LfL

Bavarian State Research Center
for Agriculture

Insights from the LfL Klima-Check

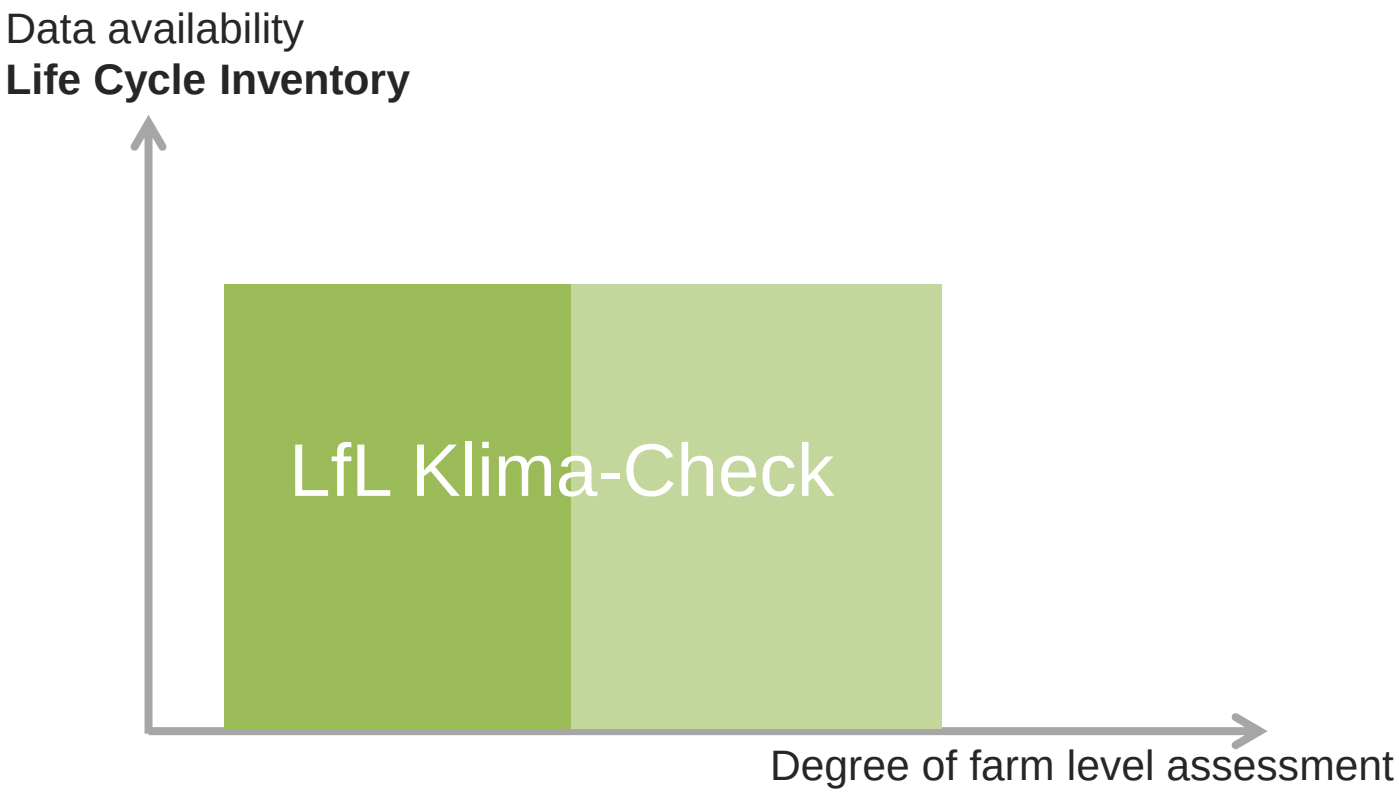
How to select cost-effective strategies for GHG mitigation on dairy farming systems?
What are potential measures to mitigate greenhouse gases from dairy cattle?

Monika Zehetmeier and Anton Reindl

Working Group on Climate Impact and Sustainability
Institute of Agricultural Economics

FRN Webinar, 9th February 2023

From the carbon footprint….
to GHG mitigation measures at farm level



From the carbon footprint….
to GHG mitigation measures at farm level

Data availab
Life Cycle I

LfL-Klima-Check

- Farm specific assessment – **detailed life cycle inventory**
- **What-if-scenarios** → partly mechanistic tool with **default values**
- Joint **economic** and **GHG emission assessment**
- Production system level, farm level and beyond the dairy farm gate level
- Open access – **bi-directional** knowledge transfer

