IEA Bioenergy Task 37

BIOGAS IN SOCIETY
A Case Story from
IEA BIOENERGY TASK 37
"Energy from Biogas"

THE FIRST ORGANIC BIOGAS PLANT IN DENMARK

DEMONSTRATION PROJECT AT BORDING ORGANIC FARM

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SUMMARY

The first organic biogas plant in Denmark is located at the organic arable farm in Bording, owned by Bjarne Viller Hansen. The plant became operational in August 2009. From 2010 to 2012 Organic Denmark conducted a demonstration project using the biogas plant, co-financed by a tax reimbursement fund and by the Ministry of Agriculture. Organic biogas is high on the agenda and here to stay in Denmark, where four more organic biogas projects received government grants in 2012.

BACKGROUND

The establishment of the first organic biogas plant in Denmark as a demonstration project has several purposes:

- To collect and disseminate knowledge about organic biogas production for crop farmers who do not have animal manure to become fertilizer self-sufficient;
- To collect and disseminate knowledge from a working example of how more climate, environment and energy friendly agricultural production can be achieved.

Figure 1: General view of the Bording Organic Biogas Plant (Photo: Michael Tersbøl, Organic Denmark)

FACTS

Conventional digester tank	3000 m³
Pre-storage tank (conventional)	480 m³
Organic post-digestion/ storage gas recovery	4700 m³
Pre-storage tank organic	135 m³
Extra storage tank	4500 m³
Retention time inside the digester	150 days
Exit tank	80 m³
Combined heat and power engine-generator	360 kW
Dry cooler	
Machinery building and office	
Gas system with sulphur removal	
Capital investment	12 mill. DKK
Plant supplier	Lundsby A/S

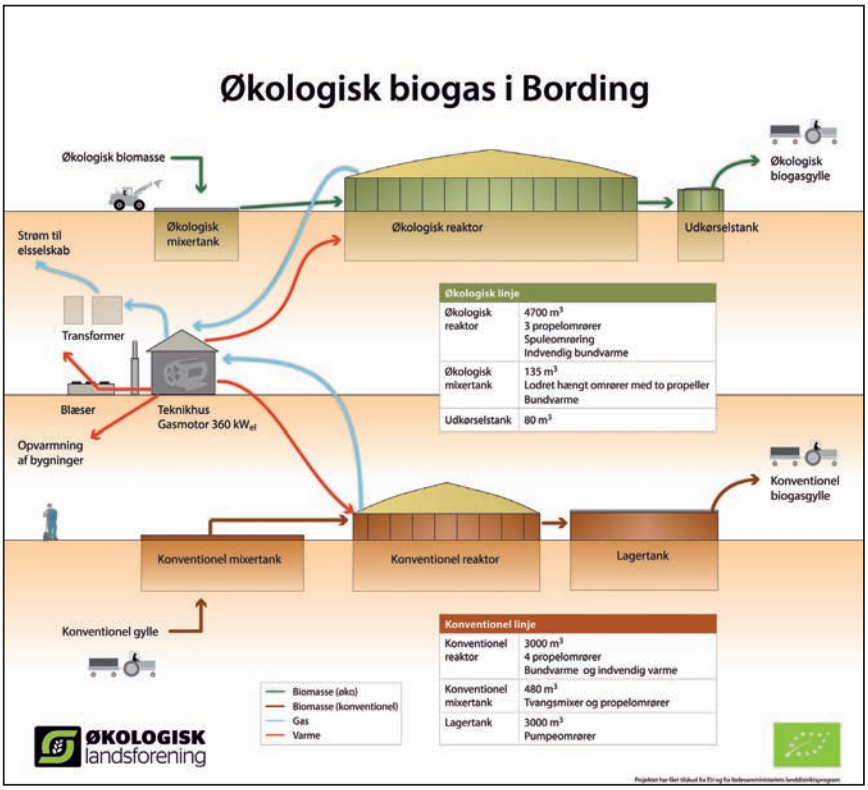

Figure 2: : Flow diagram of the Bording Organic Biogas Plant (Source: www.okologi.dk/biogas)

PROJECT DESCRIPTION

The demonstration project has two main objectives: documentation and dissemination of operating results. The results and experiences from the first years of operation are used to develop a measurement programme that analyses biomass, manure and gas output. The data are used to implement a green farm account, in essence this means CO_2 accounting for the final products. The results from the cultivation plot are used to demonstrate the fertilizer effect and the final organic product quality. The dissemination of these experiences and achievements takes place partly through the project web sites (www.elmegaard-organic.dk and www.okologi.dk/biogas) and partly through study trips to the biogas site on the organic farm at Bording ("open house" arrangements). Other forms of dissemination include making a documentary film, giving lectures, publishing articles and distributing leaflets about the construction, operation and on-going results from the organic biogas plant.

