Does welfare improvement jeopardize emission mitigation?

Model calculations for Austrian dairy farms - ”heat mitigation”

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Overview.

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Introduction.

Challenge – combining environmental impact mitigation and animal welfare improvement in dairy farming.

- Measures for environmental impact mitigation with welfare trade-offs.
- Diseases affect productivity and thus emission potential.

➢ **Effects of animal welfare improvement measures on environmental impact still unclear.**

Aim of the project.

Assessment of potential impact of animal welfare improvement measures on the product-related environmental impact of dairy farming.

- Model calculations for dairy production in Austria
- Assessment of global warming, eutrophication and acidification potential.
- Evaluation of the environmental impact of selected welfare improvement measures
  - * heat mitigation
  - * additional pasture access
  - * (increased productive life span)
  - * rubber-topped flooring
  - * increased cleaning frequency

Material and Method (1).

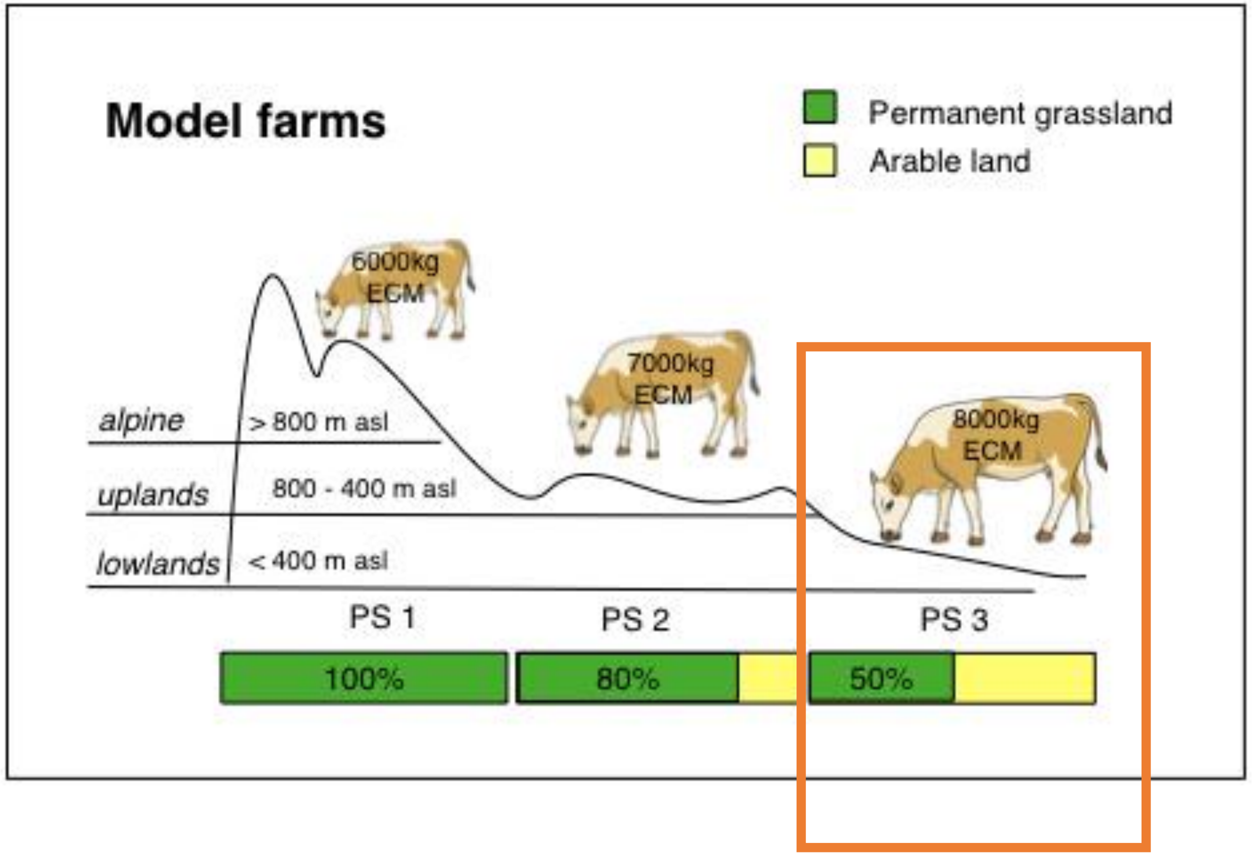
Model farms

- locality (m asl)
- arable land : grassland ratio
- production intensity
- housing type

(Statistics Austria, InVeKos)

➢Feed and nutrient intake
(estimated acc. to DLG, OEAG)

➢Emissions of CH_4 and N_2O
(IPCC 2006, NIR 2014)



Material and Method (2).

