



By Klaus Jacob Jensen, Head of Department, Ramboll Denmark
Einar Gudmundsson, biogas specialist, Ramboll Denmark

BIOGAS FROM THE FARMING INDUSTRY

WHY BIOGAS UTILISATION

The green house gas emissions from the farming industry count for a significant share of the total green house gas emission in Denmark. Approx. 18% of the total national greenhouse emissions in Denmark has its origin in the agriculture sector. Main contributions are methane (CH₄) from the domestic animals' digestion and laughing gas (N₂O) from conversion of nitrogen fertiliser in the fields.

The most efficient measure to reduce these emissions is to establish biogas plants, which have a double effect on the green house gas emission reduction in the Danish environment:

1. The biogas substitutes natural gas in the energy system; and
2. The emission of CH₄ and N₂O is reduced considerably.

Further benefits of biogas plants for the society include:

- Cheap greenhouse gas reduction
- Utilisation of organic waste from industries and waste water
- Efficient redistribution of nutrients
- Reduction of emissions of nitrogen and phosphor to the water environment
- Organic fertiliser free of pathogens and weed seeds and with a declared nutrient content
- Smell from slurry reduced as the slurry is turned into a thinner liquid, which disperses quicker into soil

However, a major barrier for implementing these environmentally friendly biogas plants is the substantial investment level.

In the light hereof, there is a focus on intelligent and cost effective integrated solutions that combine all economical and environmental benefits, such as:

- Biogas plants, which process the manure from all farmers in the region, energy crops, organic waste from the food industry etc.
- Biogas plants, which utilize the methane energy in the most efficient and cost-effective manner for production and sale of both electricity and heat.

Several full-scale projects and studies in Denmark demonstrate that a symbiosis of the farming industry and the district heating sector is an interesting combination for green house gas emission reductions in Denmark:

- New biogas plants can normally be situated near existing district heating systems due to the fact that most towns in Denmark have a developed district heating system.
- Many district heating systems have already installed natural gas fuelled CHP plants. These CHP plants can be converted or reconstructed into using biogas.
- The biogas CHP plant will be first priority base load in the district heating system, and the surplus heat can be utilized almost 100%.
- The efficient base load heat source will be a driver for enlarging the district heating system connecting individual gas and oil boilers to the network, in particular in case the heat load from the biogas plant exceeds the heat load of the network in the summer period.

MAABJERG BIOENERGY

An example of such a biogas plant is the Maabjerg BioEnergy plant – a biogas project with numerous advantages. The Maabjerg BioEnergy Plant is planned to be the largest biogas plant worldwide and will be located close to the Danish city Holstebro in North West Jutland.

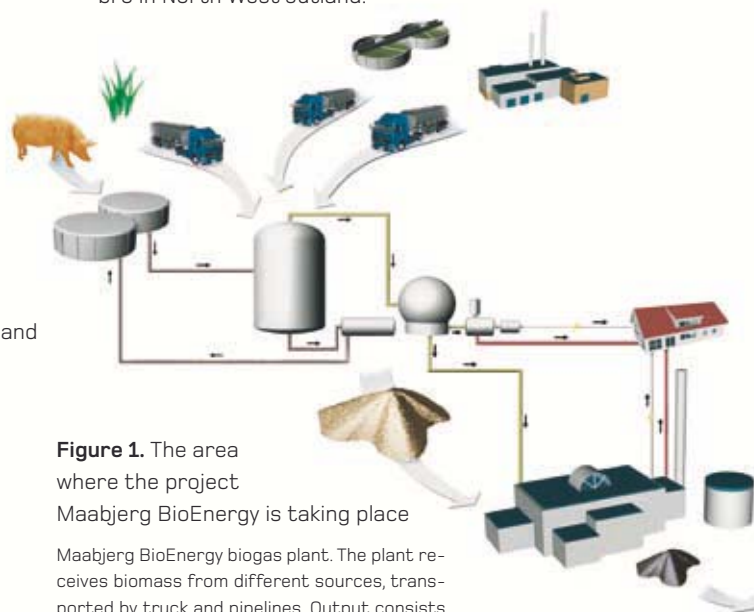


Figure 1. The area where the project Maabjerg BioEnergy is taking place

Maabjerg BioEnergy biogas plant. The plant receives biomass from different sources, transported by truck and pipelines. Output consists of the wet and dry fraction of the fermented slurry, biogas and heat and electricity.

North West Jutland is one of Denmark's most important agricultural areas. Indeed, farming and food production in the previous Ringkøbing County account for a yearly turnover of 550 mil. Euro and employment of 11,400 people.

Unfortunately, from the same area water is discharged directly into a number of large wetlands, designated by the EU as habitat areas, and the soil is sandy and highly permeable. Altogether this causes a problem with surplus nutrients (particularly phosphorous and nitrogen), which are washed out into creeks and the underground water. In order to adhere to recent legislation concerning utilisation of nitrogen it is necessary for the farmers to increase the availability and exploitation of the nitrogen.

