

BIOGAS CHP

HERNING Denmark

If the share of renewable energy in Europe is to be increased to 12% by 2010, one has to consider an increase in the use of biomass, both for heat and for electricity production. Wood, wooden waste and straw are anything but rare, but they need rather heavy investments if they are to be fully exploited. That is why the use of wood and straw as a real renewable energy source (keeping the sustainable use and growth in mind!) still is subordinate in comparison to other renewable energy sources. Nonetheless, some cities (many of them in Scandinavia) have had successful experiences, like in Herring, where the municipally began initiatives on, among other things, the exploitation of biomass on a grand scale.

GENERAL ASPECTS

Herring is situated in the middle of the Danish peninsula Jutland. The number of inhabitants are approximately 58,000, making it the largest city in the county of Ringkøbing (Ringkøbing Amt).

Herring is the centre for the Danish production of clothing/textiles and about 30% of the municipality's labour force is employed in this trade.

Climatic data:

Degree days (Basis 17 °C): 3,400

Annual mean temperature: 7.5 °C



CONTEXT

The municipally owned utility of Herring, Herring Kommunale Værker, has been proactive in many ways concerning renewable energy sources for quite a few years. The most important sources in the region are biomass and wind energy. Biomass in particular is utilised extensively in the production of energy for the citizens of Herring. This fact, combined with an extensive use of combined heat and power (CHP), creates a quite remarkable environmental record in the city. Excluding the incineration of waste, 6% of the energy consumption for district heating and 9% of the power consumption in the city were, in 1998, based on renewable energy. Wind energy played a big part in this with 6%. The total energy consumption in the municipality had, by 1998, decreased to 63% compared to the level in 1980. Research and development concerning utilisation of biomass in quite a few different ways is going on in Herring. In addition, already in 1993, the utility introduced the "One-Stretch, Pulsating District Heating" project, which is decreasing the heat losses associated to district heating. Part of this project concerns "smooth water" which is decreasing the pump work in the network. Parts of the investment to this project are funded by the European Union and the Danish Energy Agency.

EXPERIENCE OF HERNING

In 1982, a coal-fired CHP-plant was commissioned in the city of Herning supplying the inhabitants of the town with district heating and hot tap water, while at the same time producing electricity fit into the main power grid. This coal-fired CHP-plant replaced an oil-based boiler plant with no power production. The switch from oil to coal was a result of the energy crisis in 1973 and 1979, during which the industrialised worlds' fundamental dependency on oil from the OPEC countries in the Middle-East had been effectively demonstrated. The need for a reliable energy supply in the municipality based on efficient utilisation of cheap and - if possible - local energy sources became apparent. At the same time the adverse effects on the environment from energy production was a matter of growing debate highlighting the importance of a more sustainable development.

In 1985, the local policy makers decided to implement a massive extension of the collective heat supply. This meant that not only the city of Herning but all the villages in the district should get the heat demand covered by district heating.

The costs in connection to this expansion were to be financed by an 1.5% increase on the price paid by the consumers in the city of Herning for district heating from the coal fired CHP-plant. The plan was set out as a practical realisation of the four corner stones in the energy policy of the Municipality of Herning, containing:

- Optimal utilisation of fuels by use of CHP.
- Energy savings at the consumer level by means of insulation and consumption limiting installations.
- Development and utilisation of the most advanced and energy efficient technologies for production and distribution of power and district heating for as many consumers as possible.
- Development of technologies for efficient utilisation of renewable, local energy sources such as landfill gas, wind power, and biomass in general.

This plan caused a row of projects concerning, among others, utilisation of biomass. All projects were financed partly by the utility and supported either by the Danish Energy Agency, the European Union, or both.

The biogas plants

Already in 1988, Herning Kommunale Værker erected a biogas plant utilising mostly manure. The co-generation unit, burning the biogas, has a net electrical output of 620 kW and a net heat production of 1,7 MW. Based on the experiences gained in erecting this first biogas plant, it was decided to build a new and considerably bigger plant at Studsgård which was finished in 1996. The produced biogas is also utilised in a co-generation unit. The heat is distributed via the existing district heating system in Herning and the power is fit into the national grid.

Technical specifications for the Studsgård biogas plant:

Animal waste	113,000	tons/a
Industrial waste	9,000	tons/a
Household waste	7,000	tons/a
Biogas production	6 mill.	Nm ³ /a

Technical specifications for the Studsgård co-generation unit:

Total available power	1.36	MW
Total available heat	1.70	MW
Production of electricity	8,830	MWh/a
Production of heat	22,800	MWh/a

The initiator was Herning Kommunale Værker, but without local commitment from the farmers in the area, the biogas plants would not have been a possibility.

The straw-fuelled heat plant at Simmelkær

In the Northern part of the district, large amounts of surplus straw are available for energy production. In 1991, Herning Kommunale Værker erected a combined oil and straw fuelled heat plant close to the village Simmelkær. Not as many consumers as foreseen have been connected to the district heating network. For that reason, the plant was not able to run at full power, and that caused difficulties in meeting the demands concerning environmental requirements. As result of this, it was necessary for a long period of time to use oil fuel instead of straw. Today, a 212 m³ accumulator tank has been installed to absorb possible surplus heat. At present, 95 % of the heat demand in the village is covered by straw. In wintertime, when there is a high heat demand, the oil-fuelled boiler produces heat as well.



Heat production in 1996	1,868	MWh
Straw boiler power	1,000	kW
Straw consumption, full load	6-7	tons/h
Connected households	78	-

Main data of the straw fuelled heat plant

The gasification of wood chips

The objective of gasifying is to transfer biomass into a more handy fuel. At the moment, Herning Kommunale Værker is carrying out a development project with gasification of wood chips at Høgild, in the southern part of the district. So far technical aspects/bindings have kept biomass solely in large power plants with turbines. The price of a turbine earlier on disqualified the use of biomass in small applications. With gasification, it might be possible to implement small, co-generation units for the supply of smaller groups of buildings as well. The gasifier is a down draught gasifier, using mainly residual products from the furniture industry in the orbit of fuel. Wood chips can be used for fuel if they are dried to a water content of maximum 20%. For this purpose, the plant is equipped with a belt drier with a two floor drying area, especially developed for this purpose. The wood chips are usually dried from a water content of approximately 40%. The drying air is taken from the cooling systems of the gasification plant.

Wood consumption	273	kg/hour, (40% water)
Gas production	460	Nm ³ /hour
Electricity production	160	kW
District heating	180	kW
Caloric value, gas	1.1 – 3.3	kWh/Nm ³

Main data for the gasification plant

As the technique of wood gasification in connection with combined heat and power production was rather unknown, it was decided to erect a full scale experimental plant with a smaller gasifier. Until now there has not been a great deal of importance placed on achieving optimum utilisation of heat from the cooling of the gasifier, the gas engine, and the chips drying. The plant is built with the possibility for energy optimising at a later date. The total investment in this pilot project was 1.1 mill. Eur¹ of which Eur 576,000 was granted by the Danish Energy Agency.

EVALUATION AND PERSPECTIVES

It can generally be concluded, that the presence of local commitment and initiative are crucial for the accomplishment of innovative projects regarding implementation of renewable energy sources. The pioneer mentality of Herning Kommunale Værker combined with good ideas and well prepared projects have opened a passage for partial funding from both the national energy agency and the European Union. Up to 40% has been financed this way.

The objective in Herning is to cover 30% of the heat demand in the municipality with renewable energy by the year 2005. This goal will be reached partly by further reductions in the total energy consumption, by energy saving schemes, and by increased efficiencies at the production, transmission, distribution, and consumption level. Optimisation and full utilisation of the existing renewable energy plants will also be continued in the future. The extensive application of CHP-plants and smaller co-generating units ensures that an increase in the contribution from renewable energy sources to the heat production is paralleled by an increase in the power production.

FOR FURTHER INFORMATION

Herning Kommunale Værker
 Poul Lyhne
 Biomasse Sektionen
 Dalgas Allé 3, postbox 1020
 DK - 7400 HERNING
 Tel: +45 99 26 82 11
 Fax: +45 99 26 82 12
 E-mail: hkv@herning.dk

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¹ One Eur equals here 7.46 Danish Kroner