Life Cycle Assessment (ISO 14040 – 14049)

- System borders: cradle to farm gate
- Functional unit: 1 kg ECM
- Impact categories:

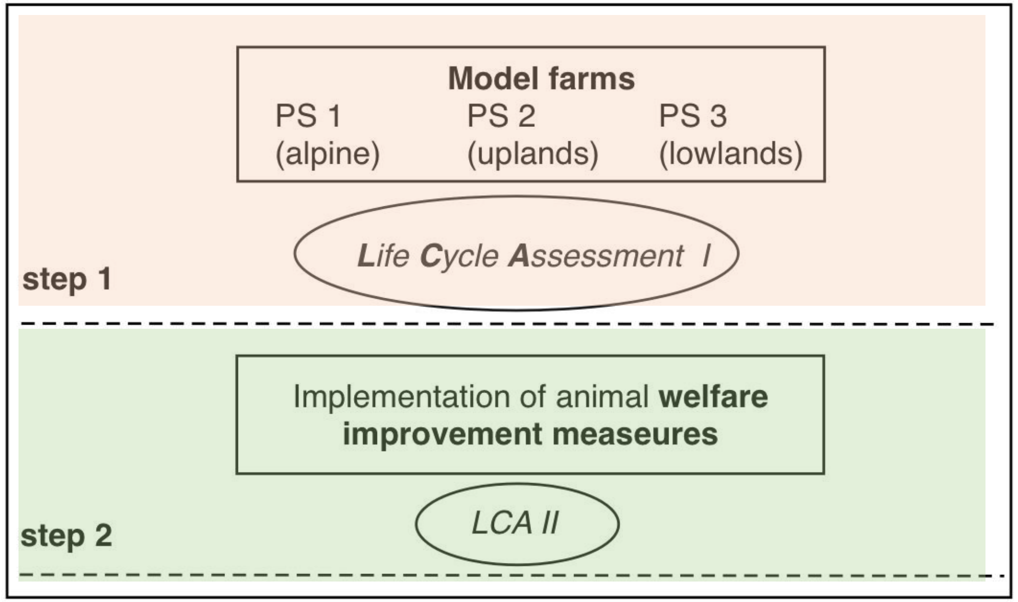
  Global warming potential (kg CO_2 –eq.)

  Eutrophication (kg PO_4^{3-} –eq.)

  Acidification (kg SO_2 –eq.)

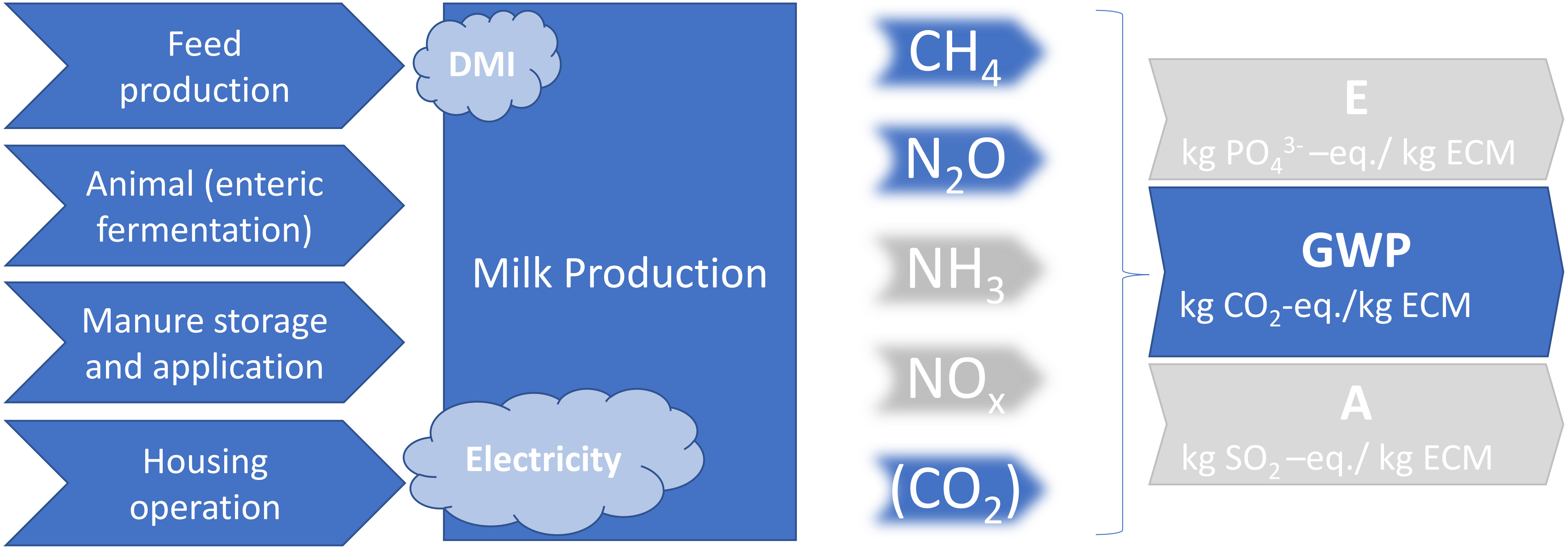
➢ Software *oLCA 1.7.2 (GreenDelta2018)*

