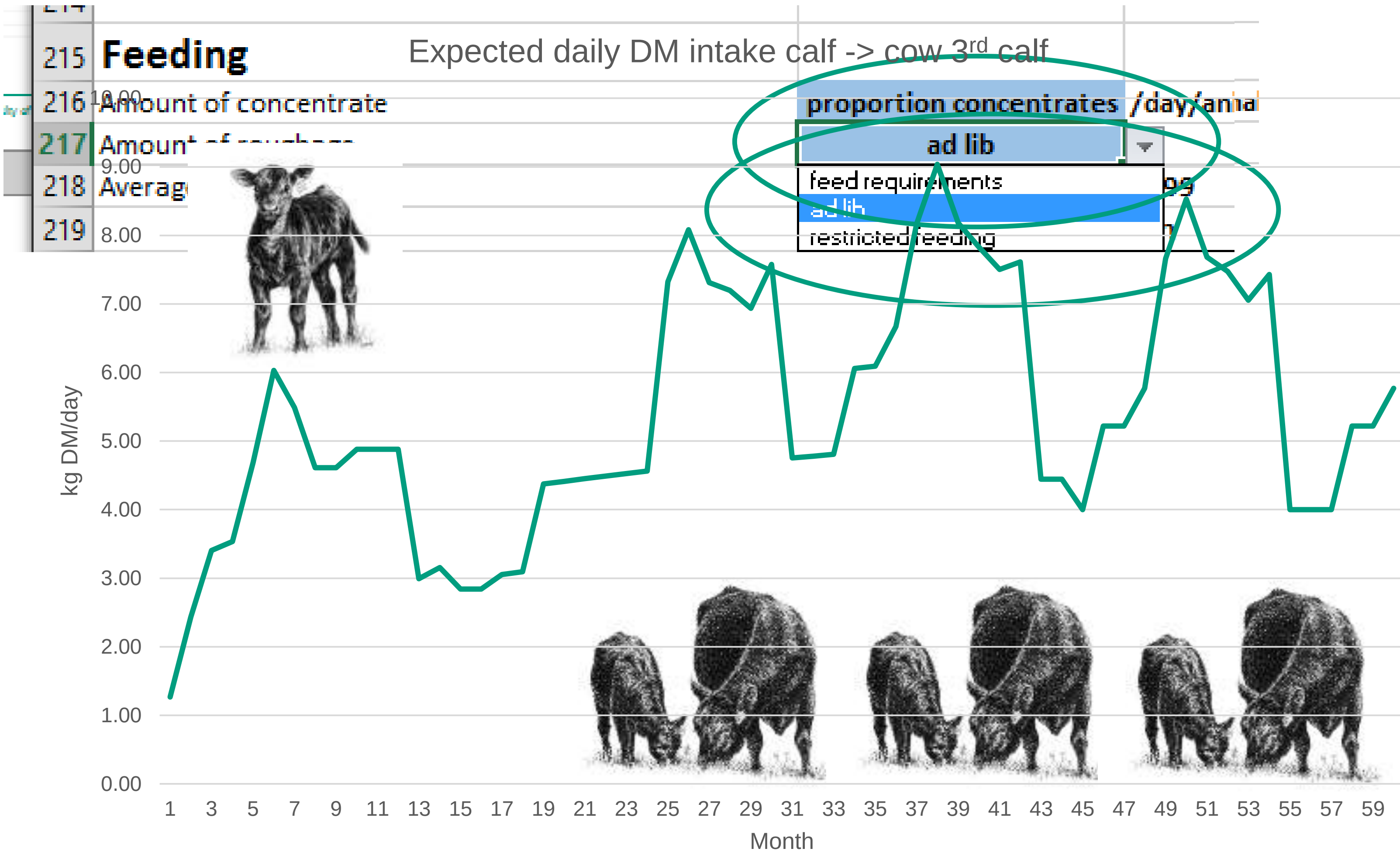
Input

Weights



Animals
Type
Breed
tung
limousin
limousin
simmental
charolais
Weight
Months
0
100
200
300
400
500
600
700
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
Heifer calves -> cows
Bull calves
Steer calves

