Pocket Power! – Extending Small-Scale Anaerobic Digestion in Flanders

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SUMMARY

Flanders counts to date about 100 active small-scale anaerobic digesters. Those ‘pocket’ digesters use agricultural residues to provide energy for a company or farm. Most pocket digesters today find their application on dairy farms. The Pocket Power project will investigate the possible extension of pocket digestion to other agricultural streams such as pig manure and crop residues. In addition, Pocket Power will quantify the contribution of small-scale anaerobic digestion to the reduction of greenhouse gas emissions (compared to manure storage). The overall process optimization will be addressed as well.

Figure 1: small-scale anaerobic digester

INTRODUCTION

Pocket digestion is a technology, where the anaerobic digestion process is applied to mainly on-farm agricultural residues for the on-site production of biogas. This biogas is combusted in a combined heat and power (CHP) unit and provides energy in the form of electricity and heat to be used on-site by the agricultural company.

The popularity of pocket digestion has increased greatly in the last few years in the Flemish region of Belgium and a number of neighboring countries. In Flanders, there are about 100 active pocket installations to this date and it is expected that this number will increase significantly over the next years (De Dobbelaere et al., 2015).

Pocket digestion has many advantages. Most importantly, it is a tool for agricultural companies to increase their self-sufficiency in terms of energy demand and processing of residual waste streams. Second, pocket digestion contributes to the reduction of greenhouse gas emissions from manure storage (Miranda et al., 2015; Maranon et al., 2011). Due to its local character and limited scale, pocket digesters have limited transport issues and cause only a minimum disturbance of the landscape. This ensures a better level of acceptance from local inhabitants (De Dobbelaere et al., 2015).

Today, pocket digestion mainly finds its application on dairy farms. Within this niche there is still some potential for growth, but in the coming years a stabilization of the number of installations in Flanders is expected (De Geest et al., 2016). Therefore, it is important to investigate how pocket digestion can be expanded within and to other sectors. This will be the **first objective** of this project. The starting point is biomass that is still underused and shows a lot of potential for digestion on a small scale.

The **second objective** includes the quantification of the reduction of greenhouse gas emissions attributed to a pocket digester. Also the relation of this reduction to operational variables will be investigated based on practical measurements on the one hand and model simulations on the other hand.

MATERIAL AND METHODS

Pocket Power comprises seven main work packages (WP), as represented in Figure 2. WP1 and WP7 focus on the overall project coordination and the distribution and communication of the results. The main research lines are described in WP2 to WP6.

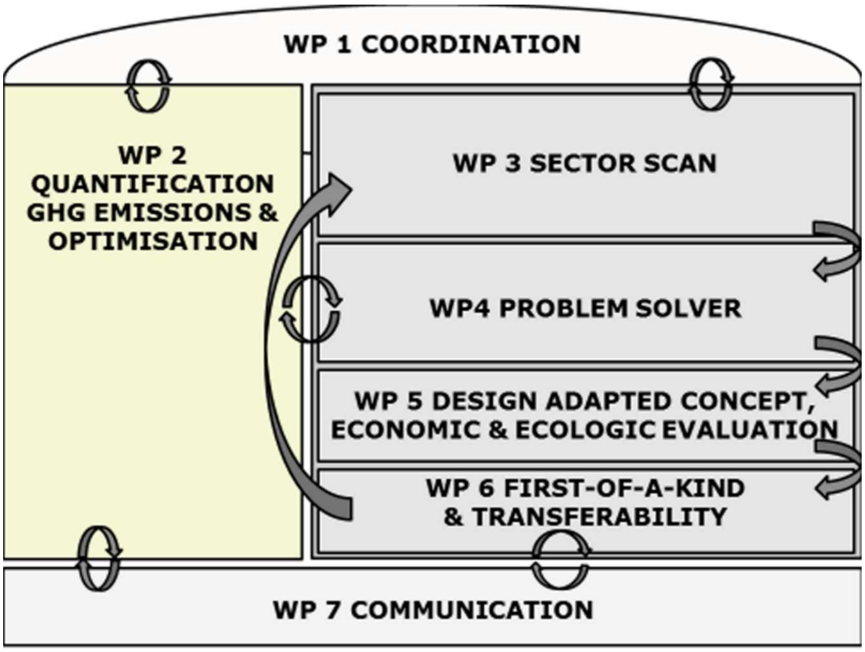

Figure 2: work plan

WP3 to WP6 comprise the **first objective**, namely expanding pocket digestion towards other sectors. A sector scan will be performed in WP3. Based on a multi-criteria analysis the potential and impact of an extension to other sectors will be defined. Criteria of interest are biomass availability, technical needs, legal restrictions, economic feasibility and ecological impact. Eventually, the two subsectors with the highest potential will be selected.

WP4 provides technical and practical solutions for pocket digestion relating to the entire process, from input streams, storage, process stability, energy interface to utilization of waste streams. Depending on the chosen biomass, specific problems will be solved. This work package aims to find hands-on solutions for the challenges that arise from valorization of the partial streams of the two subsectors selected within WP3.

WP5 makes a detailed calculation of the feasibility of the two case studies that were selected in the previous work packages. The case studies will be evaluated economically (cost-benefit analysis) and ecologically (LCA-study). The next step (WP6) is the transition to implementation and demonstration of one viable case study.

WP2 focuses on the **second objective**. The second objective includes the quantification of the reduction of greenhouse gas emissions attributed to a pocket digester. Existing small-scale digesters will be used for conducting a full-scale measuring campaign on the on one hand and modeling on the other hand. In this manner the relation between the reduction of greenhouse gas emissions and operational variables will be investigated. This knowledge will be used for process optimization in terms of maximum biogas production and valorization.

RESULTS AND DISCUSSION

The overall aim of the Pocket Power project is to respond to the demand of other sectors than the dairy sector for a profitable valorization of their agricultural residues. The first outcome will be a priority list in which the different subsectors are ranked based on their potential for a small-scale anaerobic digester. For the two types of companies (subsectors) that are on top of the list, an adapted digestion concept from delivery of biomass to production of biogas will be developed. For at least 10 companies within one of these subsectors, assistance will be given for further innovations. For at least 100 companies a feasibility study regarding pocket digestion will be performed. Finally, the possible transferability of the adapted concept towards other unexamined agricultural subsectors will be determined.

The model and full-scale measuring campaign will provide a framework for the development of information strategies to enforce greenhouse gas emission reduction. The mechanistic model will describe the dynamic behavior of the pocket digester. Next to the reduction of greenhouse gas emissions, the model aims at process optimization in terms of design and control for maximum biomass processing and biogas production.

The outcome of the economic and ecological studies will offer constructers a real help in expanding their business. A scientifically proven study like LCA is the ideal tool to convince opponents or governmental institutions of the benefits of this technology.

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