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Documentation for and report on study tour to Sweden

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Biomass Energy for Heating and Hot Water Supply in Belarus (BYE/03/G31)

Documentation for the study tour to Sweden

Colophon

BTG Biomass Technology Group BV
c/o University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands
Tel. +31-53-4861186
Fax +31-53-4861180
www.btgworld.com
office@btgworld.com

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1 INTRODUCTION

In the frame of the UNDP/GEF project *Biomass Energy for Heating and Hot Water Supply in Belarus* a one-week study tour to Sweden for eleven Belarusian high-level decision makers and technical specialists was organised between 2 and 8 April 2006. Study tour participants and their affiliation are presented in Table 1.

Table 1: Study tour participants

Name	Affiliation
Leanid SHENETS	1 st Deputy Chairman, Committee for Energy Efficiency
Mikhail MIKHADYUK	Deputy Minister, Ministry of Energy
Stanislav CHERNOUSOV	Deputy Head, Fuel & Energy Department, Council of Ministers
Ina HRYTSENKA	Head, Economic and Investment Department, Committee for Energy Efficiency
Viktar SAKOUSKI	Deputy Major of Brest Oblast of Belarus
Yury MASKVICHOU	Deputy Major of Grodno Oblast of Belarus
Andrei KUZMINCHUK	Head of Brest Oblast Department for Supervision of Energy Efficiency
Viktar IVANOU	Chief Engineer, Design Institute “Belniplerienergoprom”
Tatiana POUCHKINA	UNDP/GEF Project Assistant
Aliaksandr SAVANOVICH	UNDP/GEF Project Expert
Alena PIATROVICH	Interpreter

The goal of the study tour was to familiarise study tour participants with (a) biomass production in the forest, (b) biomass combustion for district heating and combined heat and power generation, and (c) Swedish bio-energy policy. A comprehensive programme was put together by the tour organisers, summarised in Table 2, and described in more detail in the annexes.

Table 2: Swedish manufacturers, plants and organisations visited or met

Day	Company
Monday 3 April 2006	Swedish Bioenergy Association (Stockholm) Swedish Bioenergy Combustion Association (Stockholm) Allan Bruks AB / field demonstration in Upplands Väsby
Tuesday 4 April 2006	SLU Department of Bioenergy (Uppsala) Saxlund International AB / Heby Säggwork Bruks Klöckner AB / field demonstration near Heby Hotab AB / Ljungträ sawmill in Munktrop (near Köping)
Wednesday 5 April 2006	Eskilstuna Energi & Miljö (Eskilstuna) Norrenergi AB in Solna (near Stockholm)
Thursday 6 April 2006	TallOil AB (Stockholm) KMW ENERGI (Norrtälje)
Friday 7 April 2006	ENA Energi AB (Enköping) Swedish District Heating Association (Stockholm)

Although many showcase examples and flagship projects were shown and/or demonstrated in the time available, these only represent a modest part of the large number of projects and stakeholders in the Swedish bio-energy sector. The organisers BTG and SVEBIO wish to stress that the study tour has merely offered the participants a “snapshot picture” of a long development. To fully understand the Swedish biomass energy situation a more carefully analysis is required.

The study tour was organised by Mr. John Vos of BTG with extensive support of Messrs. Johan Vinterbäck and Lars-Erik Larsson of the Swedish Bioenergy Association SVEBIO. Mr. Vos also accompanied the study tour.

SWEDISH BIOENERGY ASSOCIATION

Svenska Bioenergiföreningen / Swedish Bioenergy Association (SVEBIO)

Torsgatan 12

S- 111 23 Stockholm

Phone +46 8 441 70 80

Fax: +46 8 441 70 89

Email: info@svebio.se

Web: www.sevbio.se

Contact person: Dr. Johan Vinterbäck, Email: johan.vinterback@svebio.se

Phone + 46 8 441 70 83, Mobile + 46 703 44 70 83

Bioenergy production in Sweden has more than doubled from 48 TWh in 1980 to 109 TWh in 2004. The main reasons for this development are the introduction of strong steering taxes on fossil fuels and a widespread use of district heating (DH) systems. At the beginning of this development the political ambition was to reduce oil dependency with nuclear power, coal and domestic fuels. In the 1990s the environmental issues, e.g. the reduction of carbon dioxide, have been the main political driver.

As a non-profit organisation SVEBIO has played a central role in the development of bioenergy. At the beginning SVEBIO provided the necessary network enabling commercial use of wood chips in district heating systems. Almost all actors in the bioenergy field including communities and politicians were involved in this network. The ignorance of bioenergy was common and conferences arranged by SVEBIO played an important role in turning bioenergy into a commercially accepted fuel. A major event was the BioEnergy 84 World Conference in Gothenburg with SVEBIO as the main organiser.