➢ Database *ecoinvent 3.1 (Wernet et al. 2016)*



➢Assessment in 2 steps

Material and Method (3).



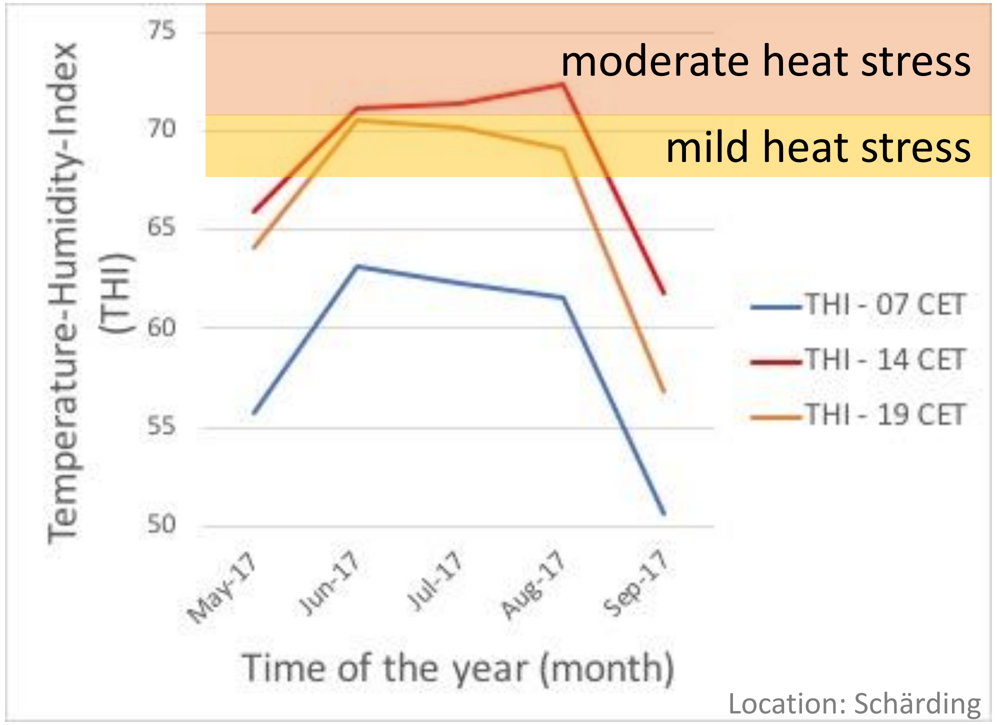
Material and Method (4).

Animal welfare measure “*heat mitigation*”

➢additional cooling (fans)

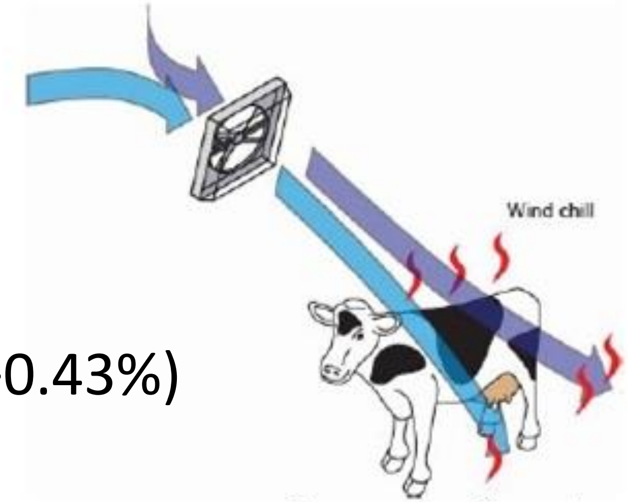
Source: modified acc. to ZAMG (2018), NRC (1971)

Temperature-Humidity-Index **(THI)**



Material and Method (5).

