



Background

As dairy cows consume large amounts of nitrogen through proteins in their diets, a large amount is excreted in urine and feces. In manure, ammonia is formed by breaking down urea and is promoted by the amount of urea, temperature and the degree of mixing feces and urine. Depending on several factors, some of the ammonia formed is volatilized into the atmosphere. Gaseous ammonia in the atmosphere is undesirable, due to its negative influence on environmental and public health, due to the effect on air quality in both rural and urban areas.

How do these strategies work?

Many mitigation practices have been identified to allow livestock systems to reduce ammonia emissions. These practices can be divided in four categories, as described below. It is important to keep in mind, that some practices could fit in more categories. Table 1 also describes specific measures for mitigation categories 1 to 4.

Categories of mitigation practices

- 1. Barn;** Emission reduction by barn design or changes in barn setup
- 2. Barn management;** Emissions that apply to existing barn designs and require a level of monitoring and labour to function properly
- 3. Manure;** Emission reduction by managing or manipulating the manure
- 4. Feed;** Adaptations to feeding routine

Measure	Reduction	Cost*	Based on	
			Source	Experts
1. Barn				
- Lely Sphere system (manure separation at floor level and scrubbing air of liquid storage)	+++	high	Rijkswaterstaat (Dutch ministry of infrastructure and water management admission list) ² https://www.lely.com/solutions/housing-and-caring/sphere/	X
- N Stripping system (mechanical manure separation → liquid fraction is stripped)	+++	high	https://joz.nl/en/solutions/nitrogen-cracker/	X
- Cow Toilet (Hanskamp)	++	medium	https://hanskamp.com/en/solutions/cowtoilet/	X
- Slatted floor to solid floor	+ ¹	low-medium		X
- Closure of mixing pits	+	low	Proeftuin Natura 2000 (2017) ³	X
- Scrubbers	+++	high	Rijkswaterstaat (Dutch ministry of infrastructure and water management admission list) ²	X
2. Barn management				
- Avoid using separated manure solids as bedding	+	low-medium		X
- ACNV (automatically controlled natural ventilation)	+	quote dep.	Proeftuin Natura 2000 (2017) ³	X
3. Manure				
- Manure robot/manure scraper	+	medium	Braam, C et al, 1997 - Effects of floor design and floor cleaning on ammonia emission from cubicle houses for dairy cows. Netherlands Journal of Agricultural Science, 45(1), 49-64.	
- Raise (manure) scraping intensity	+	low		
- Manure scraper maintenance (protocol)	+	low		
- Flushing with water	++	low-medium	van Dooren, H. J. C et al., 2022 - Reductie van ammoniakemissie door gebruik van water in melkveestallen: resultaten van emissiemetingen op Dairy Campus . Wageningen Livestock Research.	
- Dilution and mixing of manure	+	low		X
- Acidification of manure	++	high	W. Beerling, 2015. Aanzuren in mineur; slechts enkele lichtpuntjes. Veehouderij techniek.	
- Urease inhibitors	+	quote dep.	Puente-Rodríguez, D. et al., 2019 - Environmental Dairy Design for 2020 (EDD20): Ontwerpen voor huisvestingssystemen van melkvee met lage ammoniakemissie. Wageningen Livestock Research.	
- MgCl enrichment (NedMag)	+	not available		X
- Daily manure removal and external storage	++	low, quote dep.	Haeussermann, A., et al., 2006 - Influence of season, ventilation strategy, and slurry removal on methane emissions from pig houses. Agriculture, ecosystems & environment, 112(2-3), 115-121.	
4. Feed				
- Grazing (continuous)	+	none	https://edepot.wur.nl/355921	
- Reduced protein in ration	+	none-low		X

Table 1. Mitigation measure and practices for categories involved with barn design and management as well as manure and feeding routines to reduce ammonia emissions. Reduction is qualitatively expressed as: + = 0-30% reduction, ++ = 30-60% reduction, +++ = 60+% reduction.

Quote of the experts:

'What doesn't go in, can't come out. Reduction of emissions starts with nutrition'



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101000770.



¹ Influenced by the cleanliness of the floor; ² accesible via <https://www.infomil.nl/onderwerpen/landbouw/emissiearme-stalsystemen/emissiefactoren-per-map-stalypen/hoofdcategorie/>; ³ accesible via <https://agricconnect.nl>; scientific factsheets
* Costs are indicative; none (<5.000€), medium (<20.000€), high (>20.000€).

Assessment of method