Feed requirement and feed intake

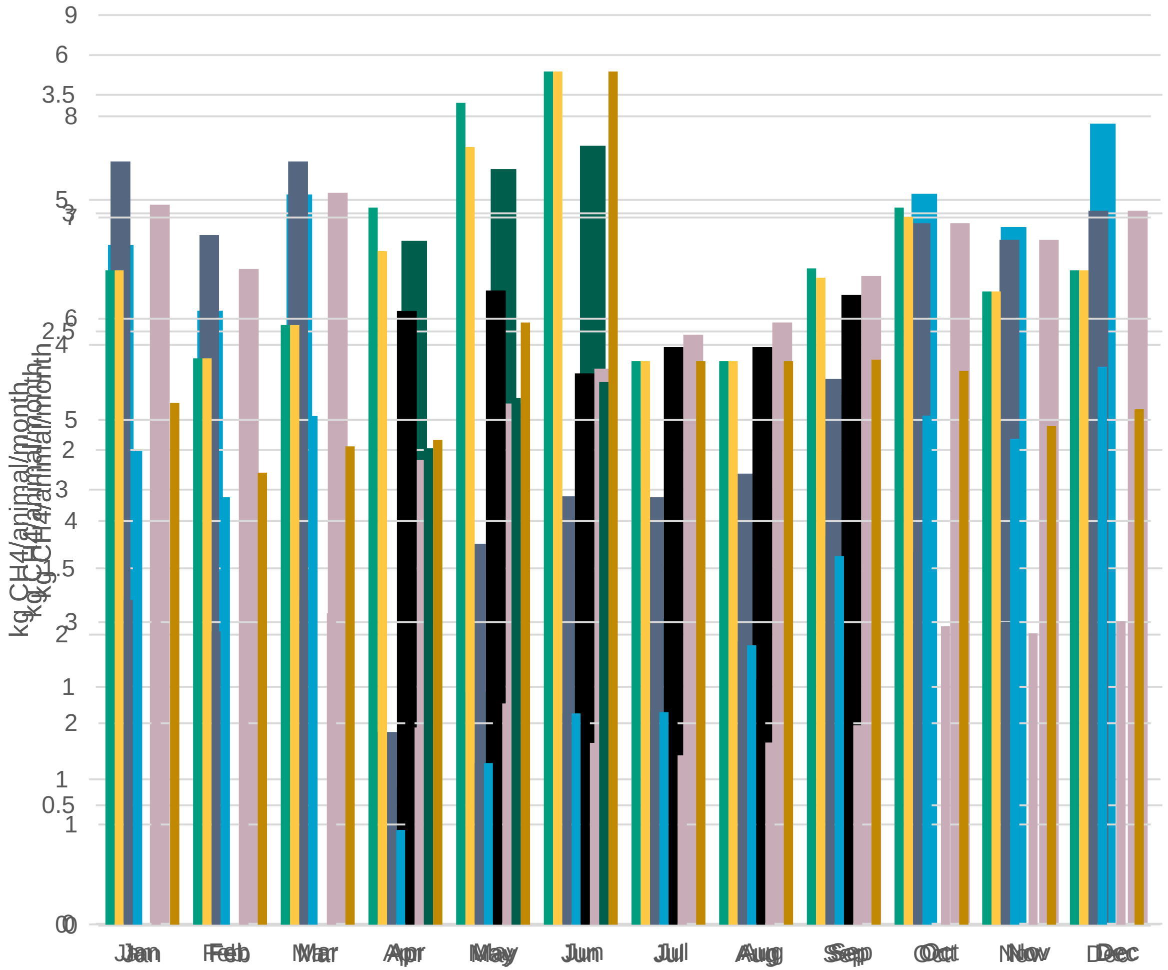


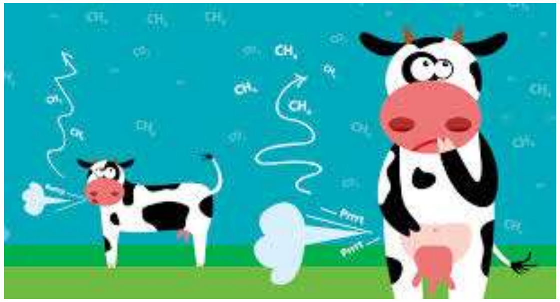
Feed

219			Jan
220	Concentrates	Type	
2234			Jan
2235	Grovfôr inneføring, andel (1 når eneste tilgjengelige grc	Type1	
2236	Cows	Silage medium	
2237	cows, 2nd calf		
2238	Heifer calves		
2239	Bull calves		
2240	Steer calves		
2241	1 yr old heifers, slaugther	Silage medium	
2242	1yr old heifers, recruitment	Silage medium	
2243	1 yr old bulls	Silage medium	
2244	1 yr old steers	Silage medium	
2245	2 yr old heifers (first lact)	Silage medium	
246	2 yr old bulls	Silage medium	
247	2 yr old steers	Silage medium	
248			