Today SVEBIO consists of around 400 members, most of them enterprises active in producing/providing biofuel or using biofuels on a larger scale. Among SVEBIO's members there are also manufacturers/providers of burning equipment, machinery for collection and processing of biofuels, consultants, scientists, politicians as well as some private members. The broad spectrum of members has contributed to SVEBIO's present position as a trustworthy part among decision-makers. SVEBIO is playing an active part in all major political decisions concerning bioenergy and bioenergy-related matters in Sweden.

Johan Vinterbäck gave a presentation on the development and current role of bio-energy in Sweden. He discussed current trends, with the bioelectricity, pellets, and liquid biofuels sectors growing fastest. He also addressed competition with fossil fuels, employment generation, markets for equipment, and future market potential.

SWEDISH BIOENERGY COMBUSTION ASSOCIATION

Swedish Bioenergy Combustion Association

Storgatan 5

Box 5510, S-114 85 Stockholm

Email: sbca@teknikforetagen.se

Web: www.sbca.se

Contact: Anders Östergren, Director,

anders.ostergren@teknikforetagen.se

The Swedish Bioenergy Combustion Association was formed in 2002. The purpose of SBCA is "To ensure quality, survival and technical development for improved environmental effects in the area of bioenergy".

SBCA caters to the companies in Sweden that manufacture and/or develop industrial combustion equipment for bioenergy fuels. Current membership includes:

- (a) HOTAB Eldningsteknik AB, Halmstad
- (b) Järnforsen Energisystem AB, Halmstad
- (c) KMW Energi i Norrtälje AB, Norrtälje
- (d) Saxlund International AB, Västerhaninge
- (e) TPS Termiska Processer AB, Studsvik (Nyköping)
- (f) Zander & Ingeström AB, Solna

At the offices of SVEBIO, Anders Östergren gave a presentation in which he addressed a.o. various types of combustion equipment. An interesting fact was that recently the Swedish Government's Commission on Oil Independence had decided that oil shall be fully phased out as fuel for heating of buildings in the residential and service sector in 2015.

Allan Bruks AB
Kärrvägen 32
S- 17760 Järfälla
Tel +46 8 584 001 30
Fax +46 8 584 001 31
Web: www.allanbruks.se
Contact person: Christina Bruks, kia@allanbruks.se, Mobile 070 – 968 7214

Allan Bruks AB has for more than 3 decades developed mobile and stationary equipment for the production of fuel chips. The company was founded during the 1960's by Allan Bruks, a pioneer in developing technique for mobile chipping in forest.

Throughout the years, this technique has continuously been improved in performance and efficiency in a close cooperation with other actors in this business. Allan Bruks AB's products have become important parts of a unique concept of biofuel production from forest residue. A concept that Sweden is world leading of today.

During the 1980's Allan Bruks AB also developed and manufactured mobile chippers, harvesters and cranes for the forest industry in Brazil.

Allan Bruks AB (ABAB) activities revolve around two main areas:

- Development and marketing of highly effective techniques to bring forward more materials from thinning and forest residues for biofuel production
- Marketing and sales of products from CBI (Continental Biomass Industries) in the Nordic region. CBI is a world-leading manufacturer of mobile and stationary machines for grinding wood waste materials.

The study tour delegation was met at the IBIS hotel in Kilna by Christina Bruks and one of her colleagues. First an industrial waste recycling centre in Edstippen (Malärvägen, Upplands Väsby) was visited, where a high capacity CBI grinder was seen at work. Next, the operation of the ABAB accumulating felling head and of a forwarder equipped with ABAB carrier was demonstrated at a forest site.

Sveriges Intbruksuniversitet / Swedish University of Agricultural Sciences (SLU)
Department of Bioenergy
Vallvaegen 9-10, Ultuna, Uppsala
P. O. Box 7061, S-75007 Uppsala
Tel: +46-18-671922, Fax: +46-18-673800
Web: www.bioenergi.slu.se
Contact person: Prof. Bengt Hillring

The Department of Bioenergy conducts research, education and information in the field of bioenergy. Our research area covers the chain of biofuel and energy production: forest management, production and handling of biofuel, distribution, upgrading, conversion, economy and market issues. The major research focuses on technique, economy, socio-economics and environmental questions. The work includes applied research in collaboration with industry, society and national and international universities.

Vision for the Department of Bioenergy

The Department should be one of the leading actors in Europe – within research, education and information – working for a sustainable energy system based on bioenergy.

Bioenergy is gaining ground!

Every year 4 % more energy is produced with biofuels than the year before. An increased use of domestic biofuels creates jobs and revenues from taxation, simultaneously Sweden becomes less sensible for international political complications and currency fluctuations. Furthermore the Swedish energy system will be more sustainable and the eutrophication and acidification will be mitigated. In 2003 biofuel, peat etc constituted 17 % or 103 TWh of totally 624 TWh supplied energy in Sweden.

What is bioenergy?

