FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF GREEN CHEMISTRY AND TECHNOLOGY
DEPARTMENT OF AGRICULTURAL ECONOMICS

Model-based analysis of greenhouse gas emission reduction potential through farm-scale digestion

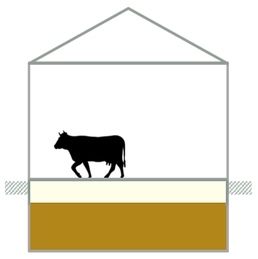
Tine L.I. Vergote, Wouter J.C. Vanrolleghem, Caroline Van der Heyden, Anke E.J. De Dobbelaere, Jeroen Buysse, Erik Meers, Eveline I.P. Volcke

Problem statement

Can the carbon footprint of dairy farms be reduced through farm-scale anaerobic digestion?

Scenarios

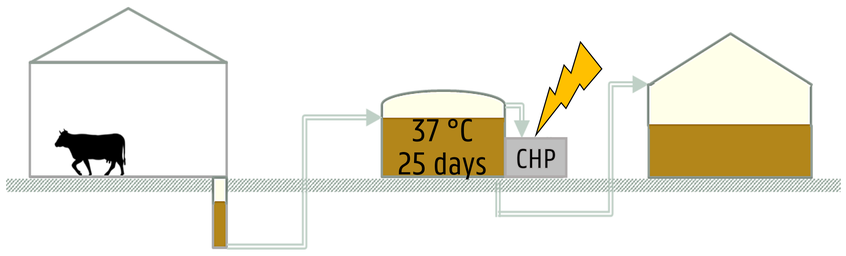
① **Manure pit**



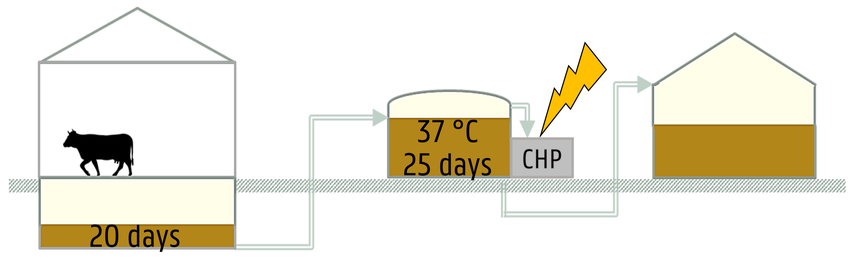
CH_4

Long-term manure storage
=
Unwanted **methane** formation

② **Fresh manure digestion**



③ **Pre-stored manure digestion**



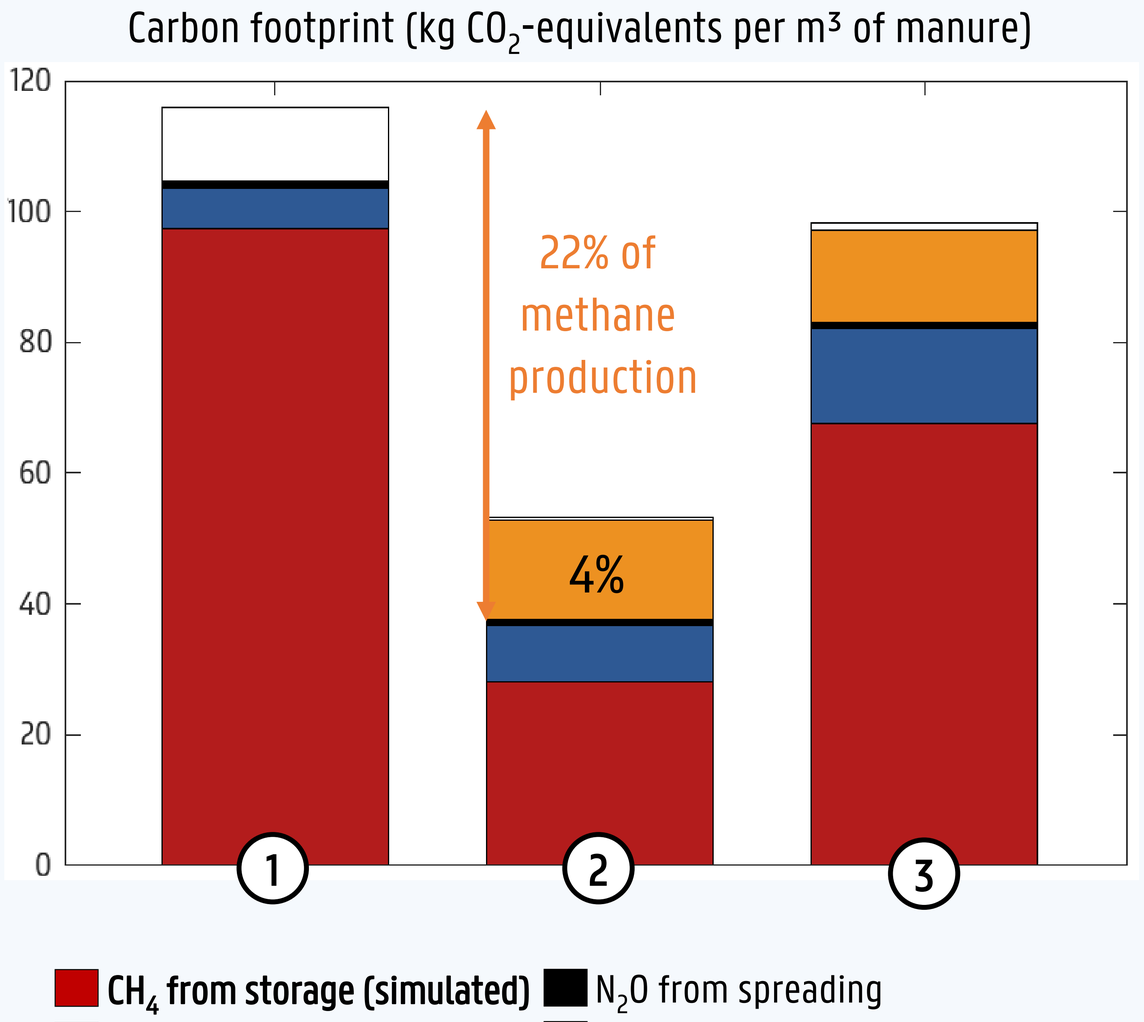
CH_4 **Farm-scale anaerobic digestion =** Renewable energy production from **methane**

CH_4 BUT ALSO: Digester **methane** losses
Methane emissions from (pre-storage of manure and) long-term digestate storage

Method

Fit-for-purpose anaerobic digestion model based on simplification of ADM1 assuming **hydrolysis as the rate-limiting step**.
Inclusion of **temperature dependency** and **constraints for storage** for dynamic simulation of methane emissions and production.

Results



Conclusions

Methane emissions from storage

- Up to **70% reduction** through fresh manure digestion at a digester retention time of 25 days
- Digestion of pre-stored manure or decrease in digester retention time = more **methane** emissions and less energy production from **methane**

Carbon footprint of dairy farms

- Over **80%** related to **methane** emissions from manure storage, under relatively warm conditions and without controlled digestion
- Up to **50% reduction** through fresh manure digestion (compared to a default dairy farm with a manure pit) assuming that digester methane losses are 4% of the methane production in the digester
- Possible reduction **completely offset** (no reduction compared to a default dairy farm with a manure pit) if digester methane losses are 22% of the methane production in the digester

Farm-scale anaerobic digestion can reduce methane emissions and the overall carbon footprint of default dairy farms with a manure pit if the digester is correctly dimensioned, properly managed and frequently monitored.

Further reading: Vergote et al. (2019). Model-based analysis of greenhouse gas emission reduction potential through farm-scale digestion. *Biosystems Engineering*, 181, 157-172.

More information: Tine.Vergote@UGent.be

Research conducted within the framework of the LA project Pocket Power, with support of Vlaio (http://www.vlaio.be), Boerenbond, ABS, Biolectric, Continental Energy Systems, Innolab, Vermeulen Construct, United Experts, Biogas-E, Inverde and VLACO.