

# ECONOMIC SUSTAINABILITY OF MANURE BASED CENTRALISED CO-DIGESTION

GOOD LEADERSHIP MAKES A DIFFERENCE

**RIBE BIOGAS A/S DENMARK**

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## MISSION AND VISION

Ribe Biogas Plant is one of the most successful manure based joint co-digestion plants in Denmark, owned by RIBE BIOGAS A/S. The owners are the farmers supplying slurry, a food processing company supplying organic waste to the plant, the regional power company and two investment companies.

The aim of the biogas plant is to produce biogas for CHP-generation and simultaneously to solve some agricultural, veterinary and environmental problems in the area, through co-digestion of animal slurry with suitable organic wastes from food industry and recycling of the resulting digestate as fertilizer.



## FACTS

Animal manure .....	390 tons /day
Organic wastes.....	60 tons/ day
Biogas production .....	5.5 million Nm <sup>3</sup> /year
Digester capacity (3 × 1745 m <sup>3</sup> ) .....	5235 m <sup>3</sup>
Process temperature .....	53°C
Sanitation .....	MGRT 4 hours at 53°C
Gas storage capacity .....	1000 m <sup>3</sup>
Utilization of biogas .....	CHP-plant/gas boiler
Transport vehicle .....	3 × slurry tankers
Average transport distance .....	15km
Investment costs .....	45.3 million DKK
Government grant .....	12.9 million DKK
EEC-grant .....	4.8 million DKK
Contractor .....	Krüger Ltd.
Operation start-up .....	1990

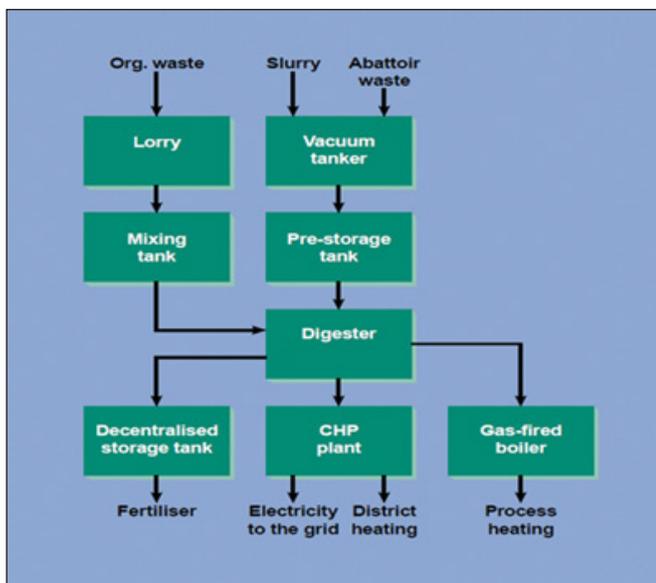
**Figure 1:** General view of the three digesters of Ribe Biogas Plant, with the administrative building and the gas flare in the foreground. (Photo: Ribe Biogas A/S)

**TECHNICAL SPECIFICATIONS**

The co-digestion plant processes yearly about 164,000 tons of biomass, consisting of 138,000 tons of livestock waste and 26,000 tons of industrial waste (maximum 25% of the feedstock mixture). The biogas plant co-digests cattle, pig, poultry and mink slurry from 62 livestock farms along with intestinal content from abattoirs, digestible fatty organic wastes from food and fish processing industries and from medicinal industry and with flotation sludge from a poultry abattoir. The digestion temperature is 53°C (thermophilic). A minimum guaranteed retention time of 4 hours at 53°C ensures efficient sanitation of digested biomass.



**Figure 3:** The gas buffer storage of 1000 m<sup>3</sup>



**Figure 2:** The flow diagram of the plant

**UTILIZATION OF BIOGAS**

The 5,500,000 m<sup>3</sup> CO<sub>2</sub>-neutral biogas produced yearly is sold to the Ribe Fjernvarme CHP-plant. The biogas is transported to the CHP plant through a low pressure pipeline.

The CHP-plant, which supplies the city of Ribe with electricity and heat, was established in 1997, to replace three earlier coal-fired CHP-units. The gas engines are fuelled with a mixture of biogas and natural gas (dual-fuel), where biogas has the first priority and natural gas is used as a back-up. The plant produces annually 130,000 GJ of energy from biogas, providing heat for 1000 households and electricity for 1700 households. Ribe Biogas A/S also utilizes the biogas in its own process heating system, thus contributing to a cleaner, greener environment.

**UTILIZATION OF DIGESTATE**

The digested biomass (digestate) is returned to the slurry suppliers as pathogen-free and nutrient declared liquid fertilizer. Twenty five decentralized storage tanks for digestate, with a total capacity of 50,000 m<sup>3</sup>, are shared by the farmers supplying slurry to the AD plant. The tanks are located close to the agricultural fields, where the digestate is applied as fertilizer. This practice has reduced significantly the cost and time consumption for biomass transport and enlarged the area where digestate can be applied as fertilizer. The storage tanks were built with 40% investment grants from the Danish Ministry of Agriculture.



**Figure 4:** Biomass transport tankers

**ASSOCIATION OF BIOMASS SUPPLIERS**

The 62 farmers supplying slurry to the biogas plant are members of the cooperative association of biomass suppliers, Ribe Biomasseformidlingsforening a.m.b.a., which owns 5/6 of the shares of Ribe Biogas A/S, while 1/6 of it is owned by Danish Crown slaughterhouse. The primary aim of the association is to collect and transport the agricultural biomass from the farmers to the biogas plant and to transport and redistribute digestate back to the farmers.

