MM23: Biogas Capture and Flaring

Category

Livestock management: slurry management

Overview

Biogas flaring is a liquid manure storage technology, whereby the CH_4 generated during storage is collected and burnt, converting it to less potent GHG CO_2 (Pellerin *et al.* 2013). Liquid slurry systems, due to the mostly anaerobic environment in the liquid, are important sources of CH_4 emissions. Part of the organic material in the excreta is converted to CH_4 by bacteria in anaerobic respiration process. Along with the substantial amount of NH_3 and odour, the CH_4 escapes to the atmosphere from traditionally stored slurry. These emissions can be reduced by various ways, including covering the stores. If an airtight, impermeable cover is used the gases can be collected. One option is to purify the gas and sell the CH_4, while a technologically simpler solution is flaring the gas. This measure is different from anaerobic digestion not only in the use of the biogas (i.e. no heat and energy capture), but also in the way that the bacterial processes are not managed (e.g. no additional feedstock is used and the temperature is not controlled) and the gas is not used for electricity or heat generation. As with slurry covers, NH_3 emissions are substantially reduced, leaving more N available in the manure, potentially leading to increased emissions from manure spreading.

Mitigation summary

Table 1 Effects on emissions

GHG categories	Effect*	Notes
Enteric CH_4		
Manure CH_4	-	
Manure N_2O	- or + on direct N_2O, - on indirect N_2O	
Soil N_2O: applied N	+	Unless appropriate spreading technology is used
Soil N_2O: grazing		
Energy CO_2: fieldwork		
Energy CO_2: other		
CO_2 liming and urea		
CO_2 sequestration below ground		
CO_2 sequestration above ground		
Pre-farm emissions		Production of equipment
Post-farm emissions		
Substitution of higher C products		
Production increases by more than the emissions		

GHG categories	Effect* Rating	Notes
Confidence in mitigation effect	High	
Cost-effectiveness**	Medium	
Confidence in cost-effectiveness	Low	

*   ”-“ GHG reduction, “+”: GHG increase, “ ”: no significant effect
** low: =< £0/tCO_2e, moderate: £0/tCO_2e< >SCC, high: >SCC

Related measures and potential synergies

Table 2 Likely effects on the abatement potential of other measures

Measure	Impact
	-
	-

Inclusion in other marginal abatement cost curves

Table 3 Past assessment of the measure

UK 2008	UK 2010	UK 2015	Ireland 2012	France 2013	France 2019
No	No	No	No	Yes	?

What does the measure entail?

The measure assumes installing an airtight cover (e.g. flexible HDPE membrane) on above and below ground slurry tanks and no too large slurry lagoons (VanderZaag *et al.* 2015). A pumping system with ducts under the plastic film and an exhaust leading to a burner needs to be constructed to remove and flare the gas. The vacuum generated under the cover keeps the film attached to the liquid surface, reducing the risk of wind damage. Further pumps are needed to remove rainwater accumulating on the top of the cover. The advantages of the slurry cover include the reduced slurry volume, while practical difficulties can include snow and ice damage and difficulties in manure handling (agitation and pumping.

Abatement rate

As no study was found which reported on GHG emissions from biogas flaring systems, information on the GHG effects of impermeable covers was used (Table 4 Data from literature on abatement), complemented with assumption on the flaring efficiency.

Table 4 Data from literature on abatement

Abatement	Value	Country	Reference
CH_4 emissions (impermeable floating cover)	-47% (g CH_4–C (kg VS)$^{-1}$)	Sweden	(Rodhe *et al.* 2012)

Abatement	Value	Country	Reference
Direct N_2O emissions (impermeable floating cover)	-100% (g N_2O–N m^{-2})	Sweden	(Rodhe *et al.* 2012)
NH_3 emissions (negative air pressure)	-80% (range: 0% - -95%)	Various	Review of four papers in (VanderZaag *et al.* 2015)

Cost

VanderZaag *et al.* (2015) reported that the lifetime of these systems is over 10 years. They gave an estimate of €63 m^{-2} as the capital costs of such systems, with an annual 2% maintenance cost.

Applicability

Biogas flaring systems can be installed on all slurry tanks and small and medium size lagoons.

Current uptake and maximum additional future uptake

There is no information available on the current uptake of the measure; it is assumed to be zero.

Assumptions used in the MACC

Parameter	Change in value	Notes
MCF	-47%	Based on (Rodhe *et al.* 2012)
CH_4 conversion to CO_2	90% efficiency	Flaring efficiency, based on (Cherubini *et al.* 2015)
Manure N volatilisation	-80%	Based on (VanderZaag *et al.* 2015)
Direct N_2O emissions from slurry	-100%	Based on (Rodhe *et al.* 2012)
Capital cost	£16 m^{-3}, lifetime 10 years	Assuming €63 m^{-2} and 3.5m depth based on (VanderZaag *et al.* 2015)
Maintenance cost	2%	Based on (VanderZaag *et al.* 2015)

Wider effects

Table 5 Wider effects of the measure

Aspect	Effect	Reference
Positive effects		

Aspect	Effect	Reference
Off-farm GHG		
Production		
Adaptation		
Environment	Reduced odour, reduced NH_3 emissions (and related negative environmental effects, like acidification, eutrophication)	(VanderZaag *et al.* 2015)
Negative effects		
Off-farm GHG		
Production		
Adaptation		
Environment		

Identified implementation challenges and barriers

Table 6 Potential barriers of the measure

Barrier to uptake	Reference
Practicality	(English and Fleming 2006, VanderZaag *et al.* 2015)
Cost	(English and Fleming 2006, VanderZaag *et al.* 2015)
Other key risks/uncertainties	**Reference**
Limited scientific evidence on GHG effects	

References

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