Figure 1: Cl
CFT = Cool
Agroscope,

LfL-Klima-Check – Data Inventory – Default values

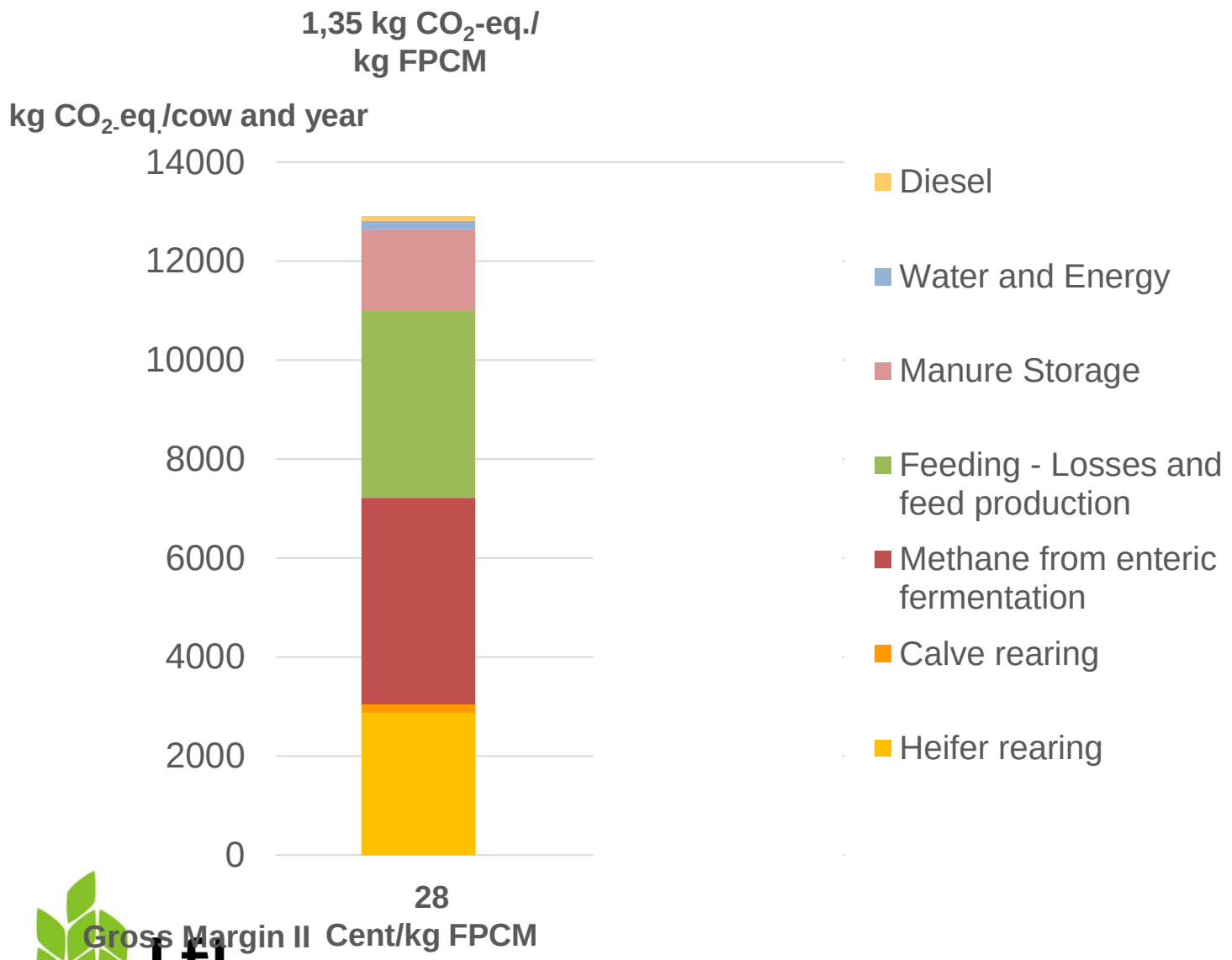
Characteristic values of the production process

Breed:	Fleckvieh			
Replacement rate:	31.3		Ø-Live weight	725.0 kg LW
Calving interval:	393.0 days			
Dairy cow replacement by:	First calving in own herd:	0.0 %	Purchase of young cows: 100.0 %	
Calf loss rate:	7.4 %		Calves per cow and year:	0.86
Protein content of milk	3.54 %		CF-Insert	290.0 g/kg milk
Fat content of milk	4.21 %			

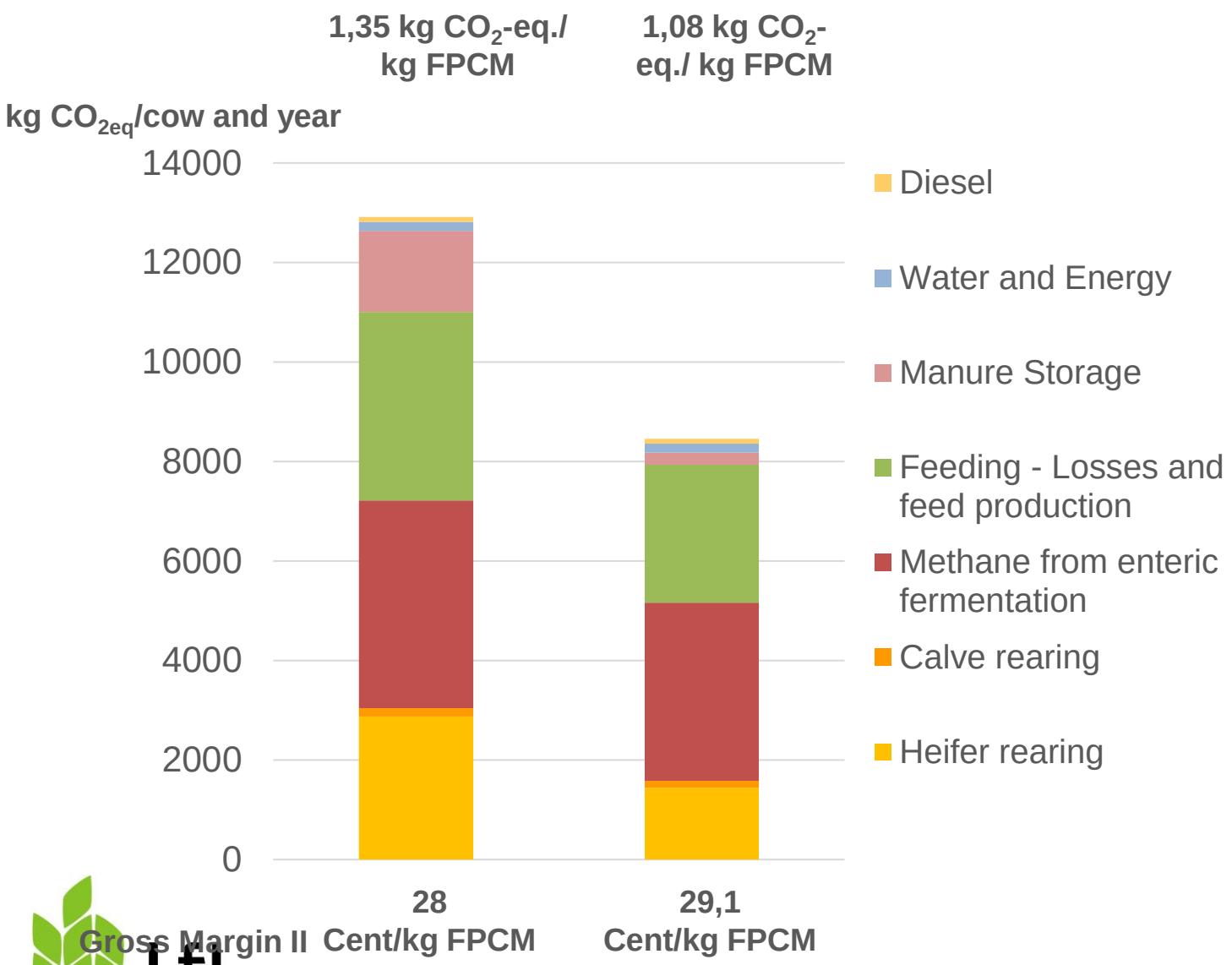
Characteristic values of the production process

