IEA Bioenergy Task 37

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

RINGKØBING-SKJERN, DENMARK – DECENTRALISED BIOGAS NETWORK MODEL

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MISSION AND VISION

Ringkøbing–Skjern Municipality (RKSK) in Denmark has adopted an energy supply plan aiming to make RKSK self-sufficient with renewable energy by 2020. It is anticipated that biogas, produced by co-digesting 80% of the animal manure available in the municipality along with energy crops grown on 5% of the municipality's farmland, will be able to replace 20 % of the fossil fuels.

The biogas will be produced in 40-60 decentralised farm scale biogas plants, connected by a biogas pipeline to the municipal combined heat and power (CHP) plants. The biogas potential is estimated to be of the order of 30 million Nm^3 methane from animal manure and slurry and a further 30 million Nm^3 methane from energy crops.

The decentralised model aims to minimise the transport distances of manure, and makes better use of energy than the traditional farm-biogas plants where it is not always practicable to utilise the available heat. In the long term, the aim is that all transportation of animal slurry will be done by piping, rather than by road.

Figure 1: A typical Ringkøbing-Skjern biogas plant.

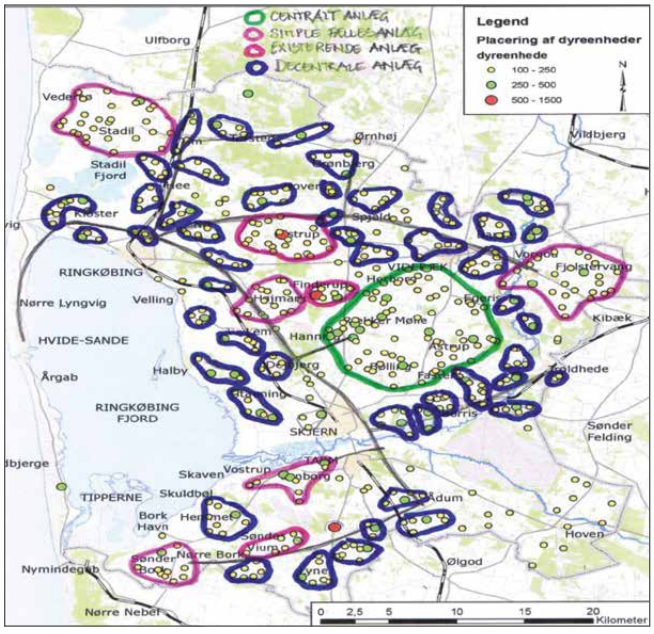

Figure 2: Geographic location of the biogas plants

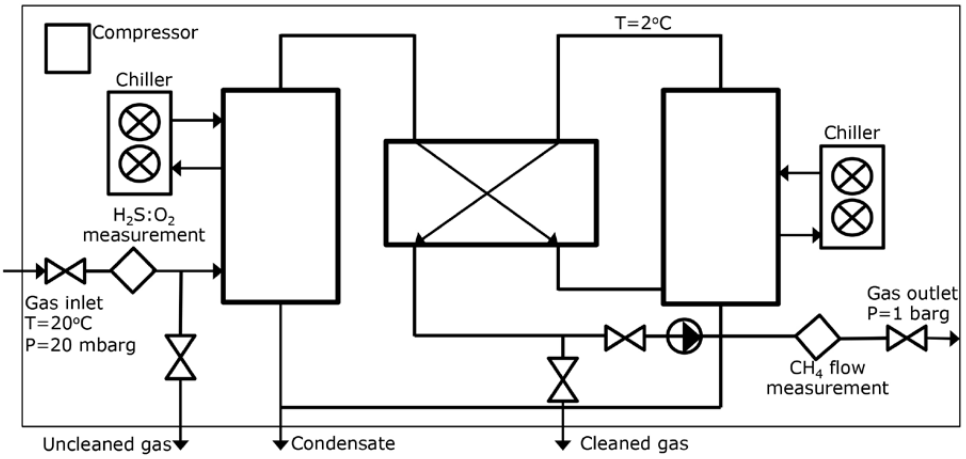

Figure 3: Biogas drying, flow measuring and pressurizing module

TECHNICAL SPECIFICATIONS OF A TYPICAL AD PLANT

Key figures	**(each biogas plant)**
Animal slurry	200 t/day
Energy crops	25 t/day
Biogas production	2.5 million Nm^3 CH_4/year
Digester volume	9000 m^3
Process temperature	52°C
Sanitation	6 hours (MRGT); 52°C
Biogas utilisation	Processing industry - CHP
Investment costs	30 million DKK
Grant	7.5 million DKK
Contractor	(to be decided)
Start up	2016

Figure 4: Biogas pipes being installed to connect biogas plants with local CHP units

GAS TRANSMISSION NETWORK

The gas piping system is designed as a dry, low pressure net, to reduce operating costs. Before entering the piping network, the biogas is cleaned, dried and pressurized. Condensation wells are installed at the biogas plants as a security measure in case of gas cooling failure.
As there are different suppliers of gas to the network, the exact amount and calorific value is measured in order to allow accurate accounting of each biogas supplier. The gas piping net is dimensioned in such a way as to allow the connection of several biogas plants with a total annual capacity of 25 million Nm^3 CH_4.

