



Pig manure and used cooking oil for heat, power and odour reduced fertiliser

Anders Gustafsson uses pig manure and used cooking oil in his biogas plant on a farm in Sweden. Located just on the outskirts of the town of Skara, the biogas plant provides electricity and heat to his farm. It is a good example of how small-scale biogas production can be used in urban areas to minimise odour from animal husbandry.

ANAEROBIC DIGESTION OF PIG manure greatly reduces odour associated with the manure. Furthermore the digestion process makes the nitrogen in the manure more accessible to the crops when it is used as a fertiliser.

—It is important for me to be able to spread the liquid manure on our fields without disturbing my neighbours, explained Anders Gustafsson the owner of the farm-based biogas plant.

Pig manure and used cooking oil

His farm is located just outside Skara, a busy market town with a population of around 11 000 in southwest Sweden. Gustafsson has 270 hectares arable land cultivated with cereals although pig production is his main business. His 6 000 pigs generate about 5 000 cubic meters of manure at 8.6 percent dry matter content annually that is used in the biogas plant. The rest of the feedstock is used cooking oil sourced locally from Scan, a food

processing facility just four kilometers away. He buys about 40 cubic meters oil a year through a farmer-owned joint purchasing company Kretslopp Skaraborg.

—I took part in the foundation of Kretslopp Skaraborg so the owners of nearby biogas plants would not have to compete with one another for energy-rich feedstock, said Anders Gustafsson.

Enough supply

The supply of cooking oil is still good, since none of his neighbours that planned for biogas production four years ago have built their plants yet.

Anders Gustafsson previously digested residues from a potato processor in Skara, but that industry is now closed.

—Potatoes are rich in energy and a good feedstock, but it also contained a lot of water that made it less valuable, commented Anders Gustafsson.

Gustafsson thinks that it is difficult to quantify exact gas produc-

tion from the different feedstocks because the quality varies a lot and you have to try each feedstock out. —You cannot even say how much biogas that manure can provide, because the energy content of manure depends on the feed rations given to the animals.

Investment help

The biogas plant at Brunsbo Farm is constructed from small-scale Swedish technology. It was built in collaboration with the episcopate of Skara and received investment help from the Swedish Board of Agriculture. Up until 2013, farmers and other rural entrepreneurs in Sweden could get a grant covering up to 30 percent of the cost of building a biogas plant. The feedstock at Brunsbo, like most other small-scale biogas plants in rural Sweden, is based on manure combined with various rest products from the food processing industry.

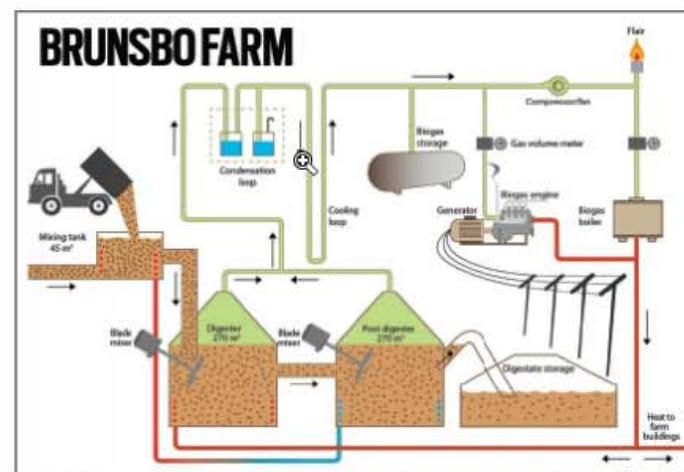
The Brunsbo plant has been in operation since 2010 and generates 150 000 Nm³ of raw gas annually.

The gas is converted to 750 MWh of energy, with equal parts going to electricity, heat for external application, and heat used internally in the process to pre-warm the plant's substrates.

—It took us around two and a half months to get the biogas plant going. We took 80 cubic meters of digester inoculum from a biogas plant nearby, Gustafsson said.