Breed:	Holstein			
Replacement rate:	29.7		Ø-Live weight	675 kg LW
Calving interval:	413 days			
Dairy cow replacement by:	First calving in own herd:	0.0 %	Purchase of young cows: 100.0 %	
Calf loss rate:	10.7 %		Calves per cow and year:	0.79
Protein content of milk	3.43 %		CF-Insert	290.0 g/kg milk
Fat content of milk	4.1 %			

Calculation of different scenarios assuming a constant milk yield (8032 kg FPCM sold)



Calculation of different scenarios assuming a constant milk yield (8032 kg FPCM sold)



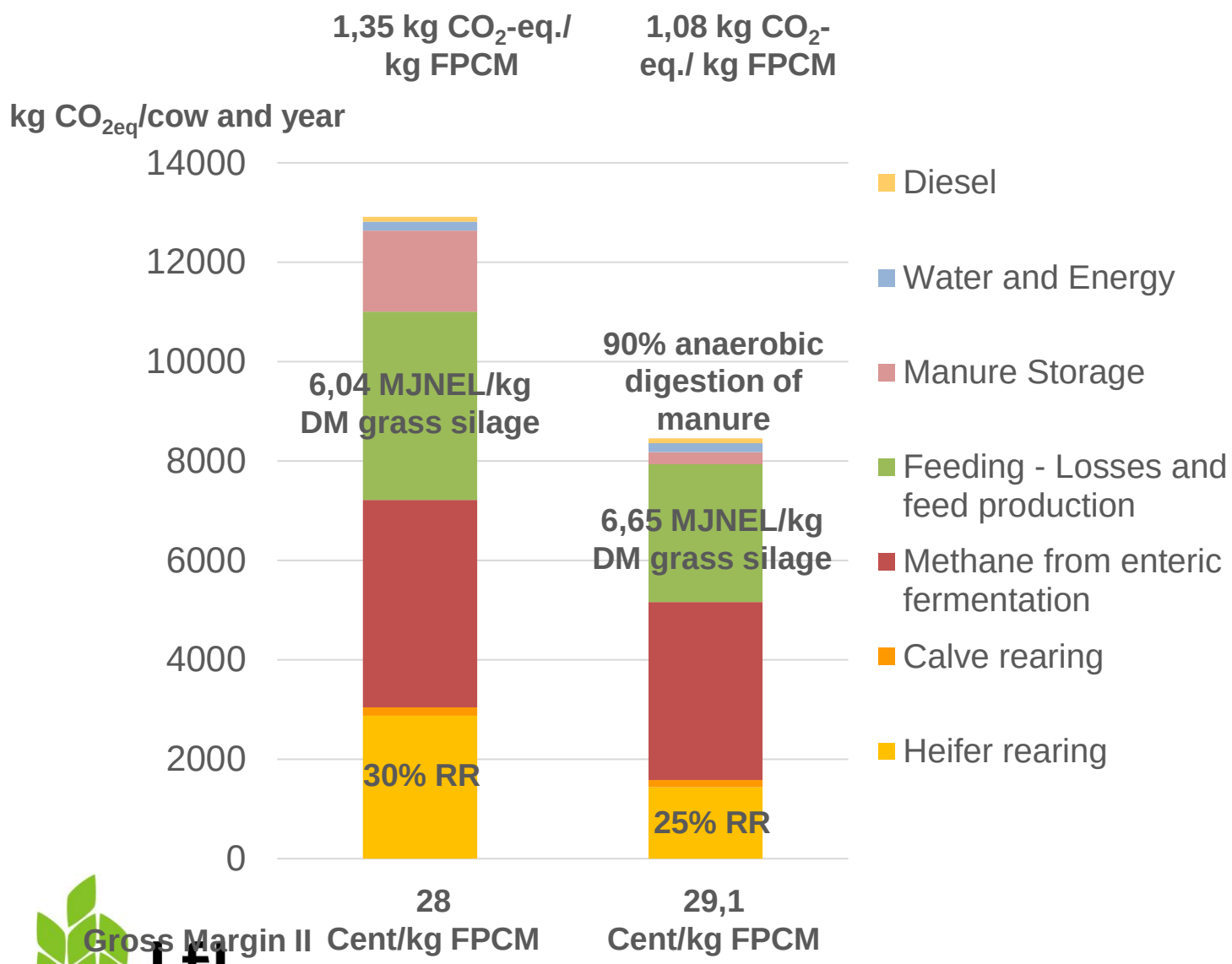
GHG mitigation measures

Technology

Forage quality
Protein sources, By-products
Efficent fertilizer application,
Reduce losses