Bioenergy is the energy obtained direct or indirect after conversion of biomass (biological material). Fuels from trees, energy crops, peat and waste are considered biomass. Bioenergy is solar energy stored as energy rich organic compounds in plants through photosynthesis. In quantity the biggest chemical components are cellulose, starch, sugar and lignin. Historically energy from biomass is one of the most important energy sources for humanity.

During the second day of the study tour, Associated Professor Tatjana Stern of SLU accompanied the study tour delegation. Dr. Stern (tatjana.stern@bioenergi.slu.se) is responsible for SLU's bio-energy co-operation with Northwest Russia. During the day she informed the delegates in Russian on (bio-energy status and) developments in Sweden.

SAXLUND INTERNATIONAL

Saxlund International AB
Förrådsvägen 1, SE-137 22 Västerhaninge
P.O. Box 79, SE-137 22 Västerhaninge
Tel. +46 8 504 105 80
Fax. +46 8 504 105 99
Web: www.saxlund.se / www.saxlund-international.com
Contact: Agneta Sporrøng, commercial manager, sporrøng@saxlund.se

Saxlund International supplies efficient systems in four business areas: (1) material handling and recycling, (2) sludge handling, (3) energy plants for biomass fuel and (4) ash/slag handling. The Swedish company is headquartered in Västerhaninge. It has further design offices and factories in Germany, United Kingdom and USA.

Energy plants for biomass fuels

Saxlund International offers complete grate-fired energy plants with outputs up to 50 MW. Since a combustion system is only as good as the feeding and other auxiliary systems, Saxlund International is able to supply high quality bulk material handling systems that have a proven track record the world over. Since 1984 Saxlund has supplied some 65 biomass boiler plants using different types of biofuels.

The Reciprocating Grate

Saxlund has many years of experience in the design of reciprocating grates. This knowledge has been used to develop a completely new design that has resulted in the best system available. The new grate has following major advantages:

- The new patented grate bars may be rotated to double their service life.
- Grate side cooling prevents slag formation which means less maintenance.
- The grate bars are machined to tight tolerances and then bolted together to give a uniform airflow over the entire grate resulting in better combustion and no hot spots.
- Stable combustion can be achieved even at very low outputs.
- The grate design is modular; it can be retrofitted easily into existing boilers or furnaces.
- All actuators are placed at the front of the grate. This means that there is no maximum width limitation.
- When combined with the patented fuel feed system, the whole grate is only used for combustion, not feeding fuel. This means the heat release is maximized.

In the frame of the study tour the biomass boiler at the Heby Sägwork was visited under the guidance of Saxlund's Agneta Sporrøng. This 15 MW_{th} Saxlund boiler was built in 1997 as has operated without difficulties since. It uses bark and wood chips as fuel to produce process heat (for drying kilns) and process steam.

BRUKS KLÖCKNER

Bruks Klöckner AB
PO Box 46,
S - 82010 Arbrå
Tel: +46 278 642530
Fax: +46 278 642520
Web: www.bruks-klockner.com
Contact person: Mr John Erik Eriksson, j.e.eriksson@bruks.com
Phone: +46 278 642 500. Mobile: +46 70 633 9514

Bruks Klöckner is an international mechanical-engineering group that develops, manufactures and markets machines and systems for the wood-processing industry. Customers include sawmills, board and pulp mills as well as energy suppliers all over the world but predominantly in the European Union. The group has a total of about 165 employees and an annual sales volume of some 27 million EUR (of which some 20% in mobile chippers) with export sales amounting to some 80 %. Bruks Klöckner is part of the Forest Technology Group, a partnership of companies selling forestry equipment.

Bruks Klöckner is

- The market leader for residue handling equipment in sawmills
- The largest supplier of drum chippers
- A supplier with a wide product range for the pulp, board, energy and wood recycling industries
- A supplier with a large market coverage and representatives in 50 countries.

The study tour delegation was met over lunch, after which the operation of a Bruks Klöckner mobile chipper was demonstrated at a farmhouse near Heby.

HOTAB ELDNINGSTEKNIK

HOTAB Eldningsteknik AB
Gamledammsvägen
SE-302 41 Halmstad
Tel: +46 35 135540
Fax: +46 35 148137
Web: www.hotab.se
Email: info@hotab.se
Contact person: Per Brandes, Mobile +46 705 –313070

Introduction

The Hotab Group includes HOTAB Eldningsteknik AB, Holst El AB and Olje- & Pannservice AB, all based in Halmstad or Kristianstad. The group has a staff of about 50 persons and an annual turnover of approx. SEK 100 million. HOTAB has delivered more than 1,000 solid fuel plants since 1979, of which about 400 complete heating systems.

The Hotab Group offers total solutions for oil as well as solid fuel. The group is experienced in and masters the heating technique for a wide range of biomass and waste types, including pellets, briquettes, joinery waste, chippings, bark, straw, grain screenings, plastic and paper. Hotab operates in Sweden and abroad (with main focus on Northern & Eastern Europe).

