Samenwerkingsverband Regio Eindhoven

Avans University of Applied Science and Amsterdam University of Applied Sciences: Flying on pig manure

Development Plan Summary (Breda, Netherlands)

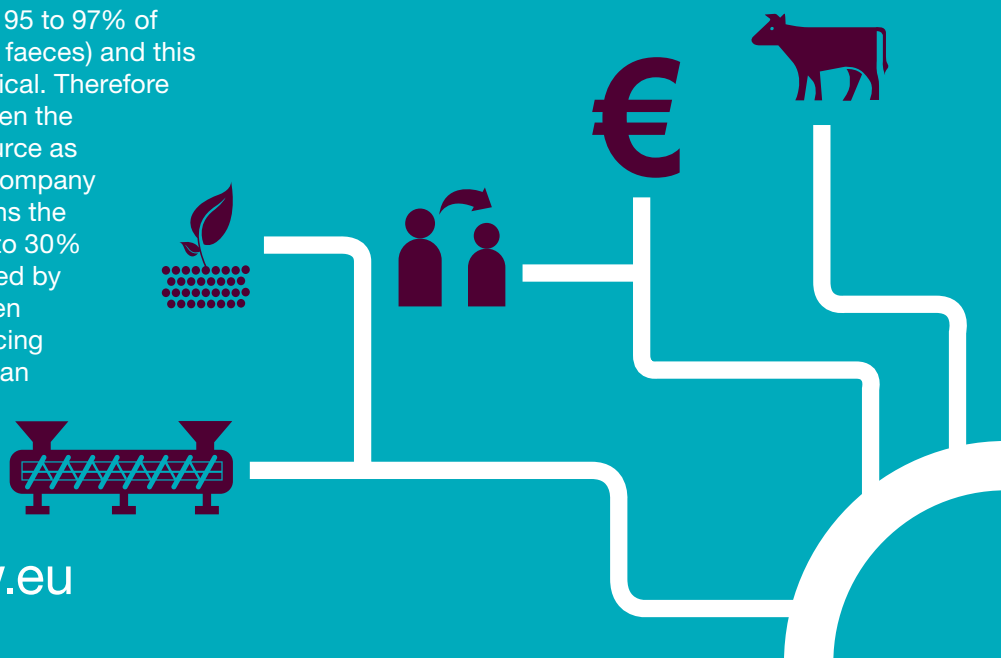
Overview: In the Netherlands, pigs produce about 70 million tonnes of manure every year. Whilst the majority is used to fertilise fields and meadows, a change in legislation in the Netherlands now restricts the amount of manure that can be spread to land. This has resulted in a surplus of 5 million tonnes of manure every year – and this figure is still increasing. If there is no outlet for this surplus, the amount of livestock would have to, by law, be reduced.

Pig manure as feedstock

To address the issue of this surplus manure, Avans University of Applied Science and Amsterdam University of Applied Sciences approached the BioenNW project to investigate whether pig manure could be turned into feedstock to produce kerosene in an economically and environmentally responsible way. Many previous similar initiatives to turn manure into energy have failed or could only survive through government subsidies.

The issue is that pig manure contains 95 to 97% of liquid (as it consists of both urine and faeces) and this makes transportation very uneconomical. Therefore the first step in the process is to thicken the slurry at a location as close to the source as possible. A process developed by a company called Hobe Manure Processing means the dry matter content can be increased to 30% with the addition of flocculants followed by pressing. Reverse osmosis (RO) is then used to concentrate the liquid, producing pure water and a saline liquid which can be used as manure.

The semi-solid mixture can therefore be transported over longer distances in an economical way for further pre-processing in the form of drying. A pulverised air drying (PAD) process developed by Biovalor – which uses an airstream to remove moisture mechanically – increases the dry matter from 30% to 70%. This process is more economical than a traditional belt dryer and allows nitrogen to remain in the manure rather than being released as an ammonias gas with a powerful odour.



The dried manure can then be turned into fuel using either gasification or pyrolysis.

Gasification

Gasification is the process of burning under oxygen-depletion conditions in the presence of steam and at high temperatures (around 3000 °C). Under these circumstances pig manure breaks down into atoms which then rearrange themselves into carbon monoxide (CO), hydrogen (H_2) and carbon dioxide (CO_2). After removing CO_2 through a shift reaction the remaining CO and H_2 can be converted into kerosene, naphtha and diesel through the so-called Fischer-Tropsch reaction.

Pyrolysis

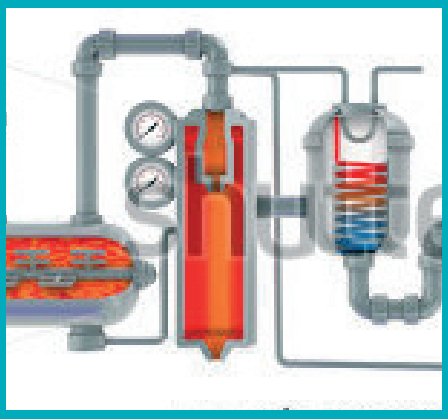
Pyrolysis is an ancient technique used to turn wood into charcoal. The dried manure is heated within a low-oxygen atmosphere at much lower temperatures than during gasification (about 500 °C). This turns the manure concentrate into charcoal or 'biochar'. Apart from carbon, it also contains almost all the phosphorus from the original manure. The biochar can then be enriched with RO-concentrate, the salty liquid from the first drying step, which contains much of the nitrogen and potassium. This mixture of biochar and RO concentrate is perfect for improving agricultural land as it is nutrient rich and is also a source of bio-digestible carbon that, when added to the soil, stimulates humus formation. It also improves soil structure and water retention.

The business case

In addition to biochar, pyrolysis also produces oil and gas, which can be turned into an aircraft fuel - kerosene. This means that pig manure from the region could help Eindhoven Airport reach its sustainability goals by enabling a big reduction in fossil fuel use.

A study carried out by Renovia showed that it is technically difficult to transform pyrolysis oil into fuel due to its composition. However, fuel could be obtained through the gasification of biochar and converting the resulting CO and H_2 (syngas) into kerosene. Preliminary calculations showed that 1 million tonnes of pig manure could yield around 4,000 tonnes of fuel after separation, drying, pyrolysis and gasification. At present this process is uneconomical as fuel from manure would be several times more expensive than kerosene from crude oil. Therefore, the focus for Renovia at present is to convert the 1 million tonnes of pig manure into an enriched biochar for use as a fertiliser and soil improver.

This development plan has been produced through BioenNW – a €7.9m strategic initiative of the European Union INTERREG IVB North West Europe Programme (2011-2015). BioenNW is led by the European Bioenergy Research Institute at Aston University, UK and sees 11 partners working together to deliver small-scale bioenergy schemes throughout North West Europe.



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BioenNW
Delivering Local Bioenergy to NW Europe

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IVB.
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