Two-stage digestion

Digestion takes place in two stages, each with its own 270 cubic meter digester. The primary digester receives the substrate from a 45 cubic meter mixing tank where the substrate is also preheated with heat recovered from the post digester through heat exchange tubes. The digestion takes place in a mesophilic process at 38 degrees Celsius. Both digesters are equipped with oblique blade mixers. From the constantly stirred primary digester, material flows to the post digester, and then to the digester storage that is covered to minimise gas leakage.



A schematic of inputs and outputs of the two-stage biogas plant at Brunsbo Farm. According to JTI, a plant this size would require a ballpark investment of SEK 3 - 6 million (Illustration: Tove Frisk/Godnatbild.se).

The produced gas is taken out of the top of the digesters and led through a cooling loop for drying. Subsequently, the gas can either be stored in a low-pressure storage unit or used directly as fuel in the gas engine generator, a rebuilt V6 engine with a 40 kW generator, to produce electricity and heat — or in a gas boiler that only produces heat. The post digester is cooled by heat exchange with the mixing tank.

The surplus heat is used to heat the piggery, farm shop and staff areas. The electricity is used on the farm and the excess is sold to the national grid.

—It has been very easy to sell the electricity. We have been treated very well by our local power company. Skara Energy, commented Anders Gustafsson.

Low profit

Evaluators following the development of the biogas plant consider it to be commercially viable. But is it profitable?

—It breaks even, but I had honestly expected more. With these low energy prices that we currently have it's pretty tough to get good profitability in such a facility, says Anders Gustafsson.

Gustafsson does, however, see many advantages of the facility beyond the pure economics. Having a good relationship with his neigh-

bours and reducing nitrogen runoff from the fields are two benefits that are hard to put into monetary terms. Anders Gustafsson has a passion for environmental management and a strong belief in the potential of bioenergy production, and he thinks that the biogas plant is an exciting project that contributes to the overall development of his farm.

Manure-based grant?

Like many other Swedish farmers with manure based biogas plants, Gustafsson hopes that national plans for grants based on biogas production from manure will be a reality. The Swedish Board of Agriculture has petitioned the European Commission (EC) and is waiting for confirmation that the suggested grant scheme is in compliance with EU state aid rules, in order to start receiving requests for assistance. However, the situation at the end of November is still unclear. According to the plan the manure-biogas grant would last for ten years and could involve up to 0.02 Eurocents per kWh produced.

—I personally think that all operations should set out to support themselves, but a biogas manure grant at 0.02 Eurocents would give me an extra 6 500 EUR a year, and that would mean a lot to me, says Anders Gustafsson.



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Text: Carina Johansson, JTI - Swedish Institute of Agricultural and Environmental Engineering Photos: Anders Broberg and Scan

BIOGAS

FACTS

- Biogas3 – biogas for self-sufficiency
The biogas plant at Brunsbo Farm is an example of a type of biogas plant promoted within the EU project Biogas3. In this two-year project JTI – The Swedish Institute of Agricultural and Environmental Engineering is cooperating with actors from six European countries (Spain, France, Italy, Germany, Poland and Ireland). The goal is to promote small biogas plants where waste and by-products from the food industry and agriculture are converted to energy for self-sufficiency. The project is led by the Spanish Institute, Ainia.

- Energy-rich substrate from Kretslopp Skaraborg
The company Kretslopp Skaraborg (name meaning Recycling in the geographic area Skaraborg) brokers energy-rich substrate from the food industry and agriculture to biogas plants in the region. The company is probably the only one of its kind in Sweden. Started in 2011 and owned by farmers, it aims to secure agricultural biogas production in the area Skaraborg from economical and quality aspects. Demand for substrates is now greater than availability. Kretslopp Skaraborg plans to build their own hygienisation plant so that small biogas plants can afford to utilise animal by-products from slaughterhouses while complying with the EU animal by-product regulation.

- The biogas plant at Brunsbo Farm is situated near the city Skara in Sweden.
Anders Gustafsson runs a biogas plant with feedstock from pig manure and cooking oil. The Brunsbo Farm biogas plant is constructed from small-scale Swedish technology, with two digesters of 270 cubic meters each. In the 45 cubic meter below-ground mixing tank, the substrates are preheated with heat recovered from the post digester. Some of the feedstock at Brunsbo Farm comes from used cooking oil from meatball production at the local food processing facility Scan. Photo: Scan.