Replacement Rate (RR)

Calculation of different scenarios assuming a constant milk yield (8032 kg FPCM sold)



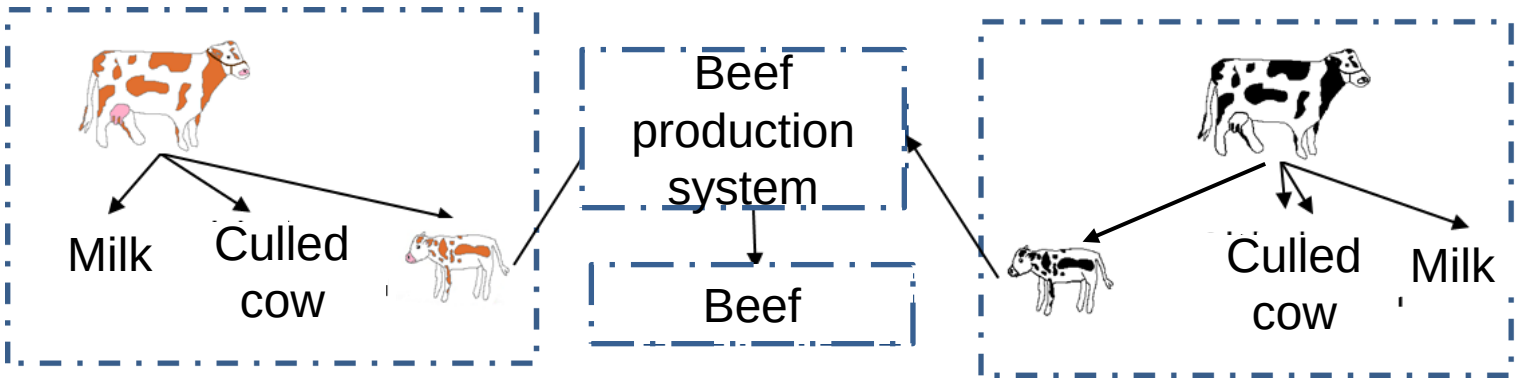
GHG mitigation measures

Technology

Forage quality
Protein sources, By-products
Efficent fertilizer application,
Reduce losses

Replacement Rate (RR)