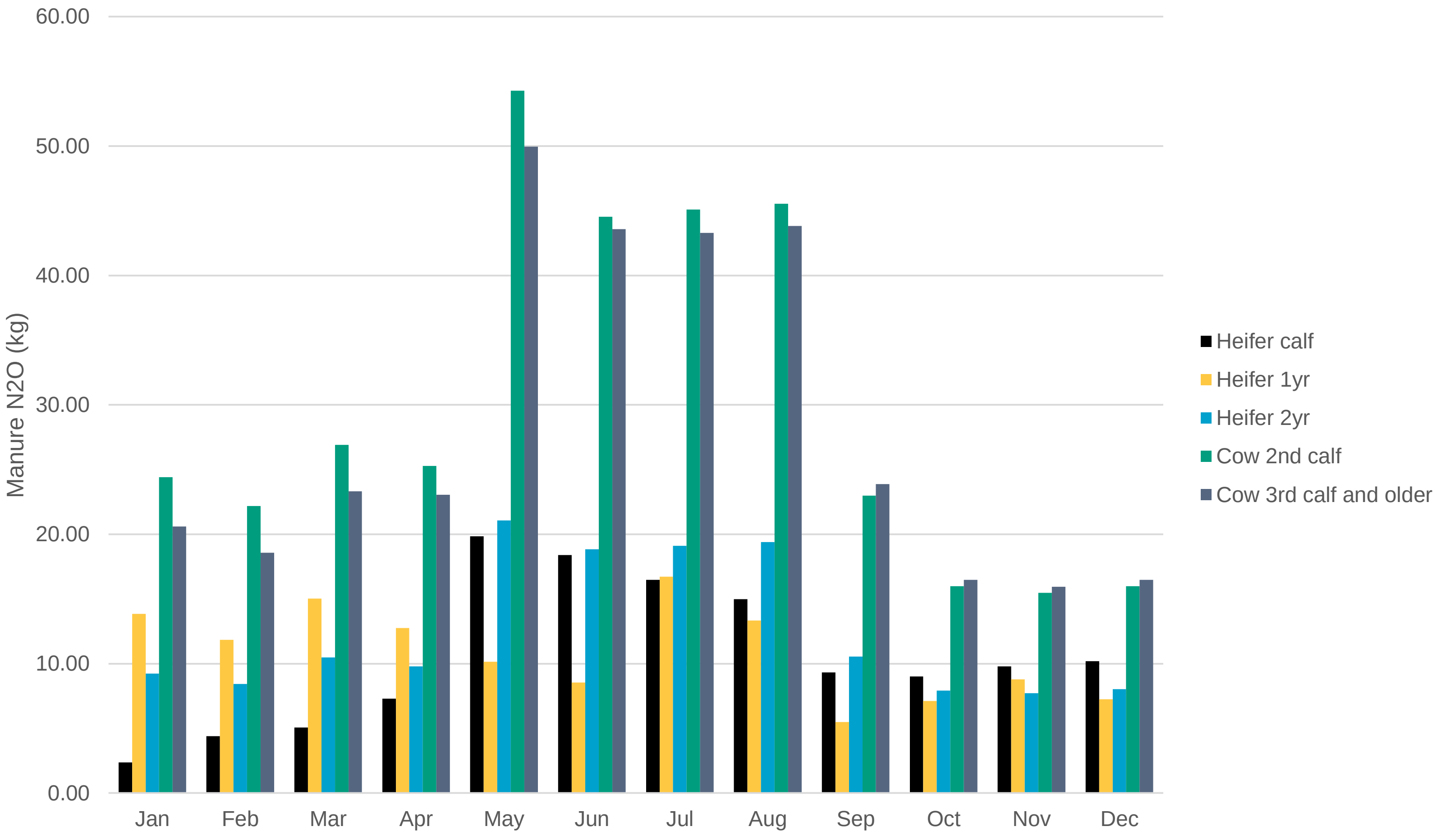
- Silage low
- Silage medium
- Silage high
- Straw NH3
- Dry straw
- Silage very low