Modelling assumptions:



Source: microclimasystems.com

Energy demand

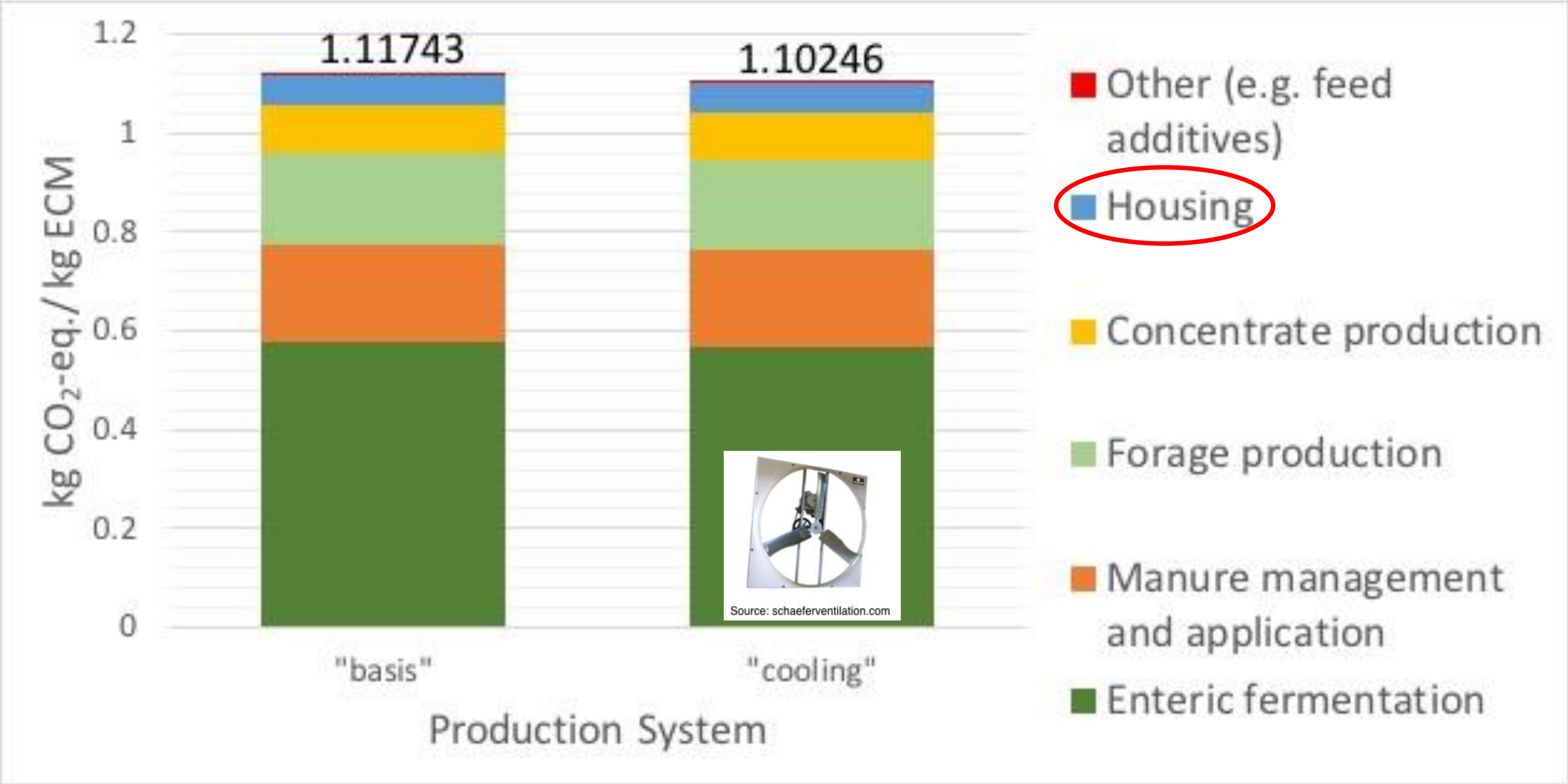
- Additional ventilation: **+ 48 kWh/ cow.a** (+5.6%)
- Additional milking and cooling: **+ 3.7 kWh/ cow.a** (+0.43%)