System boundary beyond the dairy farm gate



Rinder

Milchkuhhaltung* — Dairy cow production system

Kalbinnenaufzucht* — Heifer rearing

Fressererzeugung

Bullenmast* — Bull fattening

Ochsenmast

Färsenmast

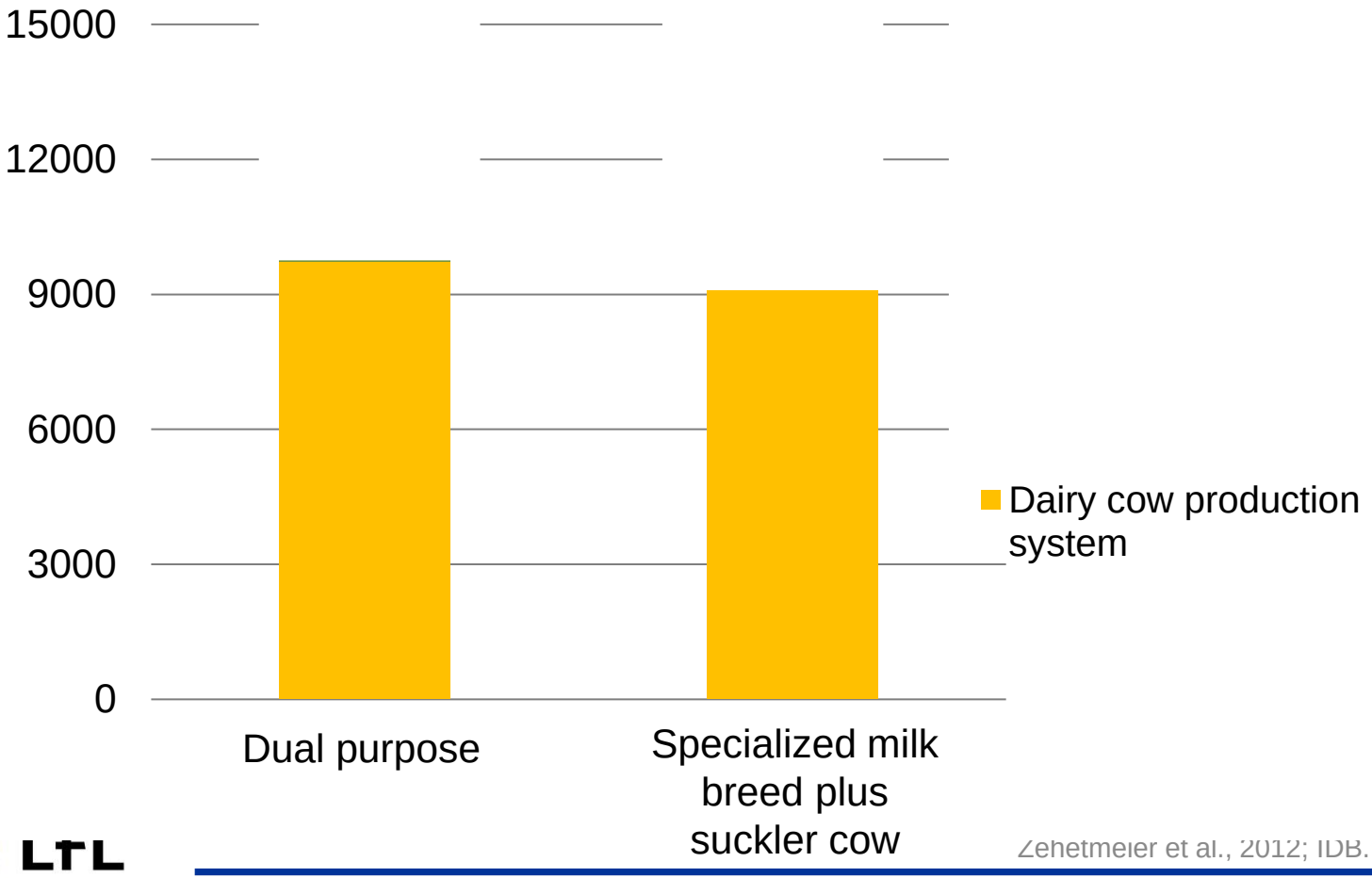
Mutterkuh Absetzer-produktion

Zehetmeier et al., 2012; IDB.THG, 2022

GHG emissions assuming a constant amount of milk and beef

Production system: 8320 kg milk und 312 kg beef

kg CO_2-eq./Production system and year

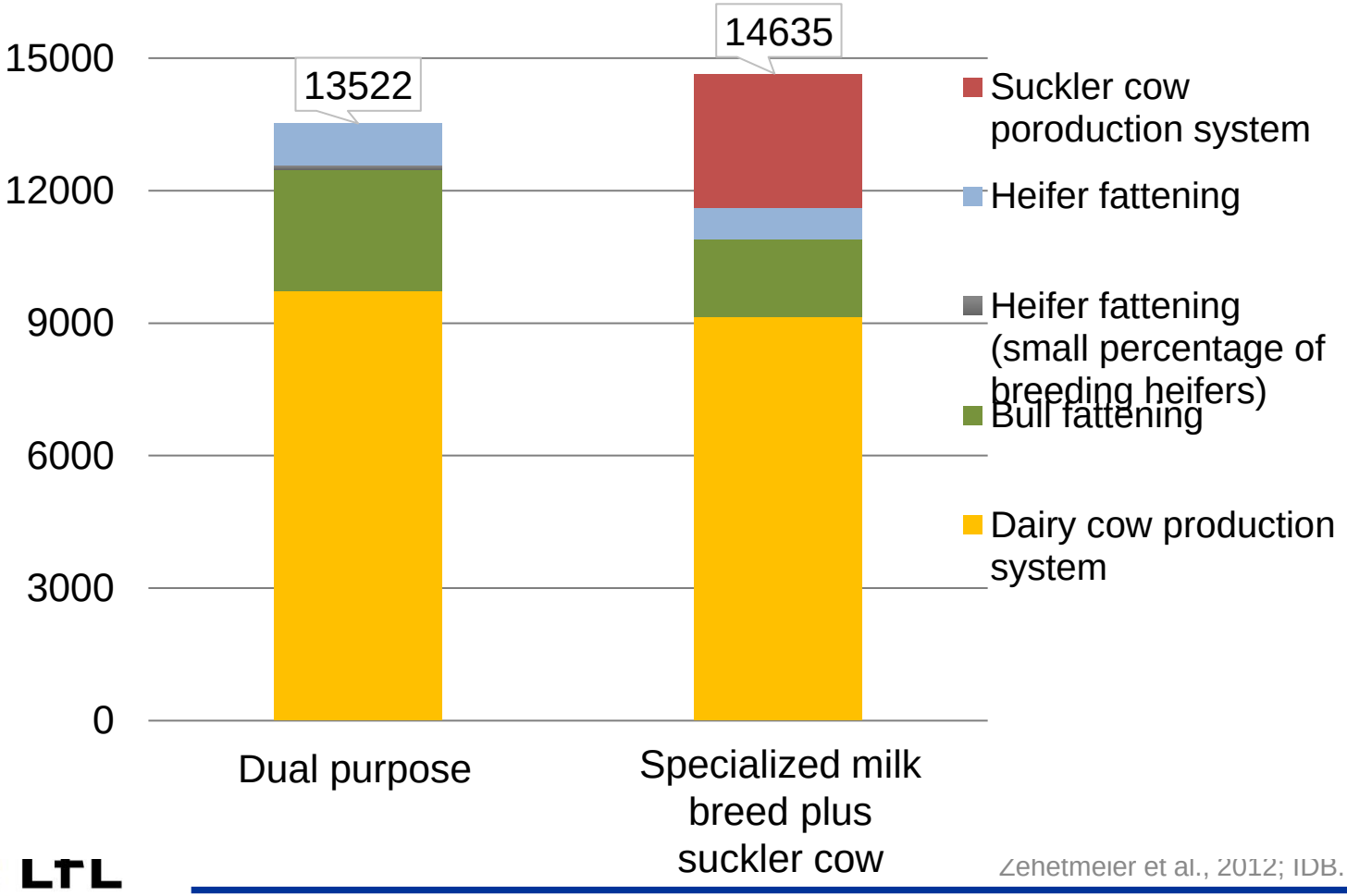


Zehetmeier et al., 2012; IDB.THG, 2022

GHG emissions assuming a constant amount of milk and beef

Production system: 8320 kg milk und 312 kg beef

kg CO_2-eq./Production system and year

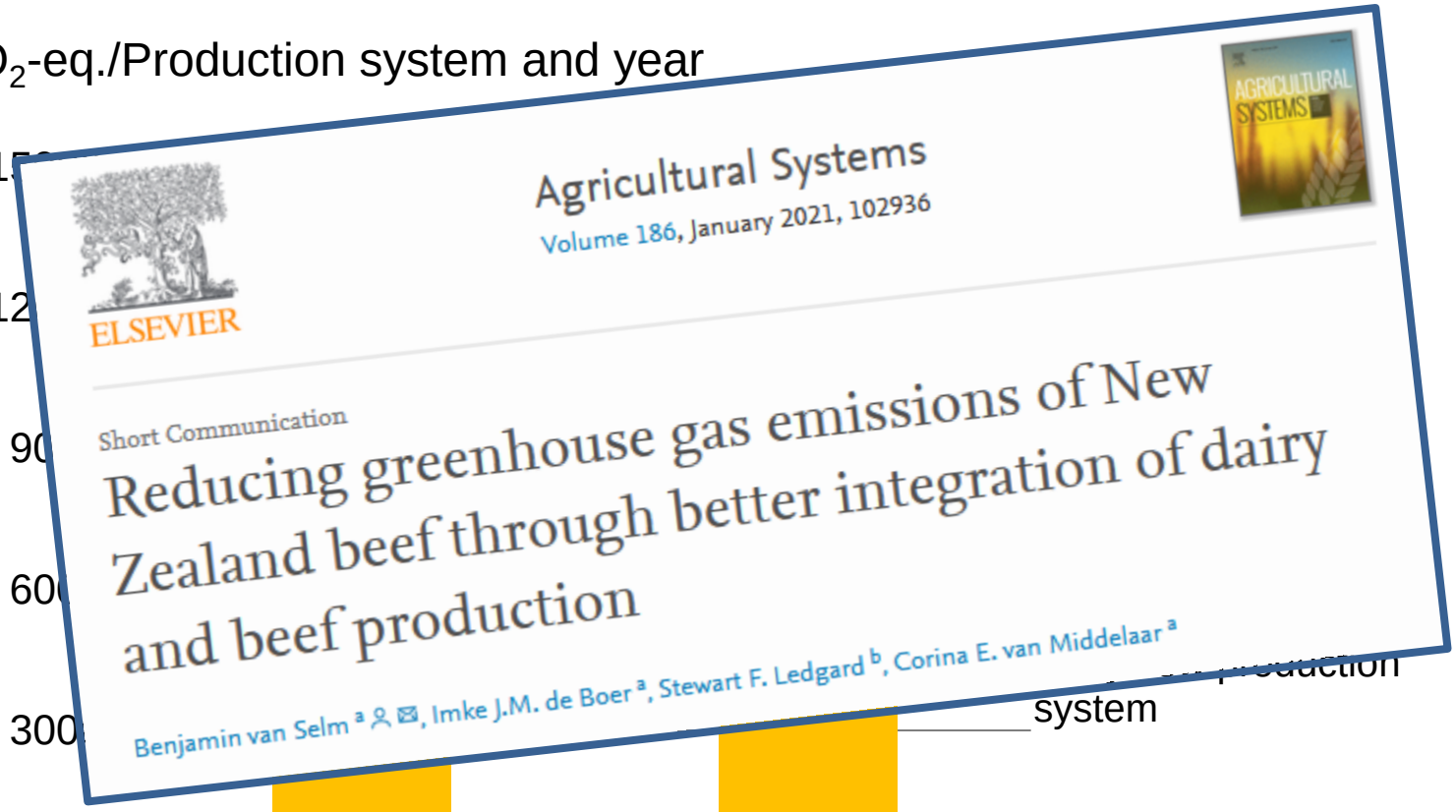


Zehetmeier et al., 2012; IDB.THG, 2022

GHG emissions assuming a constant amount of milk and beef

Production system: 8320 kg milk und 312 kg beef

kg CO_2-eq./Production system and year



Zehetmeier et al., 2012; IDB.THG, 2022

Summary and Future steps

- Detailed economic and GHG assessment can identify **farm specific hot spots**
- A joint economic and GHG emission assessment benefits from **data inventory synergies**
- **Scenario analysis** can show the leverage - **10-20%** GHG mitigation potential on average - for each farm and cost effectiveness → Economics as a “door opener” for advisory service; **Additional mitigation options with technological measures** e.g. anaerobic digestors → costly
- **Mitigation measures beyond the farm gate**: Joint milk and beef mitigation measures