Enteric CH4

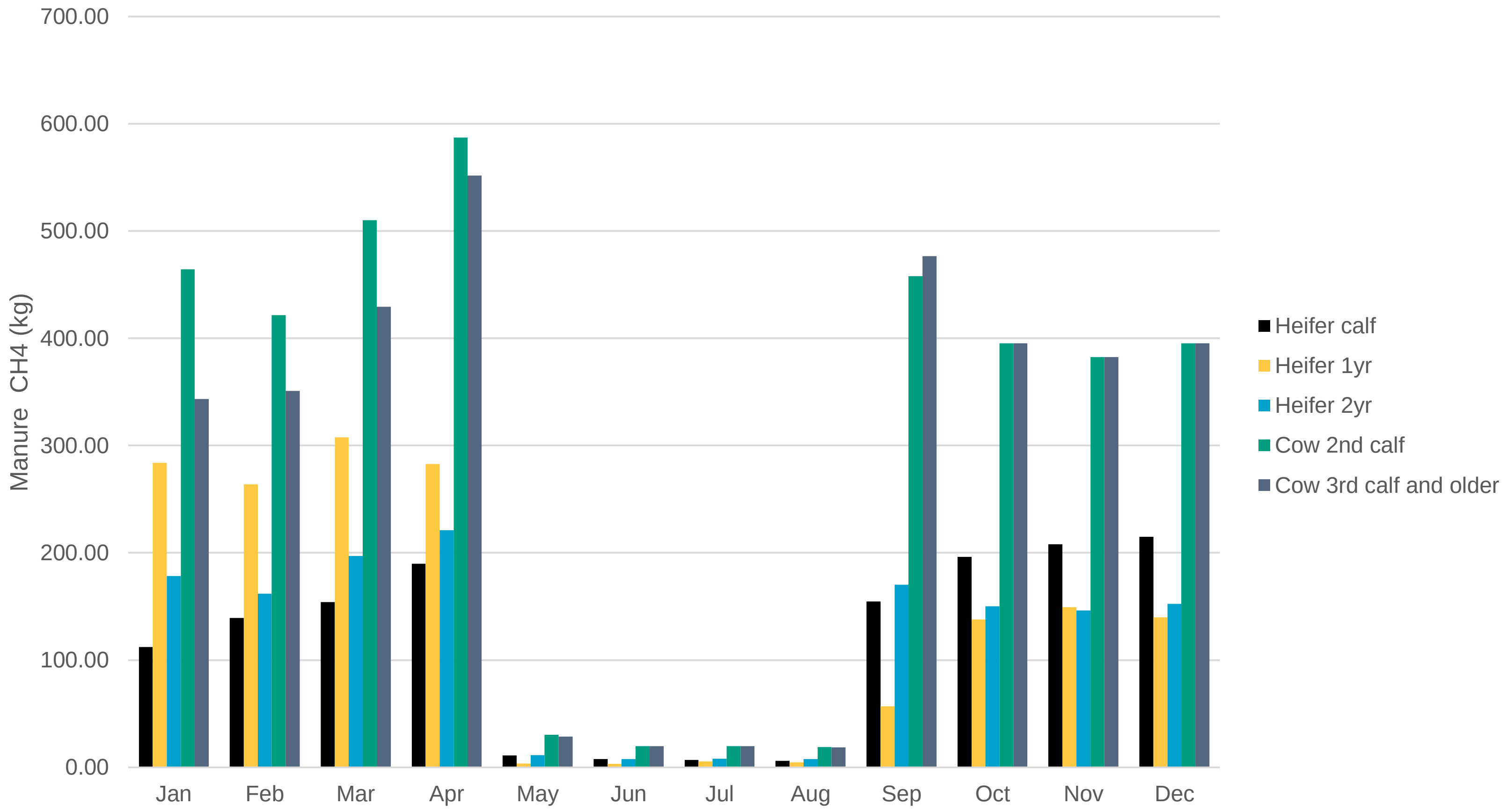

kg CH4/animal/month
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Cows, 3rd calf and older
Cows, 2nd calf
Heifer calves
Bull calves
1 yr old heifers, slaughter
1 yr old heifers, recruitment
1 yr old bulls
2 yr old heifers