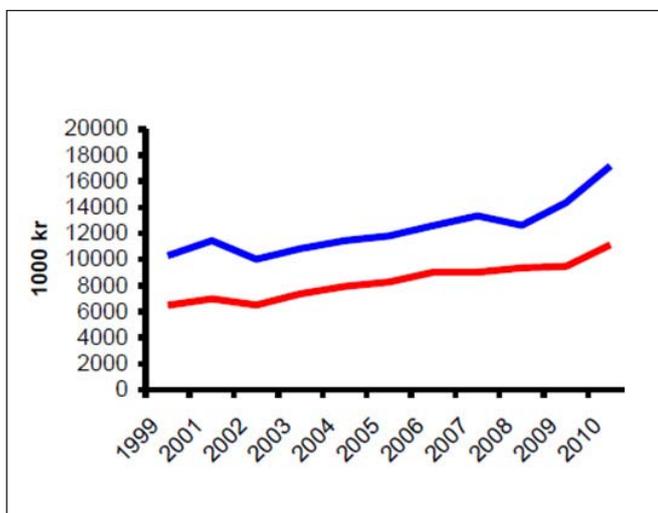
The slurry suppliers receive back only that amount of digestate which they are allowed to apply on their fields, according to the Danish "harmony rules" on nutrient input per ha per year. The surplus of digestate from Ribe Biogas A/S is sold to 72 crop farmers in the area, and the income obtained is returned to the slurry suppliers.

**Table 1: Average content of nutrients in raw slurry and digestate in 2010 (kg/m<sup>3</sup>)**

	Ammonium -N	Nitrogen (N-total)	Phosphorus	Potassium
Digestate	3,31	4,58	0,80	2,57
Raw slurry	3,23	4,70	0,80	2,64

**ECONOMIC RESULTS**

The plant has a very good and stable operation, reflected in the economic situation, with a current income which is constantly significantly above the level of breakeven.



**Figure 5:** Ribe Biogas; Total turnover [—] and expenditure [—]

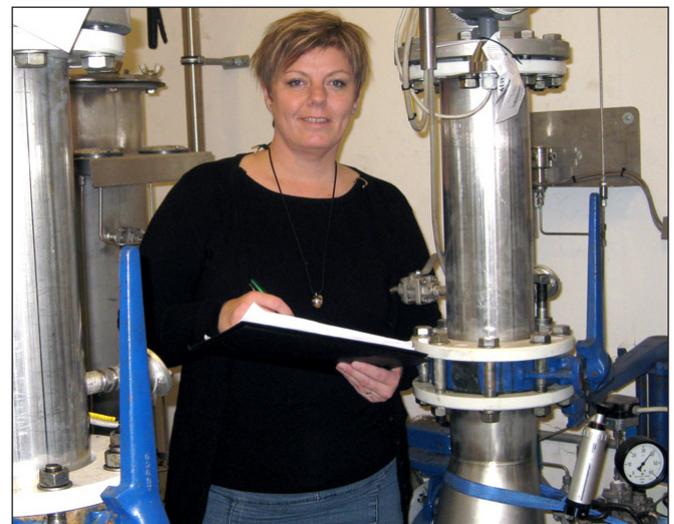
Higher income from the sale of biogas and from the gate fees for treating organic wastes, while maintaining the same level of operation costs, increased significantly the annual turnover of the plant.

**Table 2: Average prices for sale of biogas (DKK/m<sup>3</sup>)**

2008	2009	2010
2.47	2.47	2.79

**PLANS FOR THE FUTURE**

The farmers would like to increase the amount of slurry digested. For this reason, an increasing of the AD-treatment capacity is planned. Capacity enlargement will imply higher biogas production, which exceeds the present utilization for CHP-generation. RIBE BIOGAS A/S anticipates that this barrier for the enlargement of the treatment capacity of the plant can be removed if the extra biogas produced is upgraded and sold as vehicle fuel or injected into the natural gas grid.



**Figure 6:** Director Lisbeth Ljungstrøm is charged with the operation and management of Ribe Biogas Plant.

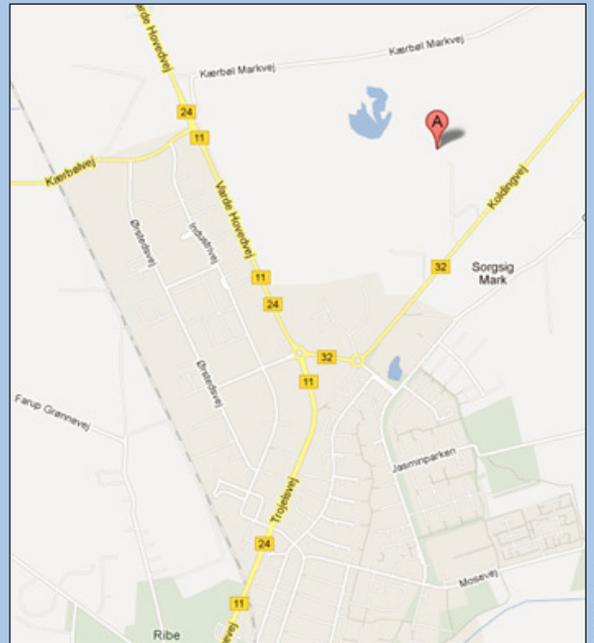
**CONCLUSION**

The good economic performance of the plant is attributed to the synergistic effect of the organization of the plant as a limited company, with a board of directors with broad expertise and competences and a skilled plant management and effective daily leadership. The Ribe Biogas plant is known for its high process and operational stability, with constant supply of high quality feedstock.

## CONTACTS

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