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The Swedish Bioenergy Association, SVEBIO, was founded in 1980. Its members consist of private persons, companies, authorities and organisations. The Association works for an increased use of energy in an environmentally considerate and optimal manner.

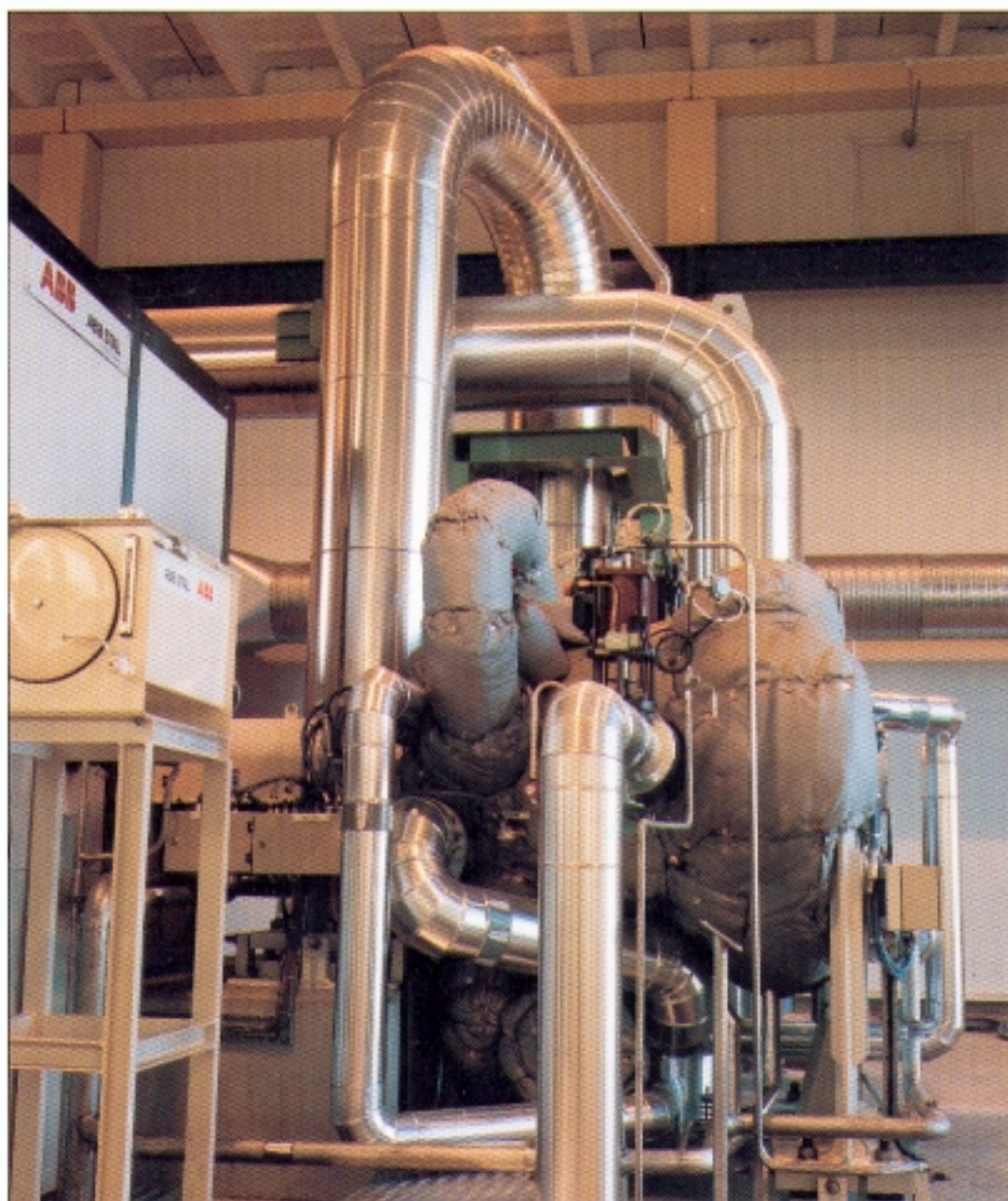


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The 35 MW steam turbine in the co-generation plant in Skellefteå produces electricity from the first bio-combinate in the world.

Winners for the future

- The world's first bio-combinate.
- Local employment opportunities.
- A co-operative that both produces fuel and delivers energy.
- Production of biogas used in city buses.

This fact sheet introduces a number of energy actors who have invested in bioenergy, both large and small, and sometimes using technology that is still under development.

The conversion to a new and sustainable energy system must start somewhere. There is always somebody who takes the initiative and shows the way. New ideas and successful projects may function as inspiration for others. A number of examples of effective and environmentally considerate energy production using biofuels as base are given below, both large and small.