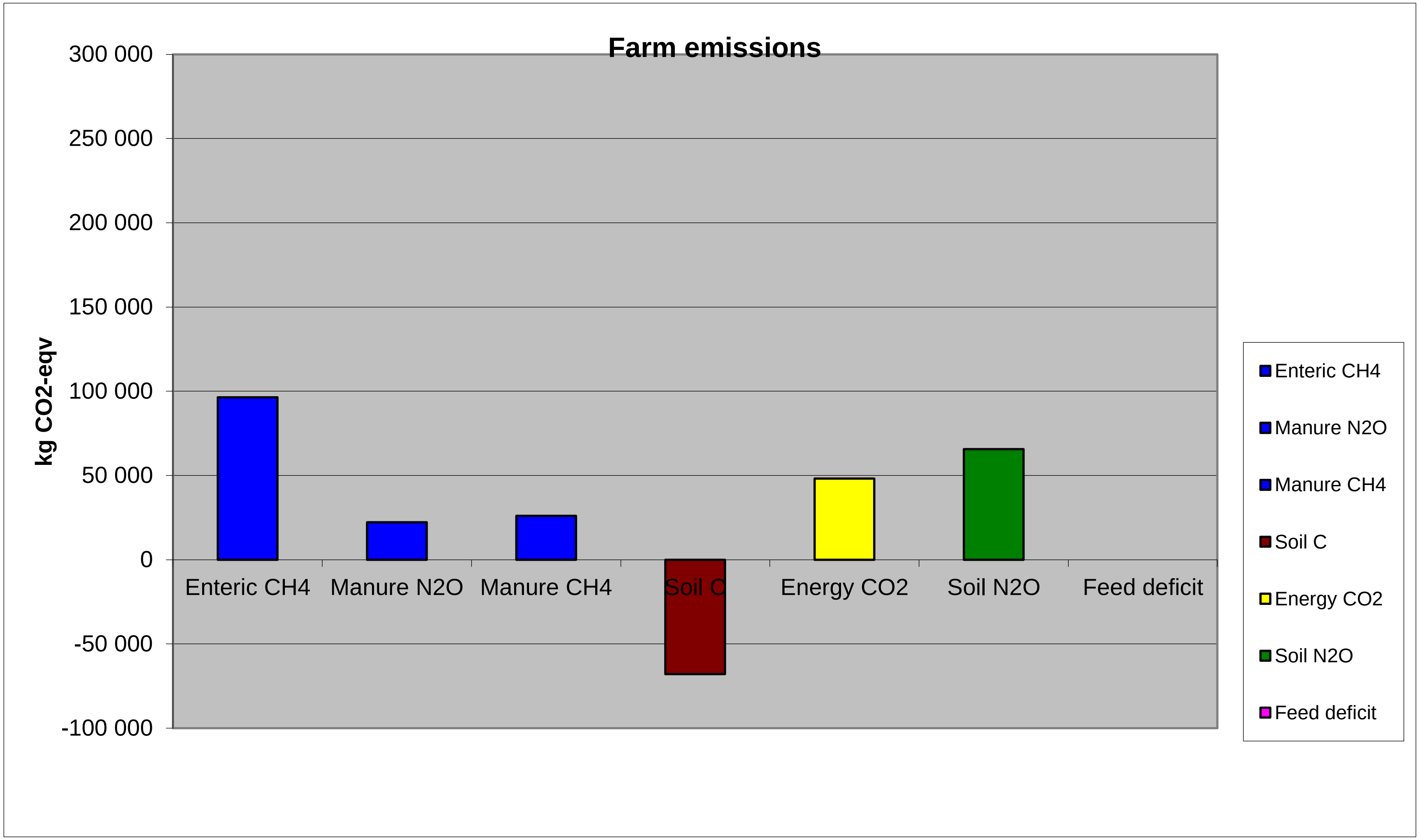
N2O from manure



CH4 from manure

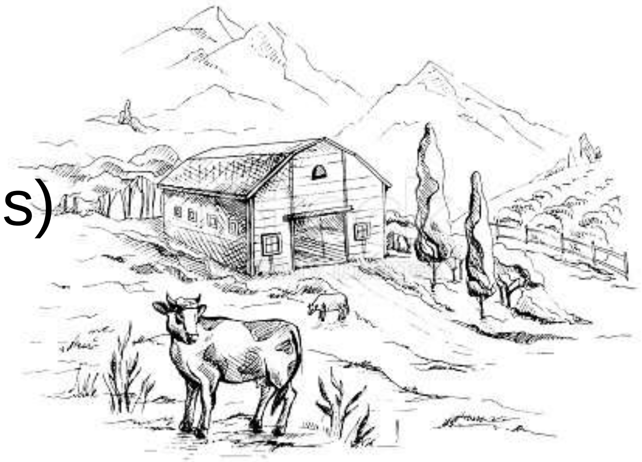


Total emissions



Data

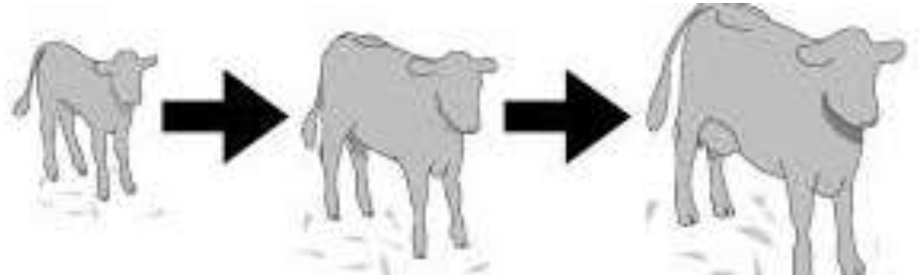
- Farm data - 2 locations (A and B)
  - –Areas and yield (silage and crops)
  - –Silage quality
  - –Soil and weather data
  - –Fuel and electricity
  - –Pesticides, fertilizer



Farm caracteristics (unit)	**A**	**B**
Farm size (da)[6]	446	415
Ley area (da)[6]	389.1	401.2
Silage yield (kg)[67]	407564.6	475680.5
Silage moisture content (% DM)[6]	33	32
Silage nutritive value (FUm)[6]	0.87	0.84
Electricity (NOK)[6]	26300	29100
Fuel (L)[6]	3854.42	2947.36
Precervatives (NOK)[6]	6293	440

