## Odour emissions impact of on-farm biogas production with co-digestion : a case study in four European farms of the Great Region

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### The production of farm-based biogas and electricity is an area of alternative-energy interest to many livestock producers. On-farm biogas energy production is not only a potential source of income for farmers, but can also generate environmental benefits to society. The cobenefits associated with on-farm biogas energy production are important from the point of view of both the farmer, the policy analyst and other social planners. Cobenefits of on-farm anaerobic digestion are : i) mitigation of greenhousegas emissions from agricultural activity, ii) manure odour reduction, iii) toxicity and pathogen reduction in livestock manure, iv)reduction in weed seed germination, v) heat energy production and, vi) reduced water contamination (Yiridoe et al., 2009). This work aims at evaluating odour impact of on-farm anaerobic co-digestion practice. In European countries, to maintain economic sustainability of the agricultural biogas plant, most operators do not only use farm by-products, such as animal manure, slurry and crop residues but they also add substrates from different origins and quality such as energy crops and food industry wastes. It is commonly recognized that digested livestock manure and slurry are less odorous and offensive than raw manure and slurry (Pain et al., 1990). Even though, anaerobic co-digestion implies the use of unusual products in the farms, which can represent additional sources of odours and mitigate the odour impact of the farms on their neighbourhood.

The case study targets farms of the Great Region, with one farm per country (Belgium, Luxembourg, France and Germany). Depending on the environmental and energy policies of each country, farms practise anaerobic co-digestion in different ways. For example, German farm only introduces in the anaerobic reactor animal manure and energy crops whereas Belgian farm employs a 50 % of food industry waste as digester substrate.

Several methods were applied to monitor odour impact of farms practising anaerobic co-digestion. Dynamic olfactometry was used to assess the concentration of odour in the ambience of the farm and the specific odour emission rate from surface odour sources, through dynamic flux chamber and wind tunnel when spreading digestate or raw slurry. Field inspection and back-calculation with an atmospheric dispersion model were applied to assess the global odour emission rate from the facilities.

For the evaluated farms, neighbourhood was not affected by the activity of biogas production but care must be taken in the manipulation and storage of the co-substrates, especially food industry liquid and solid wastes. Food industry wastes were observed as an important additional source of odour emissions at the farm level. In average, farms odour emission rate was between 10 000 and 80 000 ou s-1 and perception distance was between 250 and 600 m, which is similar to conventional farms with no biogas production in those regions.

Concerning land application of digested and undigested slurries, in some preliminary tests, it was observed that in the same conditions, cow slurry odour emission rate was more variable than digested slurry (figure 1). It was also observed that digestate odour emission rate was more rapidly decreasing over time than cow slurry, even if sometimes initial odour emission rate was similar.



Figure 1 Specific odour emission rate (SOER) of manure and digestate expressed by Nitrogen unit per ha during the first hour following the application on the land. Bars represent the standard deviation.

# References

Pain, B. F., Misselbrook T. H., Clarkson C. R., Rees Y. J. (1990). Odour and ammonia emissions following the spreading of anaerobically-digested pig slurry on grassland. Biological Wastes, 34, 3, 259-267.

Yiridoe, E. K., Gordon R., Brown B. B. (2009). Nonmarket cobenefits and economic feasibility of on-farm biogas energy production. Energy Policy, 37,3, 1170-1179.