Production characteristics

- Increase in DMI: **190 g DM/ d** (+1.1%)
- Increase in milk yield: **0.375 kg ECM/ d** (+1.7%)

Results (1). preliminary

GWP of "heat stressed cow" vs. "cow receiving cooling"

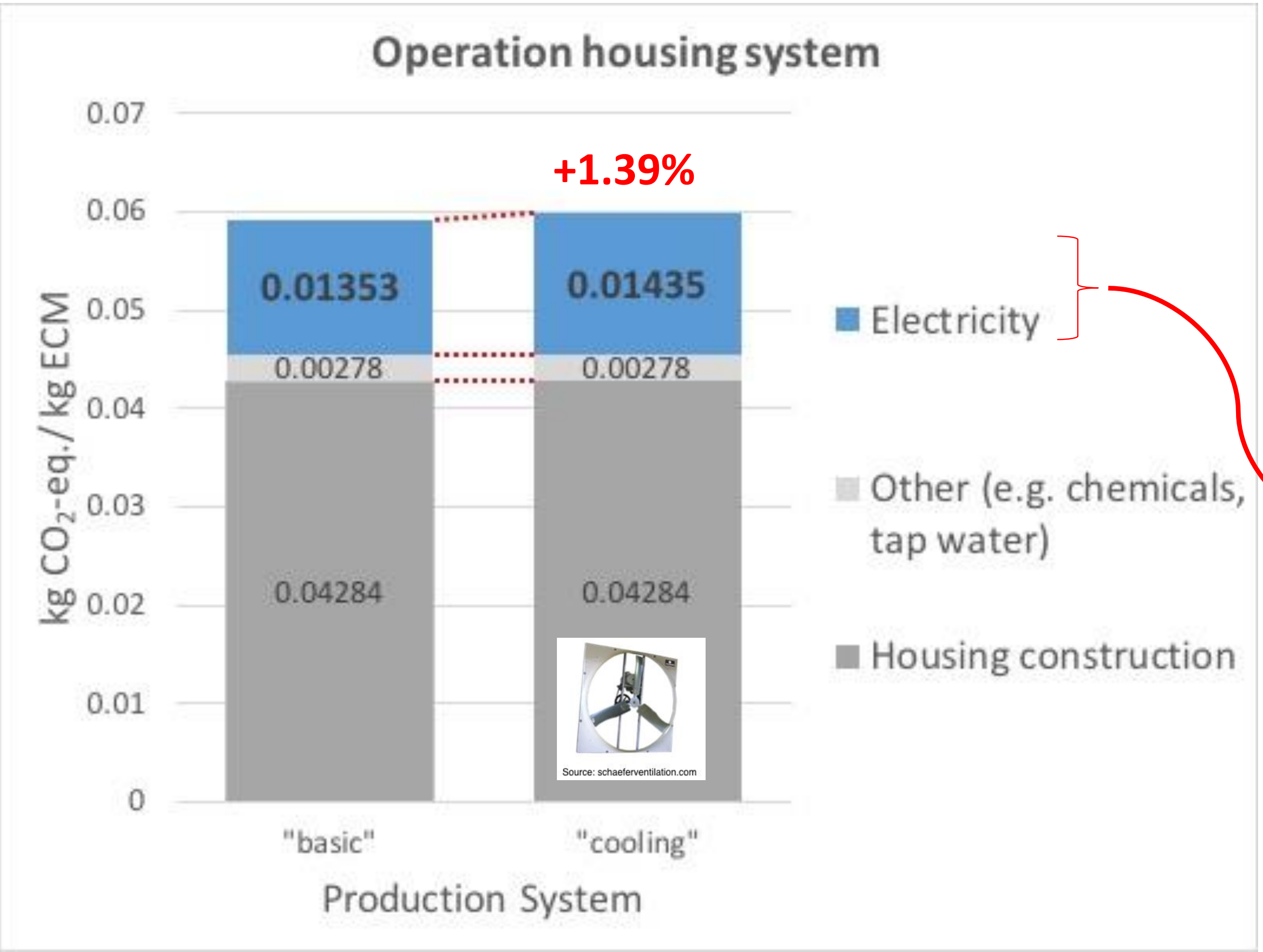


- **Fan only:**
  +0.07% kg CO_2-eq./ kg ECM (1.11825)