The Maabjerg BioEnergy plant offers a solution to this problem, since manure from the participating farms is separated into two parts:

- A wet fraction, which is returned to the farmers, with a high content of easily accessible nitrogen (75% of total amount of nitrogen) and a low content of phosphorus (25% of total amount of phosphorus).
- A dry fraction (fibre fraction), with a high content of phosphorus and a low content of nitrogen. This fraction will be combusted and used as a new CO₂-neutral biofuel.

MAJOR BARRIERS AND CHALLENGES

For several years the owners of Maabjerg BioEnergy Ltd. have been working for the establishment of the biogas plant Maabjerg BioEnergy Ltd. The owners are:

- The Farmers' Association of the Region (Hedens og Fjordens Landbrugscenter)
- Holstebro Fur Farmers' Association
- Vestforsyning, a municipality-owned company supplying electricity, heat and water and treating wastewater
- DONG Energy Ltd., one of Denmark's main producers of electricity and heat and the owner of the local CHP plant of Holstebro, Måbjergværket
- Nomi, a regional waste company

During the past four years the project has phased and overcome a large number of challenges.



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BIOGAS FROM THE FARMING INDUSTRY

As a result of a comprehensive dialogue with national authorities about the possibilities for using the fibre fraction for combustion, various laws have been amended and approved by the Danish Parliament and notified by the EU-Commission, so that:

- It is allowed to combust the fibre fraction from manure. For many years the fibre fraction from degassed waste water sludge has been burned in waste water treatment plants.
- The farmers do not need to account for nitrogen reduced through the combustion process in the fertiliser balance sheet.
- The fibre fraction from manure, energy crops etc. is exempted from waste incineration tax, while the fibre fraction from waste water sludge is not exempted.
- Combustion of the fibre fraction needs to fulfil the EU Waste Incineration Directive.

In January 2007, the Board of Maabjerg BioEnergy decided to put the project on hold, because the financial framework conditions at that time were not sufficient attractive to implement the project.

In February 2008 the Danish Parliament entered into a new energy agreement for promotion of electricity, generated from renewable energy sources. According to the act the feed-in tariff for electricity from biogas, including grant, has been increased substantially (from previously 8.0 Eurocent/kWh in project years 1-10, and 5.4 Eurocent/MWh in project years 11 – 20 to now 10.0 Eurocent/kWh in the entire project period). Furthermore, the Government guarantees a 60% regulation of this new tariff with the inflation in society. Besides, there is an indirect subsidy on the heat, as biogas is exempted from taxation, which is not the case for heating from natural gas.

The Danish Government expects that these favourable conditions for sale of energy from the plants should boost the development further up to around 50 new large-scale biogas plants with a total biogas production of 8 PJ within the next 10 years. In the longer term, the potential biogas production from the Danish farming industry could be more than 16 PJ or even more if other suitable organic waste products are included.

Måbjergværket is a large CHP plant, supplying district heating to Holstebro and neighbouring towns. The plant has today a capacity of 28 MW electricity and 76 MJ/s heat. The energy at the plant is currently produced from municipal waste, straw, wood and natural gas. There are two boilers for burning waste and one for burning biomass. The natural gas is used at the so-called over-heaters of the boilers.

Placing the biogas plant next to Maabjergværket makes it possible to exploit a number of synergies. One advantage is that dry fraction can be delivered as biofuel to the CHP plant with minimal transport costs. The dry fraction replaces imported wood chips in the existing biomass boiler.

It is estimated that app. 40 GWh electricity and 63 GWh heat will be generated on the basis of biogas, while 6 GWh electricity and 42 GWh heat (assuming heat recovery of the water in the fibre) will be generated on the basis of the fibre fraction.

Thus, the generation of CO₂-neutral heat and electricity from Maabjerg BioEnergy will increase with almost 50% when utilising the carbon in the fibre fraction for combustion instead of spreading the fibre fraction on the fields.

BENEFITS TO THE SOCIETY

The Maabjerg BioEnergy plant will both provide environmental benefits and benefits related to employment in the area around Maabjerg. Farming and food production related to the farms, which will be connected to the Maabjerg BioEnergy plant, account for an annual turnover of 42 million Euro responding to an employment of 863 man-years.

Increasing environmental demands from the side of the authorities will make it necessary to reduce production of domestic animals at the farms in the area, unless action is taken. If not, it will be necessary in the future to reduce the number of animals at the farms, thereby reducing the annual turnover with 17,5 million Euro and the employment with 364 man-years - equivalent to a reduction of employment with 42%.

With the Maabjerg BioEnergy plant it may be possible to increase the production leading to an increase in the annual turnover of 6.7 million euro and an increase in employment of 129 man-years - equivalent to an increase of employment with 15%. Another option is to further reduce the emissions of phosphor and nitrogen to the water environment and keep the animal production constantly.

The establishment of Maabjerg BioEnergy plant will furthermore result in substantial reduction of CO₂-emissions, NO_x-emissions to air and emissions of nitrogen and phosphor to the ground water.

• For further information, please contact:

Ramboll

Att.: Mr. Klaus Jacob Jensen or Einar Gudmundsson

Teknikerbyen 31

DK-2830 Virum - Denmark

Phone: +45 4598 6000

kjj@ramboll.dk or eig@ramboll.dk