Table 1: Bording Organic Biogas – inputs and outputs

Daily Input	
Into the 3000m³ conventional digester	50 tonnes cattle slurry
Into the 4700 m³ organic digester	15 tonnes of organic cattle manure 5–12 tonnes of clover grass silage 1 tonne of mixed biomass (e.g. discarded vegetables)
The quantities of daily biomass input can be increased, if necessary	
Output	
Planned energy production/day	8400 kW

DAILY OPERATION

The daily operation of the plant consists primarily of mixing the biomass feedstock, monitoring and adjustment as necessary. The biomass feedstock is retrieved from storage and mixed in the feed container which is equipped with knives to chop straw and vegetables. The chopping process inside the feed container is normally carried on for about fifteen minutes to ensure sufficient mincing of the biomass mixture.

The process control system (PLC) runs the plant under normal conditions, with set points controlling the amount of

Figure 3: Clover grass silage (Photo: Michael Tersbøl, Organic Denmark)

digested slurry transferred from the post digestion tank to the pre-storage tank, where it is mixed with the green biomass. The average dry matter (DM) content of the feedstock mixture is around 7.5 percent.
The green biomass consists of organic cattle slurry, discarded vegetables and grass-clover silage.
The higher proportion of grass silage used the more time is needed for reactor feeding. This is because the silage has a tendency to form a floating layer in the mixing tank, making it difficult to feed the desired amount to the reactor.

Figure 4: Weeding by hand in organic farming, without use of herbicides (Photo: Bording Biogas)

BIOGAS UTILISATION

The biogas is used in a MAN-engine to produce electricity and heat. The electricity is supplied to fed into the grid managed by the local energy company and the heat is used partly as process heat and partly to heat buildings in a nearby residential area. The excess heat could be used for drying processes on the farm. The digestate is used as organic fertilizer on the crops of the Bording Organic Farm.

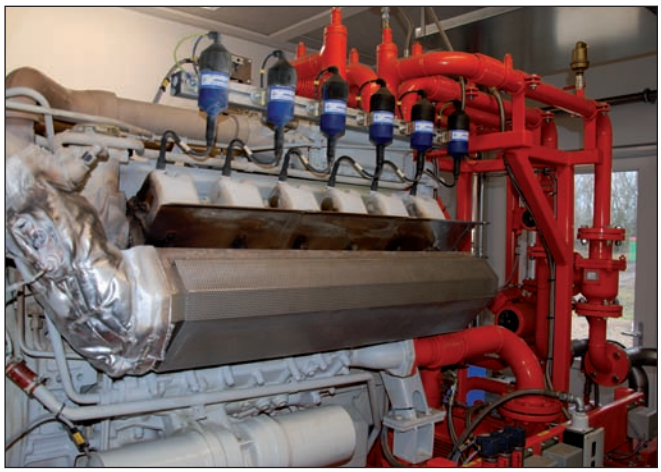

Figure 5: The 360 kW motor-generator (Photo: Michael Tersbøl, Organic Denmark)

RESULTS

The results and the experience gathered since operation started in 2009 can be summarized as follows:

1. Increased crop yields: However, increased yield will only be achieved when the digestate is applied on growing crops. Pretreatment of soil with digestate outside growing season will increase nutrient leaching and cause no uptake, or low nutrient uptake.
2. Contract negotiation and binding requirements for plant supplier: There must be competent legal assistance during contract negotiations with the biogas plant supplier company. The contract should stipulate the responsibility of the plant supplier concerning the technical performance of the plant, within a reasonable flexibility of biomass input, and its obligation to perform all the necessary adjustments and corrections of the built in errors which may arise during the commissioning period of the plant.
3. Pre-treatment, stirring and pumping of green biomass: The equipment for maceration, pumping and stirring of green biomass must be carefully chosen and dimensioned and must be robust enough to handle the green biomass, which causes more wear than manure or grass silage.

PLANS FOR THE FUTURE

At the beginning of 2013, the biogas plant was divided into two lines: an organic line and a conventional line. This division will significantly lower the organic share of the plant. Along with the permanent monitoring of the operational parameters of the biogas plant, on-going adjustments and improved operational solutions will subsequently be the main focus. The establishment of a spray stirring system in the organic reactor is on the list of priorities as well as the installation of a chain crusher for the pretreatment of the green biomass in order to avoid surface floating. To help the economy of the plant, solutions for utilization of the excess heat are to be found.
A new co-financing grant from the Ministry of Agriculture and the EU Programme for Rural Development was obtained in 2012 with the aim of refurbishing/reconstructing and improving elements and functions of the initial biogas plant project. The new project is designed to address the built-in errors discovered during the first years of operation.
The operational experiences will continue to be collected and disseminated through the home pages: www.elmegaard-organic.dk and www.okologi.dk/biogas as well as by various other means, in close collaboration with the national association for organic farming – Organic Denmark (Økologisk Landsforening).

CONTACTS

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