

MILK WITH LESS EMISSIONS – AT WHAT COST?

Climate protection is becoming an increasingly important focus in dairy farming – demanded by politicians and dairies alike. While Denmark is planning to introduce a climate tax, German dairies are increasingly demanding climate assessments. But what does this mean in concrete terms for dairy farms? Which adjustments really reduce emissions – and what does this cost the farm? A practical example provides some answers.

The sources of emissions in dairy farming are diverse – and vary greatly from farm to farm. Using a sample farm as an example, this article illustrates how costly climate protection measures can be.

The example farm: A classic north-western German grassland farm with 330 Holstein cows, 300 hectares of land and a milk yield of 10,100 kg ECM per cow per year.

Currently, the farm's emissions are 1.03 kg CO₂ equivalent per kg of milk or 10,414 kg CO₂ equivalent per cow per year*.

The aim is to identify practicable reduction measures – and to calculate not only the reduction potential but also the costs of implementation. The basis for this is the farm's carbon footprint (Fig. 1), from which four key emission areas can be derived:

1. Rumen digestion
2. Feed production
3. Restocking and calf rearing
4. Farm manure and bedding

On this basis, scenarios are calculated that can reduce emissions and show how these affect production costs.

The emission sources shown in Fig. 1 can be reduced primarily through management measures such as a lower age at first calving, a lower replacement rate or better basic feed quality. In addition, feed additives or nitrogen granules can be added to the manure. The overall results are summarised in Table 1 and will be examined in more detail below.

Lowering the age at first calving

After rumen digestion, herd replacement and calf rearing cause the second largest share of emissions (Fig. 1). By lowering the age at first calving from 25 to 24 months, CO₂ can be reduced, assuming that a weight of 420 kg is achieved at insemination. In the example farm, this requires feeding more concentrated feed and purchasing weighing equipment.

What does CO₂ equivalent mean?

CO₂ equivalent (CO₂eq.) is a unit of measurement used to compare different greenhouse gases, such as methane or nitrous oxide. It describes how much a gas contributes to global warming compared to carbon dioxide (CO₂). In a company's carbon footprint, all emissions are therefore converted into CO₂eq.

And what are the savings in Euros?

Many industries have to purchase emission allowances for the expansion of their CO₂-intensive production processes. Even though agriculture is exempt from the EU Emissions Trading System (EU ETS), it is worth comparing it with the system, as it puts a price on greenhouse gas savings. In August 2025, an EU emission certificate cost €76, which was less than the cost of most climate protection measures on the example farm. Only the improvement in the quality of basic feed stands out as a cost-effective measure.

* Emissions from organic soils are not taken into account



TAB. 1: OVERVIEW OF THE OVERALL RESULTS

Strategy	Emission reduction in kg CO ₂ eq. per kg ECM	Cost of measures in ct per kg ECM	Reduction costs in € per t CO ₂ eq.	Reduction in total emissions in %
Reduction in age at first calving	0.01	0.40	272	1.4
Reduction in restocking rate	0.07	1.66	232	6.9
Increase in grass silage quality	0,01	-0.10	-80	1.2
lime nitrogen	0.06	0.50	80	6.0
Feed additive*	0.11	0.93	85	10.6

*3-nitrooxypropanol

Good herd management is essential for success, which primarily requires more working time.

The measures to reduce the age at first calving cost approximately €13,100 per year (0.4 ct/kg of milk) and reduce emissions by 1.4% or 0.01 kg CO₂ eq/kg ECM. The reduction costs are €272/t CO₂ eq.

Reducing the restocking rate

Fewer unproductive animals mean fewer emissions. In the example farm, the restocking rate is to be reduced from 35% to 25% – through fewer losses and longer useful life. To achieve this, investment is being made in a digital animal monitoring system; this will increase veterinary costs for older cows.

The measure costs approximately €55,000 per year (1.66 ct/kg milk), but saves 6.9% of emissions (0.07 kg CO₂ eq/kg ECM). The reduction costs amount to €232/t CO₂ eq.

Improving basic feed quality

Better grass silage with a higher energy content reduces emissions from digestion.

To achieve this, grassland measures are implemented (liming, reseeding, rolling), feed samples are taken regularly and the proportion of concentrated feed is reduced – while maintaining the same milk yield.

Costs: approx. €25,700 per year (€145/ha). Savings on concentrated feed: approx. €20,000. The bottom line is that the farm saves approx. €2,300 or 0.1 ct/kg of milk. Emissions are reduced by 1.2%, resulting in negative reduction costs of minus €80/t CO₂ eq. – a profit for the farm.

Lime nitrogen-based slurry additives

They reduce foaming and reduce methane, nitrous oxide and CO₂-emissions. The advantage lies in their ease of use.

Costs: approx. €16,600 per year (0.50 ct/kg milk). The measure saves 6% of emissions (0.06 kg CO₂ eq./kg ECM) at reduction costs of €80/t CO₂ eq.

Feed additives

Example: 3-NOP (3-nitrooxypropanol): Reduces methane formation in the rumen. It is

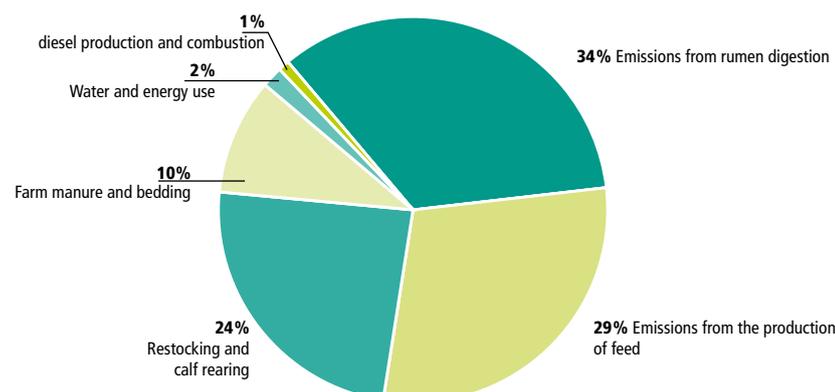
added to the mineral feed. In addition to the cost of the additive, labour and consulting costs for ration adjustment are also incurred.

Costs: approx. €31,200 per year (0.93 ct/kg milk). Emissions are reduced by 10.6% (0.11 kg CO₂ eq/kg ECM). Reduction costs: €85/t CO₂ eq.

Conclusion

All of the measures considered have advantages and disadvantages and cannot be universally applied to other farms. The costs in particular vary greatly from one farm to another. However, calculations based on the example farm show that in farms that are already well established, reducing emissions through efficiency improvements is often expensive. In less optimised farms, certain emission reductions can be achieved through management measures and efficiency improvements at an acceptable cost. Above all, optimising the quality of the basic feed provides positive results, as the negative reduction costs result in a positive balance.

FIG. 1: THE MOST IMPORTANT SOURCES OF EMISSIONS PER ANIMAL AND YEAR IN PERCENT



Anne Helene Ahrend

Thünen Institute, Braunschweig
E-mail: anne.ahrend@thuenen.dee



Dr. Hauke Tergast

Thünen Institute, Braunschweig
E-mail: hauke.tergast@thuenen.de