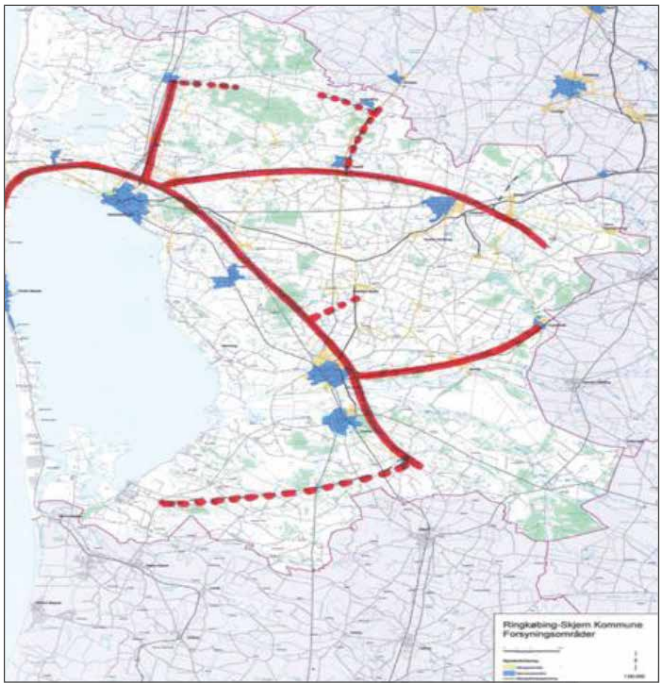

Figure 5: The planned biogas piping network

UTILIZATION OF BIOGAS

The local CHP-plants have a high utilization of renewables, other than biogas. Among these solar, wood and waste heat are used. The first stage in the implementation work of the

Figure 6: A 4MW gas engine for CHP-production

RKSK model was therefore to find a buyer for the produced biogas that allows a constant sale throughout the year. The biogas buyer is the local process industry, with an annual consumption of 30 million m^3 natural gas covering their own electricity and heat consumption, and with a great desire to phase out the natural gas and to replace it with biogas.

In 2010, Bioenergi Vest (BEV) was established with the aim of demonstrating the economics of the RKSK model, through the implementation of Stage 1: Establishment of five decentralised biogas plants, all connected to Skjern District Heating Plant by a 35 km biogas piping system.

The premises for implementing Stage 1 have since changed to ensure better utilisation of the waste heat in the district heating system. A wood chip fired biomass boiler has also been installed.

The district heating plant with variable heat demand means that the biogas supplied from the farms cannot be used at a constant rate. For this reason, Stage 1 of the project was implemented with three decentralised biogas plants connected through a 42 km biogas piping network to a process industry unit, which uses the entire biogas production for CHP-generation. In the final stage of the project when all biogas plants are operational, it will be possible to supply biogas to both process industry and the local CHP plants.

UTILISATION OF DIGESTATE

The digestate produced is used as crop fertiliser, primarily by the biogas plant owners depending on the amount of nutrients they are allowed to apply to their crops. Nutrient use is stipulated by Danish regulations which define input per ha, the so called harmony rules. Any excess digestate that cannot be used on the farm where the feedstocks for biogas are produced are sold to crop farms in need of fertilisers, in the nearby area.

THE FUTURE

- The successful demonstration of Stage 1 of the project provides the economic data for the decentralized model and its viability. The gas grid will be expanded according to the Future expansion of biogas production in the municipality will enable the supply of biogas to both process industry and the local CHP plants. Bioenergy West will correspondingly expand the grid.
- Besides the piping system for biogas, a piping system for pig slurry from the nearest suppliers to a biogas plant in the project will also be established. Once sufficient positive operating experience has been acquired, trials with piping cattle manure will be carried out, in the long term aiming to completely eliminate the present truck transport of cattle slurry.
- In order for the biogas plants to achieve the highest gas price and the best economic results, several different scenarios have been analysed, including biogas upgrading, both at individual biogas plants and at a central upgrading plant located near the natural gas grid. At the present time, there are a number of large processing plants using much larger volumes of natural gas than the potential of biogas production from animal manure in the area. For the time being, it is not economically attractive to upgrade the biogas. It will be possible to set up a large central upgrading installation relatively quickly if energy policy changes sufficiently to favour biomethane.

Estimated societal effects of the fully implemented RKSK-Model

- 100 million m^3 of natural gas replaced with biogas equivalent to 2 PJ
- GHG effect reduced 22 times per methane molecule recovered from manure
- Climate impact reduced overall by 190,000 tonnes CO_2eq.
- Decentralised biogas production is the renewable energy technology that generates most jobs (765 jobs/1PJ)
- Biogas network provides market-determined prices and reduces dependency of imported energy
- Reduction of nutrient leaching and increases harvest yield as crops can absorb up to 25% more nutrients from digestate, compared with raw slurry
- Great business and export potential, national and international
- Establishing and consolidating farmers as energy suppliers
- Biogas is bridging the gap between rural and urban society

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