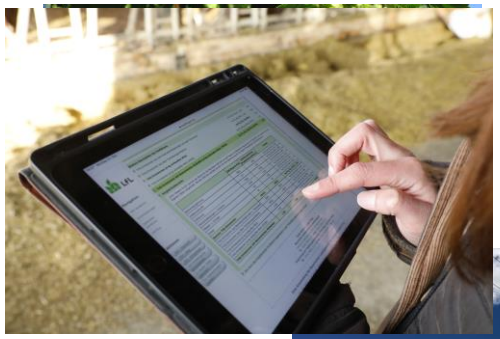
Summary and Future steps

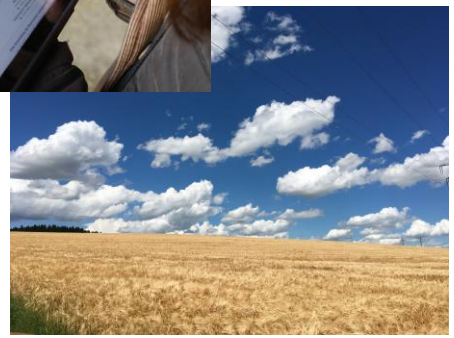
- Detailed economic and GHG assessment can identify **farm specific hot spots**
- A joint economic and GHG emission assessment benefits from **data inventory synergies**
- **Scenario analysis** can show the leverage - **10-20%** GHG mitigation potential on average - for each farm and cost effectiveness → Economics as a “door opener” for advisory service; **Additional mitigation options with technological measures** e.g. anaerobic digestors → costly
- **Mitigation measures beyond the farm gate**: Joint milk and beef mitigation

Indicators needed to assess cost effective GHG mitigation options

GHG emissions ✓	Carbon Sequestration	Product quality	Indicators that link farm and regional/national… level
Economics ✓	Land use	Feed Food competition	

Thank you for your attention!





Klima-Check Contact Person
Anton Reindl, Vanessa Karger
and Monika Zehetmeier
E-Mail:
klima.check@LfL.bayern.de

Classification of GHG assessment tools

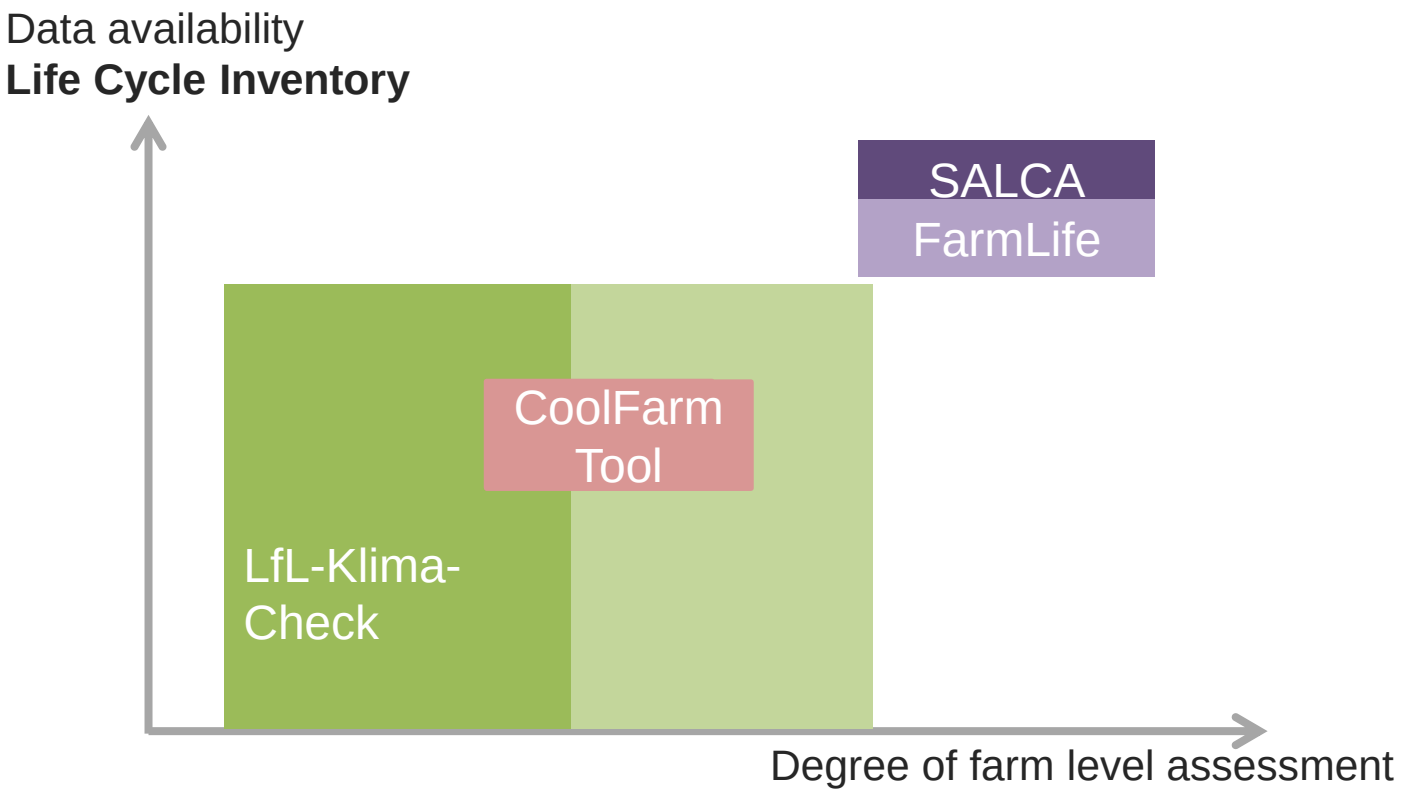


Figure 1: Classification of tools according to individualization and mapping of a farm (Source: LfL, Zehetmeier, 2021)
CFT = Cool Farm Tool, International; SALCA = Life cycle assessment tool Agroscope, Switzerland; FarmLife = Life cycle assessment tool Gumpenstein, Austria