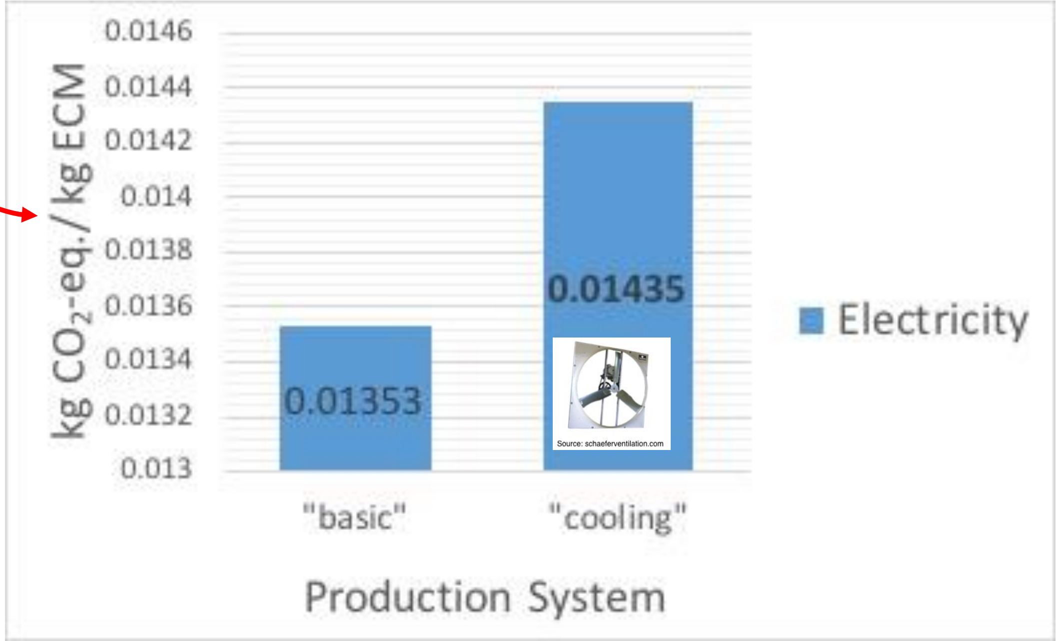
- Fan + DMI + yield increase:
  -1.34% kg CO_2-eq./ kg ECM

Results (2). preliminary

GWP of housing without/ with additional cooling



- GWP$_{housing_electricity}$ increase with additional cooling:
  +6.1% kg CO_2-eq./ kg ECM



Conclusion

- ”Heat mitigation” can improve animal welfare and slightly reduce the emission level per kg of product (**win-win**).

- Results concur with previous calculations: 1-2% (ADAS, 2015).

- Mitigation potential of the measure expected to increase further, when accounting for reduced disease risk (e.g. lameness) and increased productive life span (culling risk and calving interval decrease).

Thank you.

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A1 I Model characteristics of PS 3: yield level, feed quality

Characteristic	PS 3	Source
Milk yield (kg ECM/ cow.a)	8,000	assumption, based on expert opinion for the model region
Productive life span (years)	3.81	average of animals in control farms (ZAR, 2018)
DMI (kg/ d)	18.27	calculated, based on energy demand (Kirchgessner, 2014) and average forage yields in the model region (InVeKos, 2013)
Average energy density of forage (MJ NEL/ kg DM)	5.97	calculated, based on feeding value tables by Wiedner (2001) and OEAG (2006)
Average energy density of concentrate (MJ NEL/ kg DM)	7.84	calculated, based on feeding value table by DLG (2001) and producer (DDGS)
Percentage of forage per kg diet-DM (%)	77.97	calculated, based on diet composition
Percentage of concentrate per kg diet-DM (%)	22.03	calculated, based on diet composition

A2 I Model characteristics of PS 3: diet composition

Component		PS 3	(% of total ration)
Forage composition (%)	grass silage	43	33
(77.97% of total)	maize silage	25	20
	clover grass silage	13	10
	hay	10	8
	grass	10	8
Concentrate composition	wheat	23	5
(22.03% of total)	barley	46	10
	sunflower-seed meal	16	3
	rape-seed meal	6	1
	DDGS	9	2
Total			**100**