6) NIBIO (2016)
7) Eurofins

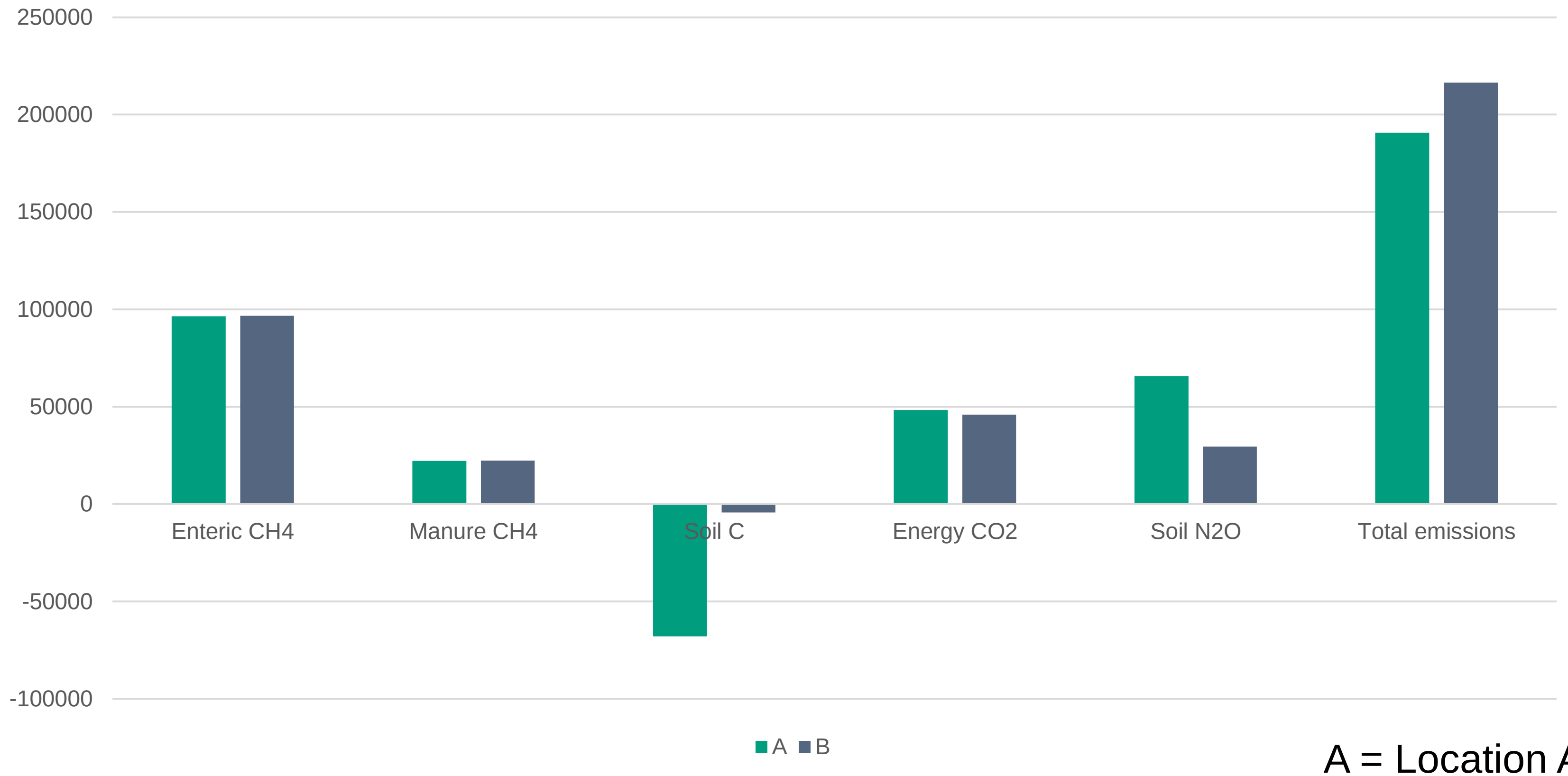
- Animal data – average values
  - British (Angus/Hereford) and Continental (Charolais/Simmental/Limousin)
  - Stilbirth, proportion twins, death<180 d
  - Replacement rate
  - Weights (birth, weaning, slaugther, adult)
  - Age (weaning, slaugther, first calf,…)
  - Proportion concentrates
  - Proportion pasture



Animal caracteristics (unit)	British	Continental
Cows, average final LW (kg)[8]	600	800
Cows, slaugter weight (kg LW)[8]	600	800
Heifers, birth weight (kg)[8]	37.7	41.9
Heifers, weaning weight (kg)[8]	250.5	295.3
Heifers, slaughter weight (kg LW)[8]	456.5	518.9
Heifers, age at slaughter (months)[9]	18.2	17.5
Heifers, age at first calving (months)[9]	26.0	26.5
Young bulls, birth weight (kg)[8]	39.6	44.8
Young bulls, weaning weight (kg)[8]	268.5	322.3
Young bulls, slaughter weight (kg LW)[8]	534.2	689.3
Young bulls, age at slaughter (months)[9]	17.5	16.8
Beef produced (kg carcass)[9]	7572.6	8914.7