Summary of farm level mitigation measures

Emission source	Mitigation options	Economics	Challenges
Forage/Feed production	fertilizer, pasture, Losses	+++	Advisory service, logistics, data availability,
Futteraufwand	Effiziency, feed quality, …	++	agricultural engineering, Advisory service, data availability
Emissions of bought in feed	By products from food industry	+-	Logistics, availability
Animal: Weight, Replacement	Longevity and age of first calving	+++	Advisory service
Methane from manure stirage	Storage system, Anaerobic digester	+-	Ligistics, costs
Methane from enteric fermentation	Milk and beef output	++	Advisory service, breeding goals
	Diet composition	+-	Physiology
	Additives	--	Costs, Long term effects, side effects

Cost effective +

Quelle nach: Karger, Zehetmeier, Lassen MIV Leitfaden 2022 und Zehetmeier & Spiekers 2022

LfL
Institute for Institute for Farm Management
and Agricultural Structure

LfL-Klima-Check – Feeding

1. Calculation of the cost of concentrate and mineral feed (CF/MF)

Feeding stuff	Concentrate and mineral feed intake				
	Feed %	Feed kg FM/cow a. day	Feed dt FM/cow a. year	Energy MJ NEL/cow a. year	Costs €/cow a. year
Energy concentrate					
Barley	30.0	1.94	7.07	5102	**118.28**
Wheat	0.0	0.0	0.0	0	**0.0**
MPF 18/4	30.0	1.94	7.07	5089	**187.28**
Corn	20.0	1.29	4.72	3485	**91.95**
Protein concentrate					
Rapeseed meal	10.0	0.65	2.36	1491	**79.39**
Soy extraction meal 44% XP	10.0	0.65	2.36	1796	**106.77**
Soy extraction meal 44% XP EU	0.0	0.0	0.0	0	**0.0**
Other and mineral feed					
Other CF I	0.0	0.0	0.0	0	**0.0**
Other CF II	0.0	0.0	0.0	0	**0.0**
Mineral feed		0.188	0.69	0	**50.51**
Sum of concentrate and mineral feed	**100.0**		**24.27**	**16964**	**634.18**
Milling, mixing					24.27
Total costs of concentrated and mineral feed					**658.45**

Barley
Ingridients and costs
DM: 88.0 %
Energy: 8.2 MJ NEL/kg DM
Price: 16.73 €/dt FM
VAT: 10.7 %

LfL-Klima-Check – Economic and GHG assessment

Variable costs		
Dairy cow replacement (incl. 10.7 % VAT)	€/cow a. year	585.5
Calf breeding (incl. 7.0 % VAT)	€/cow a. year	74
Concentrate and succulent feed, mineral feed	€/cow a. year	658
Vet, Medication, Hygiene, Dehorning (incl. 19.0 % VAT)	€/cow a. year	125.0
Insemination (incl. 19.0 % VAT)	€/cow a. year	35.0
Total variable costs (incl. VAT)	€/cow a. year	1707.0
Greenhouse Gas Assessment		
Dairy cow replacement	kg CO_2-Eq./cow a. year	1834
Calf breeding	kg CO_2-Eq./cow a. year	117
Feeding	kg CO_2-Eq./cow a. year	7242
Farm manure and beeding	kg CO_2-Eq./cow a. year	1160
Water and energy use	kg CO_2-Eq./cow a. year	182
Diesel production and combustion	kg CO_2-Eq./cow a. year	95
GHG-Emissions per cow and year	**kg CO_2-Eq./cow a. year**	**10630**
Further key figures of the procedure		
GHG emissions from the use of operationg resources and the purchase of animals	kg CO_2-Eq./cow a. year	5593
GHG emissions from the animal husbandry process	kg CO_2-Eq./cow a. year	5037
GHG emissions per kg milk	**kg CO_2-Eq./kg milk**	1.32
GHG emission per kg milk (FPCM)	kg CO_2-Eq./kg milk (FPCM)	1.27
GHG emissions with economic allocation per kg milk (FPCM)	**kg CO_2-Eq./kg milk (FPCM)**	**1.06**

LfL-Klima-Check – GHG emissions

Gross margin II in Cent je kg FPCM	**27**	**28,3**
GHG-emissions in kg CO_2-eq./kg FPCM (Allocation 100% to milk)	1,29	1,04
GHG-emissions in kg CO_2-eq./kg FPCM (IDF, 2022 Allocation)	1,08	0,88

Calf breeding		
Feeding		
Farm manure and beeding	kg CO_2-Eq./cow a. year	1160
Water and energy use	kg CO_2-Eq./cow a. year	182
Diesel production and combustion	kg CO_2-Eq./cow a. year	95
GHG-Emissions per cow and year	**kg CO_2-Eq./cow a. year**	**10630**
Further key figures of the procedure		
GHG emissions from the use of operationg resources and the purchase of animals	kg CO_2-Eq./cow a. year	5593
GHG emissions from the animal husbandry process	kg CO_2-Eq./cow a. year	5037
GHG emissions per kg milk	**kg CO_2-Eq./kg milk**	1.32
GHG emission per kg milk (FPCM)	kg CO_2-Eq./kg milk (FPCM)	1.27
GHG emissions with economic allocation per kg milk (FPCM)	**kg CO_2-Eq./kg milk (FPCM)**	**1.06**
Comparison overview		

Storage under slatted floor (over 1 month)	20.0	%

Scenario analysis

Parameter	Default Scenario	Climate Scenario
Replacement Rate %	30,1	25
Milk sold in kg FPCM/cow and year	8032	8032
Feed use in-efficiency %	5,7	2
Home grown feed protein %	0	100
Grass silage quality in MJ NEL/kg DM	6,04	6,65
Anaerobic digestion of stored manure %	0	90