Hotab's main products are combustion plants supplied with dry or wet fuel (a maximum of 60% humidity), in sizes from 0.2 to 16 MW_{th}. In the frame of the study tour a 3 MW_{th} biomass boiler plant, installed at the sawmill of Ljungträ AB in Vreta, Munktrop (near the town of Köping) was visited under the guidance of John Brandes.

The boiler (a stoker with screw feeder) uses wood chips and produces industrial heat that is used in the drying chambers installed at the sawmill. The boiler operates 24 hr/day, 340 days per year, and consumes some 80 m³ of biofuel daily. A multicyclone is used for flue gas cleaning.

ESKILSTUNA ENERGI & MILJÖ

Eskilstuna Energi & Miljö

Alva Myrdals gata 5

SE- 631 86 Eskilstuna

Tel +46 16-10 20 00

Web: www.eskilstuna-em.se

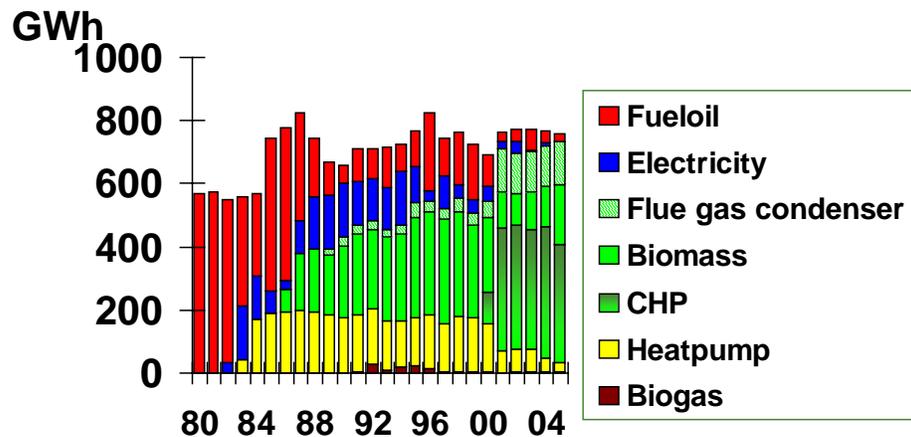
Contact persons Rolf Gustavsson, operations manager & Anders Björklund, DH manager

Eskilstuna Energi & Miljö builds infrastructure and supplies the utilities needed for living and working in Eskilstuna, a town of some 90,000 inhabitants. The main products and services supplied by Eskilstuna Energi & Miljö are: district heating, district cooling, mains electrical supply, water and sewage, refuse, transport and construction machines, IT-communication, sale of electricity, electrical installations. The municipality-owned company has about 370 employees and a turnover of approx. SEK 930 million. Annual heat sales amount to 676 GWh.

Eskilstuna Energi & Miljö supplies district heating to more than 31,000 consumers, including 27,700 households in apartment buildings (55% of use), 3,580 one-family houses (10% of use), and numerous public buildings, shops, industries etc. (35 % of use). The district heating network is 281 km long. The system contains 800 m³ of water and water losses amount to 10-15 m³/day.

Fuel consumption for district heat generation is dominated by biomass fuels. The biomass used in 2005 (nearly 1 million m³, with a caloric value of 779 GWh, or the equivalent of 80,000 m³ of fuel oil) consisted of 12 % sawdust, 21 % bark and sawmill residues, 63 % woodchips (branches and tops) and 4 % short rotation coppice (Salix, Willow). On average a price of 150 SEK/MWh is paid for the biofuel. The use of fuel oil, which 25 years ago was the only fuel used, is almost complete phased out (see figure below).

Fuel use at Eskilstuna Energi & Miljö



The Vattumanen plant

The CHP plant in Eskilstuna was commissioned in the second half of 2000. It is integrated with the district heating plant in the Vattumanen block and is responsible for 95% of the district heating production in Eskilstuna. Heat output of the CHP plant is 71 MW, excluding flue gas condenser which is 25 MW. Gross power output is 38 MW. Apart from the CHP plant there are four oil-fired hot water boilers, one solid fuel boiler, a gas turbine with waste heat boiler and the two heat pumps at the Vattumanen plant. The total capacity of the Vattumanen plant is 521 MW_{th} and 30MW_{el} (source: Eskilstuna Energi & Miljö, The CHP plant, 2001). The storage capacity of the heat accumulator is 26,000 m³.



Key technical data

Investment	SEK 465 million (€52 million)
Steam conditions	148 t/h, 540°C, 140 bar
Thermal capacity	120 MW _{th} .
Heat output:	96 MJ/s
Gross electrical output	38.7 MW _e
Net electrical output	36.2 MW _e
Annual fuel use	560 GWh/year (720,000 m ³ /year)
Annual electricity production	180 GWh/year
Annual heat production	330 GWh/year
Annual flue gas condensing	105 GWh/year
Flue gas cleaning	Electrostatic precipitator
DeNO _x	Selective non-catalytic reduction (SNCR)

More technical details about this CHP plant can be found at:

<http://bio-chp.dk-teknik.dk/plants/eskilstuna.mht>

Due to a failure of the generator the CHP plant has not been producing electricity for some time. The loss in income is covered by insurance (thus far). The generator will be repaired/replaced shortly.

VÄRMETEKNIISK SERVICE (VTS)

VärmeTeknisk Service AB (VTS)
Femte Tvärgatan 2, 611 35 Nyköping
P.O. Box 557, 611 10 Nyköping
Tel: +46 155 284915
Fax: +46 155 283315
Web: www.vts.nu
Email: info@vts.nu
Contact: Björn Forsberg, Mobile: +46 705 28 49 15, bjorn.forsberg@vts.nu

Activities

VTS is a developer of burners for any gas-, liquid- or powder fuel. VTS carries out dryer calculations and engineering for upgrading of existing and new dryer systems for upgrading to wood powder combustion. VTS also provides consulting in the energy sector with focus on dry biofuel. Finally VTS upgrades problem installations.

Multi-fuel burners

VTS builds multi-fuel burners for various fossil and renewable fuels:

- Powder: Wood; Peat; Bark; Coal;
- Oil: HFO & Diesel
- Gas. Natural Gas; Propane; Process gas

These fuels can be combined in different ways, but usually the burners are built for the fuel combinations Powder/Oil or Powder/Gas. VTS can also provide burners for more fuel types.

Supplies

VTS has delivered more than 40 powder burners, as follows:

- Smallest delivered burner size: 150 kW
- Largest delivered burner size: 28 MW
- Largest plant installation: 6x25 MW = 150MW (Ferrybridge, UK)
- Maximum burner size VTS offer today: 50 MW

Customers

VTS customers are found within the board industry, pellet plants, pulp & paper and in district heating (DH) plants. VTS customers are found in Sweden, Germany, Poland, Slovakia, Canada, Thailand and elsewhere.

Boiler plant to be visited

In the frame of the study tour the 100 Norrenergy district heating plant in Solna was visited (see next document section). VTS supplied multi-fuel burners (4 x 20 MW wood powder burners installed in two 50 MW hot water boilers) for this DH plant.

VTS is a member of the Swedish Bioenergy Combustion Association SBCA. Since 2005 VTS is owned by the company Talloil. Both SBCA and Talloil are discussed in some detail elsewhere in this document).

NORRENERGI AB SOLNA

Norrenergi AB
 Korta gatan 7
 Box 1177, SE - 171 23 Solna
 Contact person: Sven Jonsson

Tel: +46 8-475 04 04
 Fax: +46 8-475 04 04
 Email: info@norrenergi.se
 Web: www.norrenergi.se

Norrenergi AB supplies district heating and cooling services to the communities of Solna and Sundby at the outskirts of Stockholm. It has 1400 subscriptions. Last year it supplied 1071 GWh of heat and 65 GWh of cold. The net sales value stood at 550 million SEK. Norrenergi has a staff of just 60 persons, as many of the services it requires are procured on a contract basis.

Norrenergi operates two main heating stations, one in each of the communities. At each of the two plants, various boilers of different sizes, using different fuels are in use. At Solna also 4 heat pumps are installed. The DH network measures 150 km. Heat losses are 5% on average; water leakage amounts to 30-50 m³ per day. The energy generation equipment at Norrenergi's heating stations includes:

Solna Heat Station

- 4 heat pumps of totally ca 100 MW heating (sewage treatment effluent from Bromma; sewage treatment plant and sea water from the "Mälaren")
- 2 fuel oil boilers, of totally 130 MW heating
- 2 wood powder boilers, of totally 90 MW
- Boiler P4 has been complemented with electrical filter for tall oil pitch, 60 MW
- 1 electrical boiler of 30 MW heating
- 1 district cooling plant with cooled sewage treatment effluent as heating source 20 MW
- 1 cooling accumulator 10 MW
- 2 cooling chillers, of totally 10 MW
- Continuous staff; 3 shifts. Totally 17 persons for operation and maintenance

Sundbybergs Heat Station

- 3 fuel oil boilers of totally 140 MW heating
- 2 electrical boilers of 2x30 MW heating
- District cooling plant, 2 cooling units of 6 MW (to be installed 2006)
- Haga heat exchanger station 85 MW (KS Boiler centre)
- Frösunda cooling plant 15 MW
- Silverdal cooling plant, 1 MW
- Unmanned (remote) control, controlled from Solna



Kv. Krukmakaren, Solna



Kv. Dimslöjan, Sundbyberg

Like all Swedish energy companies, Norrenergi is gradually phasing out the use of heavy fuel oil, using biomass-based fuels (such as tall oil, a by-product of the wood pulp industry that is low in ash content, or sawdust pellets) instead. In 2001 Norrenergi decided to convert 2 oil-fired hot water boilers to wood powder operation.

VärmeTeknisk Service AB (VTS; see previous document section) received the contract for the replacement of the burner systems and the storage of wood powder. The scope of supply included 4 multi-fuel burner systems (20 MW on wood powder or 25 MW on heavy fuel oil each), 250 m³ wood powder storage silo, 4 dosing transport systems and electrical, control and mechanical installation. The equipment was commissioned in November 2003. The main sources of wood fuel for the plant are pellets and briquettes, which are milled on site. The boilers are equipped with SNCR system and electric precipitators to meet the stringent CO, NO_x and particle emissions.

Current fuel use

For 2006, heat pumps and biomass fuels are scheduled to cover 90% of the energy demand for district heat production at Norrenergi, with the remainder being covered by heavy fuel oil (only at Sundbyberg heating station) and the purchase of DH from Birka Värme AB in Örebro.

Fuel source	Planned share (% , 2006)
Heat Pumps	58%
Wood powder	21%
Tall oil pitch	11%
Fuel oil (Sundby only)	6%
Purchase from other heating company	4%

Because the heat pumps were installed many years ago, when (nuclear or hydro based) electricity in Sweden was very cheap, and are economically fully depreciated it is financially attractive to keep using them, even at currently much higher electricity prices

After his presentation, Mr. Jonsson answered many questions regarding sources, quantities and prices of fuels used and energy produced. Biomass fuel (60,000 t/yr) is obtained from Sweden, Finland and the Baltic countries (approx. 20,000 t/yr from the latter). Some 100km north of Stockholm Norrenergi operates a seasonal fuel storage in Hargshamn, Östhammar (capacity: 20,000 t). The biomass fuel store on site in Solna has a capacity of 2,000 ton, enough for 4 days of operation. The fuel hopper can contain biomass fuel for 2 hours of operation.

Indicative fuel prices are: 200 SEK/MWh for wood pellets (not taxed), 350 SEK/MWh for tall oil (not taxed) and 800 SEK/MWh for heavy fuel oil (incl. tax). District heat is sold at an average price of 500-550/MWh to large customers and 750 SEK/MWh to small customers.

TALL OIL

TallOil AB
Klarabergsviadukten 70, D7
SE-111 64 Stockholm
Tel: +46 (0)8 53524600
Fax: +46 (0)8 109923
Web: www.talloil.se
Contact person: Henrik Lundberg, hl@talloil.se

TallOil is one of Europe's leading company groups within the fields of biofuels and bioenergy. It specialises in long-term and sustainable biofuel solutions and supplies complete biofuel applications, from forest to chimney. The philosophy of TallOil is to fully master the bioenergy supply chain, including biofuel production, trade, logistics, engineering and delivery of plants, and to create synergies.

The expertise of TallOil is comprehensive and ranges from raw materials (pellets, briquettes, wood chips, crushed wood fuel, tall oil, bio-ethanol and biodiesel) and techniques to delivering complete turnkey biofuel applications comprising combustion techniques, hot water and steam boilers and related equipment.

The company has a staff of approximately 160, including 28 based at the Stockholm headquarters, 35 at a workshop in N. Sweden, 40 at the engineering department in Studsvik, some 30 at a sawdust pelleting plant in Latvia and a small number at engineering/sales offices in UK and Canada. In the last financial year, the company had a turnover of 110 million USD, versus 1.5 million USD in FY99/00 and 10 million USD in FY01/02. In 2004 it ranked #8 in the Top 10 of Swedish companies producing biofuels for the open market. In 2005 it jumped to first position in this market.

Company members of the TallOil group include:

- The leading Swedish combustion engineering company, TPS Termiska Processer AB, based in Studsvik. TPS has designed, delivered and licensed bubbling fluidised bed (BFB) boilers for biomass and waste fuels for more than 20 years, and has also developed gasification processes. TPS deliver both hot water and steam boilers, either separately or as turnkey plant (capacities 5-30 MW). It has integrated TPS CP Energi AB, a supplier of small- and medium-sized boiler plants 0.1-15 MW)
- VärmeTeknisk Service AB, also based in Nyköping. The main business of VTS is the engineering, construction and supply of solid fuel powder burners, in particular multi-fuel burners.
- Södertörns Bulkhamn AB.
- A number of overseas subsidiaries.

Company founder and CEO Henrik Lundberg gave a presentation on TallOil's company philosophy as an integrated bioenergy group. The presentation was translated by Tall Oil's Mr. Nikolai Berejnoi. Mr. Lundberg presented the company's history and its

development and expansion into various related bioenergy fields. He gave an introduction on the four *business areas* that TallOil is involved in, including:

- Logistics and supply of liquid biofuels (Tall Oil, Vegetable Oil, and gasification/pyrolysis derived oil for heat, power and CHP production (stationary energy generation). In this field, Tall Oil operates as one-stop-shop for pure biomass firing or biomass co-firing applications.
- Supply of renewable transport fuels such as bio-ethanol and 2nd generation liquid biofuels
- Production and supply of solid biofuels for domestic and export markets (with a view of securing access to large-scale sustainable supplies)
- Technology development e.g. development of second generation transport fuels (CHRISGAS project) and development of the BioSwirl Pellet Boiler for the retrofitting of heavy fuel oil boilers. Six 25 MWe BioSwirl pellet boilers are currently being supplied to the Ferrybridge coal power station in the UK.

KMW Energi
Baldersgatan 16 B,
SE- 76121 Norrtälje,
Tel: +46 176- 17220
Fax: +46 176-193 50
Web: www.kmwenergi.se
Leif Granroth, Managing Director, &
Christer Rosendahl, Sales Manager



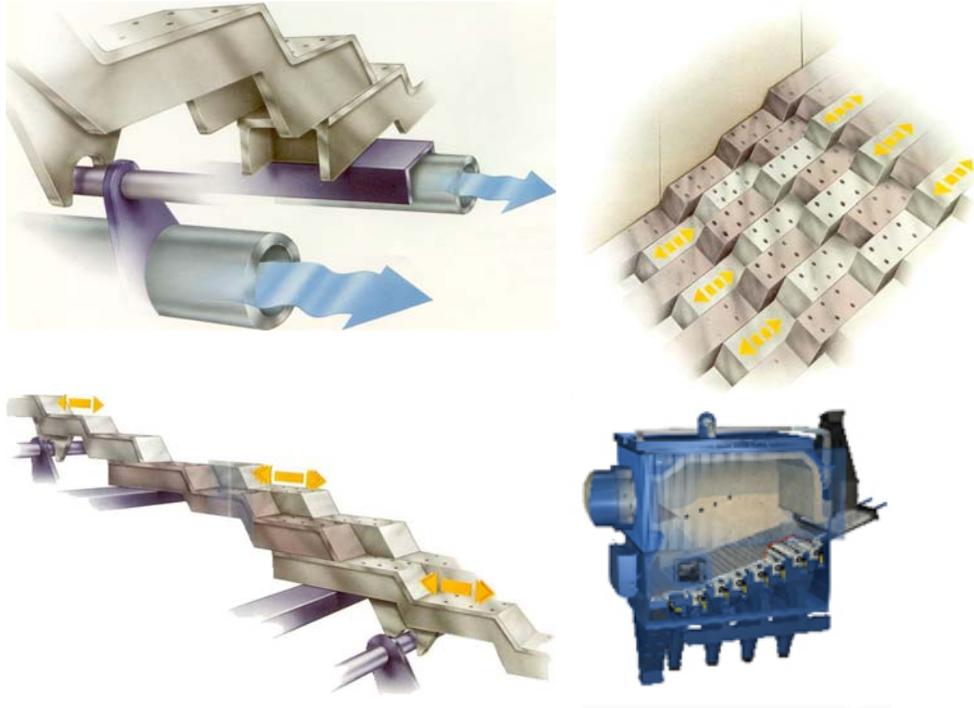
KMW ENERGI i Norrtälje AB is based in Norrtälje, some 70 km northeast of Stockholm. It supplies high-quality biomass boiler combustion plants within the effect range of 10-40 MW heat. The company was established in 1958, nearly 50 years ago, and has produced some 2000 boilers of ever increasing sizes since. It has currently 40 employees and an annual turnover of 30-35 million USD.

KMW ENERGI builds and supplies biomass combustion equipment, including pre-furnaces, fuel handling systems, ash handling systems and operation and control systems. It often operates as the turnkey supplier of biomass-based heat or CHP plants. A large part of the turnkey supplies is subcontracted.

KMW ENERGI has already supplied more than 40 biomass boiler plants in the 10-40 MW_{th} range, to Scandinavia, Norway and other countries in Europe and North America. The supply of a dozen or so more biomass heat plants is contracted for 2005 and 2006. These include 4 combined heat and power (CHP) systems:

- Mariehamns Energi, Mariehamn
- Norrtälje Energi, Norrtälje
- Älvsbyns Energi, Älvsbyn
- LjungbyEnergi AB, Ljungby
- ARLA Foods AB, Vimmerby
- YstadEnergi AB, Ystad
- ArvidsjaurEnergi AB Arvidsjaur
- BorgstenaEnergi AB Herrljunga
- SydkraftVärme, Kungsbacka
- NorskPellets AS
- TromsKraft Varme AS

KMW ENERGI uses its own patented combustion technology, which is flexible, robust, mature and offers simple process control. The systems are well suited to handle variations in (physical) fuel properties, fuel moisture content and load. Grates systems make use of water cooled grid shafts and asynchronous grid movement.