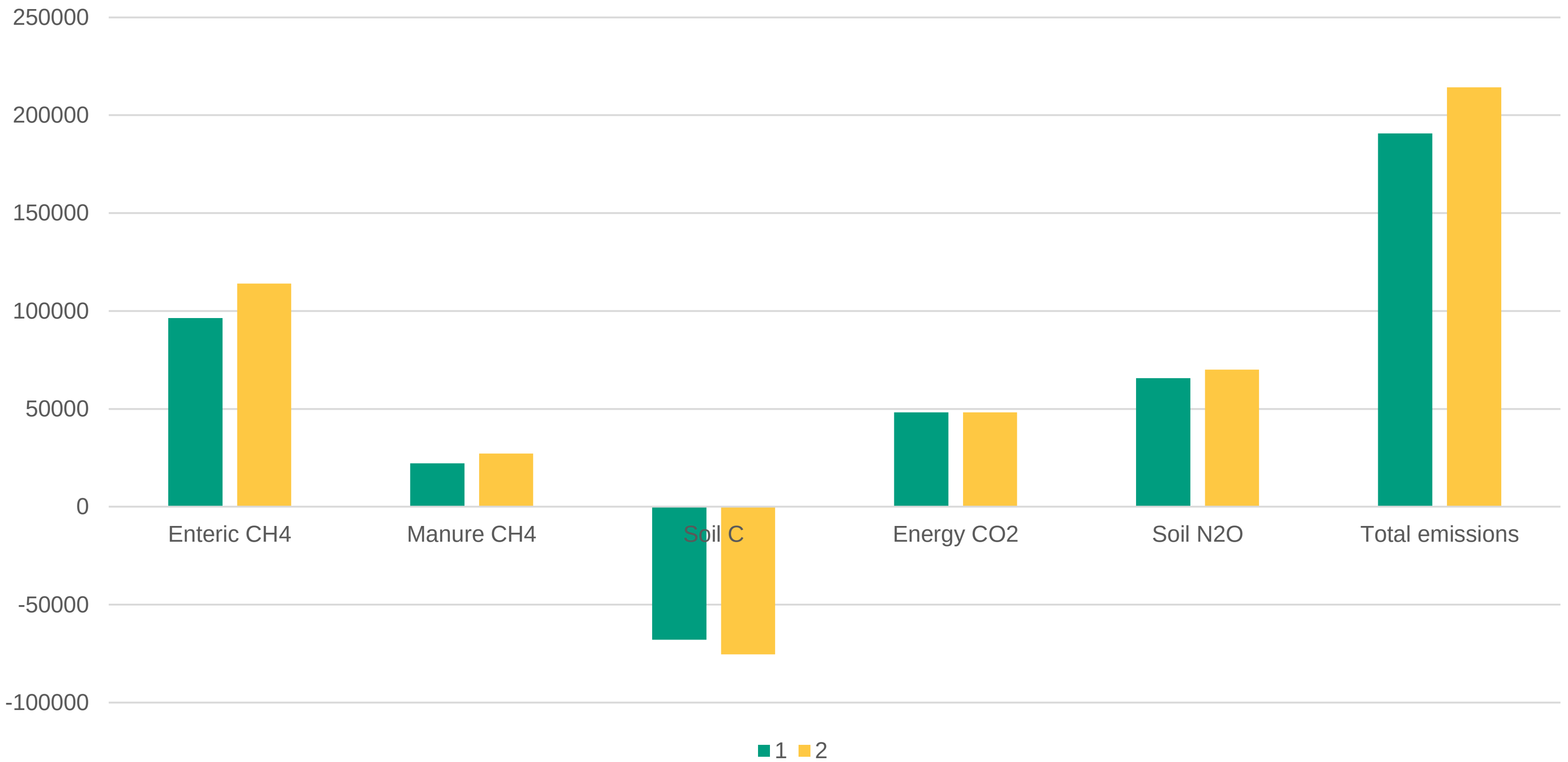
8) Aby et al 2012
9) Animalia 2016

Emissions (CO_2 eq)