Just as effective in winter as in summer

A boiler designed to cope with the energy demands placed on it during a severe winter climate will be run with a very low output during summer. This frequently creates both technical and economic problems. The energy production plant at Enköping, Sweden, has solved the problem of peak- and summer loads in an interesting way with several individual boilers in the main plant that use different kinds of biofuels.

Since wood chips are the cheapest, this fuel is used during most of the year. Chips provide about 85 per cent of the heat requirement and half the electricity requirement. When the winter sets in, an oil-fired boiler converted to use wood powder is used as a complement.

During the summer, when the demand for energy is much less, only wood powder is used. The powder is made by grinding pellets. Since pellet fuel can be stored it is a convenient fuel to use when regulating energy production. Wood powder is easy to use at different energy loads and can therefore be adapted to suit the very different demands between winter and summer.

The Enköping Energy Company produces 98 per cent of its heat and electricity using biofuels.

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Three-fold bonus

It must be convenient. That was the starting point when Sala-Helby Energi decided to promote a new business idea. An offer of delivered heat was made by the municipally-owned energy company to villa-owners who did not have access to district heating. It must also be environmentally considerate. The boiler equipment installed by the energy company at the customer uses biopellets. The company arranges all installations and service of the boiler

First and largest in the world

■ ■ This is the first bio-combinate in the world. It is also the world's largest producer of pellets. In Skellefteå, a city in northern Sweden, the investments have not only been daring but also on a large scale. The energy company, with its 2.7 terawatt hours (TWh) of electricity annually, is one of the largest producers of electricity in Sweden. The company was using bioenergy already in the early 1980s. Permission was granted to use sawdust for energy purposes even though there was still legislation restricting these possibilities. In 1995 the company produced 0.3 TWh heat and electricity from biofuel in a smaller co-generation plant. Heat was also produced in solid fuel boilers. Since then the use of biofuel has increased two-fold.

Apart from heat and electricity production, there is also production today of pellets. In 1997 yet another biofuel-fired co-generation plant was

brought into operation in Skellefteå. In conjunction with this, a pellets factory was built.

A large part of the process has been integrated in the new plant. The pellets factory contains a steam turbine that generates electricity. By integrating the steam drier and the co-generation plant the process is made more efficient and more electricity can be produced. Since the new co-generation plant was built alongside the existing heat production plant it has also been possible to make use of parts of the heating plant for the new installations.

The raw material used by the bio-combinate is waste products from sawmills and the forest industry in the district. Bearing in mind the consumption of fuels, it will also be necessary to make use of felling residues from the forest.

In addition to fulfilling the need for the increased demand for electricity, and with

its production capacity of 130 000 tonnes of pellets per year, Skellefteå has become an important supplier of biofuel to heating plants in central Sweden. Most of the production is sent by ship down to the heating plant at Hässelby near Stockholm. The more pellets the Stockholmers use, the more electricity the bio-combinate in Skellefteå can produce.

There are already plans to extend the bio-combinate. Within 10 years a factory for producing ethanol from wood raw products may be a reality. In ethanol production a residual product is lignin, which can be granulated into fuel pellets. This development is being conducted in collaboration with the National Board for Industrial and Technical Development, that has provided funding for the comprehensive investments in the present plant.

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Gas-powered buses close the biocycle

■ ■ All buses in Linköping city traffic will be converted to run on biogas by the summer of 1998. The plant in Linköping for production of biogas for vehicles is the largest of its kind in Sweden, both as regards size and capacity. Now it will be made even larger.

It started as an experiment in 1992. Five diesel buses were converted for gas operation and were supplied with fuel from a pilot plant in Linköping. During the summer of 1998 altogether 55 gas-powered buses and about 10 cars will be trafficking the streets of the city.

Biogas is produced from manure obtained from farms near Linköping, from slaughter waste from a local abattoir and from so-called risk-waste consisting of animals that have died or have been put down because of disease. The gas from the Linköping sewage works can also be used if required. The digestible material is pasteurised and the risk-waste is sterilised



A interior view of the sanitary tank for treatment of the waste before digesting it into fuel for the buses in Linköping. The bio-gas project in Linköping has become a success.

before it is digested for 25 days in an anaerobic digestion chamber. The resulting gas must then be cleaned to give vehicle gas with a methane content of 97-98 per cent. The residue from the digestion is returned to agriculture as bio-manure. The growing crop takes up the same amount of carbon dioxide that is released during combustion of the biogas and the biocycle is closed.

Apart from the fact that the waste has generated fuel, the slaughterhouse has been able to reduce the volume of polluting substances in its wastewater. In addition, farmers have got a first-class manure. