



## Fiber sludge and biomass CHP Katrinefors Kraftvärme AB, Sweden

### Summary

The new CHP plant is utilizing the fiber sludge from the nearby paper industry together with biomass (forestry residues) to generate heat to the district heating system, steam to the paper industry and electricity to the grid. The fiber sludge is a residue from the recycled paper that cannot be used for soft paper production but gives energy when combusted. Prior to this the sludge was disposed of at landfill. The concept is built upon proven technology but a similar CHP plant of this size had not been built before in Sweden. In April 1999 procurement was initiated and the new CHP plant went into operation in early 2002. The plant supplies about 240 GWh/year; 105 GWh as steam, 106 GWh for district heating and 29 GWh of electricity. The total investment was SEK 200 million.



#### End-user area

- New buildings
- Refurbishment of buildings
- Transport and mobility
- Financial instruments
- Industry
- Legal initiatives (regulations, directives, etc)
- Planning issues
- Sustainable communities
- User behaviour
- Education
- Other

#### Target Audience

- Citizens
- Households
- Property owners
- Schools and universities
- Decision makers
- Local and regional authorities
- Transport companies
- Utilities
- ESCOs
- Architects and engineers
- Financial institutions
- Other

#### Technical

- Energy efficiency
- Heating
- Cooling
- Appliances
- Lighting
- CHP
- District Heating
- Solar energy
- Biomass
- Wind
- Geothermal
- Hydro power
- Other

### Context

In 1993 the establishment of district heating started in Mariestad, Sweden. To develop the district heating network a new production system was needed. This was the first step towards today's new combined heat and power (CHP) plant. The only suitable location for the plant was in the middle of the community at Metsä Tissue, the paper industrial plant, so the scheme would require their co-operation. A feasibility study assessed that the best solution was to build a plant for both the community district heating and the paper plant. This meant that the new plant had to be able to supply steam which would give the opportunity to generate electricity as well as heat. A new company was founded, Katrinefors Kraftvärme AB which is owned jointly by Metsä Tissue and the local community owned utility MTEAB.

### Objectives

The aim was to utilise the fibre sludge from the nearby paper industry together with forestry residues to generate heat for the district heating system, steam to the paper industry and electricity to the grid. In this way the community district heating network could be developed and the steam supply to the paper industry secured, all by utilising the residue fibre sludge and biomass.



## Process

The first feasibility study was carried out in 1995 which assessed that the best solution was a partnership between the municipal utility, who were operating the community district heating network, and the paper company. In 1996 a company equally owned by these was established. Since then there has been research for district heating solutions using steam production as well as co-generation. In April 1999 procurement was initiated and the new CHP plant went into operation in early 2002.

The project has transformed an industrial waste-problem to an energy source. Combined with the CO<sub>2</sub> reduction, due to replacement of small oil boilers in the community with district heating and replacement of oil in the district heating system with renewables, the project contributes in a significant way to sustainable development. The public - private partnership demonstrate great coordination gains and the possibility of mutual responsibility for local and global environment. The project can also create local job opportunities when the oil fuel is replaced by biomass.

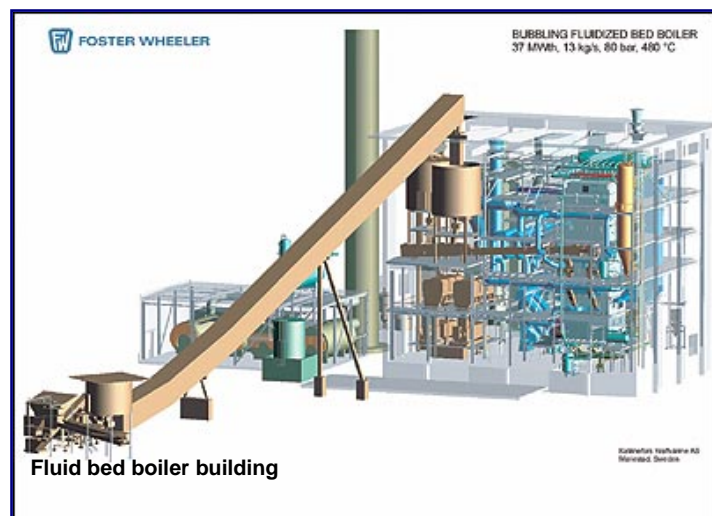
## Financial resources and partners

The project has received SEK 58.5 M of government support as a proportion of the total investment of SEK 220 M. SEK 30 M was received from the local investment programmes for environmental actions. SEK 28.5 M was granted by the Swedish Energy Agency from the programme for increasing biomass CHP installations. The grant gives SEK 3,000 per installed kW of electric power installed. The remaining part of the investment is covered by the company.

## Results

The biomass boiler is a fluidised bed with a capacity of 36.9 MW and minimum load requirement of 10 MW. The pressure and steam system is designed for operation at 480°C/80 bars. A low combustion temperature of 850°C combined with a low inlet air surplus gives low-NO<sub>x</sub> contents in the exhaust gases. Ammonium is also added in the fluidised bed boiler to further decrease the NO<sub>x</sub> emissions.

The Katrinefors CHP plant is built to replace up to 25,000 m<sup>3</sup> of heating oil. The biomass and fibre sludge used has a moisture content of 45-55%. The flue gas condensing system gives a further 11 MW capacity for district heating. The turbine has an electrical capacity of 9.5 MW; the thermal capacity is 27.2 MW.



For back up and peak load four oil boilers of each 15 MW is used, two for hot water production and two for steam generation. The plant also has a hot water accumulator of 2,000 m<sup>3</sup> for the district heating supply. The tank height is 34 m and the maximum temperature is 99°C. The maximum storage capacity equates to about 100 MWh. The accumulator enables a more even boiler load and increased efficiency of the system.

The biomass supply capacity is designed for 200 m<sup>3</sup>/hour. The storage volume is 4,000 m<sup>3</sup> which corresponds to three days of operation at full load. The fibre sludge from the paper industry consists only of 3% of combustible material. After dewaterisation, the moisture content is 45-55%.

The exhaust gas cleaning system consists of two textile filters, each with a 70% capacity. Activated charcoal can be added to decrease the emission of dioxins, but so far this has not been necessary. The ash from the fluid bed as well as the fly ash from the textile filters is separately handled. The landfill mass has decreased from 70,000 tonnes/year of fibre sludge to 7,000 tonnes/year of ash and alternative use for the ash is under investigation.



## Case Study 299: Katrinefors Kraftvärme AB, Sweden

The Katrinefors CHP plant was built to replace up to 25,000 m<sup>3</sup> of heating oil. The annual supply of fiber sludge from the paper plant gives about 58 GWh. The forestry residues which are mixed with the fiber sludge provide about 158 GWh annually. This requires around 2,100 truck loads, each of 100 m<sup>3</sup>, per annum. The flue-gas condensing system recovers heat equivalent to 43 GWh/year. As backup there are four oil boilers with a total capacity of 60 MW. These will only generate 7 GWh/annum. In total the plant is supplied with about 260 GWh of fuel energy content. During the first few years production will be about 240 GWh/year: 105 GWh supplied as steam, 106 GWh from district heating and 29 GWh of electricity.

Electricity production can be increased to 45 GWh if, for example, the electricity price increases. The future increase of district heating in Mariestad is also an important consideration for the electricity output as the outlet steam from the turbine is utilized for district heating in combination with heat from flue-gas condensing.

### Lessons learned and repeatability

The project contributes in a significant way to a sustainable development:

- Less CO<sub>2</sub>-emissions
- High combustion efficiency
- Reduction of landfill mass
- Clean exhaust gases

The operation of the CHP plant has meant that since 2002, the district heating system in Mariestad has been fuelled mainly by renewable energy. 55% comes from biomass (forestry residues), 23% from the fibre sludge and 18% from flue-gas condensing. Only 4% of oil is used and, in total, about 25,000 m<sup>3</sup> of heating oil is replaced.

The public-private partnership demonstrates great coordination gains and the possibility of mutual responsibility for local and global environment. The project can also create local job opportunities when the oil fuel is replaced by biomass.

This kind of Combined Heat and power generation from biological waste material can of course also be used in other countries, especially when the concept is built upon proven Fluid bed technology as in this case.

### Contact for more information:

Project Web Site:

Organisation / Agency: Katrinefors Kraftvärme AB

Main contact: Rolf Åkesson

Address: Box 102, 542 21 Mariestad, Sweden

Tel: +46 501 637 11

Fax: +46 501 39 34 40

E-mail: [rolf.akesson@mteab.net](mailto:rolf.akesson@mteab.net)

Web Site: [www.kkab.com](http://www.kkab.com)