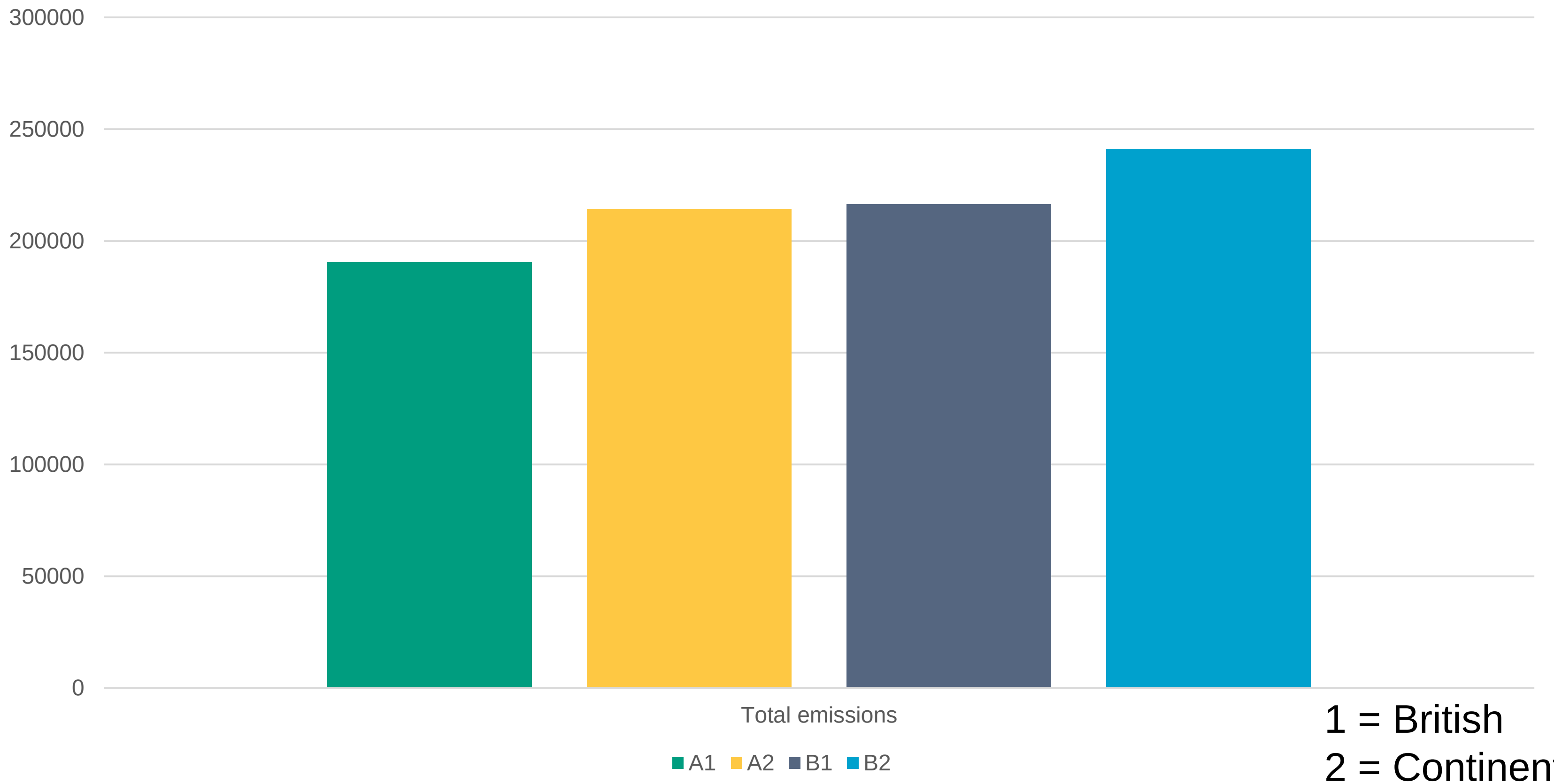
A = Location A
B = Location B

Emissions (CO_2 eq)



1 = British
2 = Continental

Emissions (CO_2 eq)



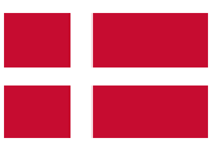
1 = British
2 = Continental
A = Location A
B = Location B

Emissions (kg CO_2 eq/kg beef)

	A		B	
	1	2	1	2
Direct kg CO_2 per kg beef carcass	16.5	16.4	21.1	20.5
Total kg CO_2 per kg beef carcass	25.2	24.0	28.6	27.1

1 British
2 Continental

Intensive system[10]: 25.4

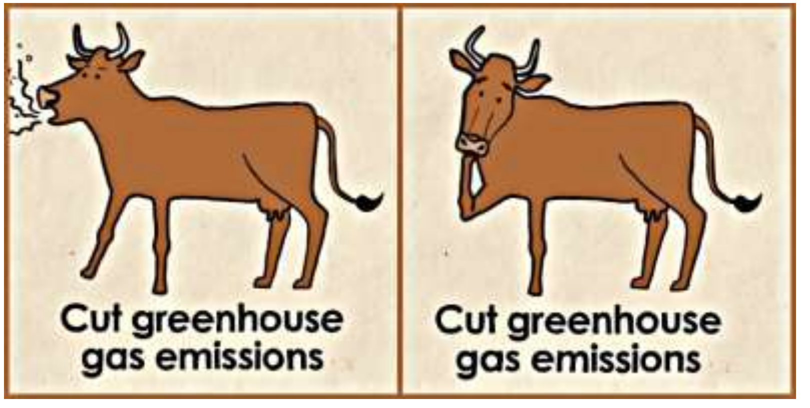


Intensive system[10]: 23.1
Extensive system[10]: 29.7

10) Mogensen et al 2015

Results and discussion

- The continental breeds have higher total emissions, but lower emissons/kg beef
- Emissions varies between regions and breeds
- GHG of average farms – variation!



Thanks for listening!