Water-cooled grid shafts, grid movement principle and furnace layout.

In his presentation, Mr. Rosendahl described the KMW technology and presented various KMW references. He also gave an insight in the investment costs of KMW systems.

ENA KRAFT AB

ENA Energi AB
 Kaptensgatan 22
 SE-74535 Enköping
 Tel: +46 171 - 25410
 Fax: +46 171 - 25412
 Web: www.ena.se
 Contact person: Eddie Johansson



ENA Energi AB is the recent merger of AB Enköping Värmeverk and ENA Kraft AB, with the latter company being the original owner of the Enköping DH/CHP plant. In the winter this plant is fired with a mixture of forest felling residues, sawdust, wood chips and short rotation wood (Salix). In the summer the heat is produced by wood powder, which means that Enköping is heated by biofuel all the year round. The use of coal and oil has been gradually phased out after 1997.

Key technical data

Investment	SEK 350 million (€41 million)
Steam conditions	108 t/h (27 kg/s), 540°C, 100 bar
Thermal capacity	80 MW _{th}
District heating output	55 MJ/s
Gross electrical output	24 MW _e
Heat accumulator capacity	25 MW/325 MWh
Fuel consumption	100 m ³ solid/hour
Wood chip consumption	400,000 m ³ solid/year
Flue gas cleaning	Electrostatic precipitator
Year of construction	1994

More technical details about this plant can be found at:

<http://bio-chp.dk-teknik.dk/plants/Enköping.mht>



Fuels used at the Enköping DH/CHP plant. Source: www.ena.se

Fuel used at the Enköping DH/CHP plant include residues from forestry operations (typical trucking distance 90 km) and from debarking at paper mills (typical trucking distance 200 km). The fuel is delivered by 100m³ truck. Up to 40 truck loads of woodfuels are received per day. A 8,000m³ short term wood fuel storage is sufficient for three days of operation. The fuel bin can contain fuel for 4 hours of operation.

The average heat losses in the heat distribution system are 10%: 8% in winter and 25% in summer. Water losses are limited to 100m³ per month. The piping of the DH network is equipped with moisture measuring equipment to detect any water leakages.

Mr. Johansson is very enthusiastic about the use of Salix (willow) as fuel, and detailed the company's experience with Salix cropping and use. After first buying Salix from local farmers, which it paid 140 SEK/MWh, ENA Energi AB has taken up the cropping of Salix itself, at a cost of 80 SEK/MWh. Even without taking support measures and tax incentives into account, this competes favourably with the current cost of coal, which is 90 SEK/MWh.

ENA Energi AB considers constructing a sawdust pelleting plant and a bio-ethanol plant in the near future so that the CHP plant can run at full load year round.

After giving a comprehensive presentation and answering many questions, Mr. Johansson showed a video of the technical installation. This was followed by a tour of the premises.

At the end of the visit, documentation (a) showing a schematic overview of the Enköping biomass CHP plant and (b) detailing prices for power production, district heat production, industrial heat production and combined heat and power (CHP) production based on the input of various fossil and renewable fuels was kindly made available by Mr. Johansson.

SWEDISH DISTRICT HEATING ASSOCIATION

Svensk Fjärrvärme AB / Swedish
District Heating Association (SDHA)
Olof Palmes gata 31
SE-101 53 Stockholm
Tel. +46 8 - 677 25 50
Fax +46 8 - 677 25 55
Web: www.svenskfjarrvarme.se
Contact person: Erik Larsson,
Energy Policy Manager,
erik.larsson@svenskfjarrvarme.se



Sites with DH systems installed

The Swedish District Heating Association (SDHA) is the trade organisation for Sweden's district heating (DH) companies, and was formed by 16 municipal agencies in 1949. The organisation currently has some 135 members companies (ownership: 70% municipal, 22% private/foreign and 8% government) producing and distributing district heating. Some of these members are also involved in district cooling (31 companies, delivering 622 GWh in 2003) and/or combined heat and power production (CHP) as well.

The first DH system in Sweden was constructed in Karlstad in 1948. Today DH is used in every community in Sweden with more than 10,000 inhabitants. District heating supplies 50 TWh per year, and has an overall share of 48% of the total heat market (7% in family houses, 75% in blocks of flats and 56% in public premises). The DH market has a volume of 2,000 million Euro per year and is still growing.

In his presentation, held at the SVEBIO offices, Mr Larsson addressed amongst others (a) the development of the -district- heat market in Sweden, including the types of fuels used, (b) the Swedish DH company certification system, known as “Reko Fjärrvärme”, (c) the current and future contribution of DH and CHP in Europe. Mr Larsson observed that surplus heat from industries and power production plants could heat all the houses in the whole of the European Union. The goal in Sweden is indeed to use “zero” -additional- fuel for heating and cooling.

Annexes

Study Tour Programme

Study Tour Background Documentation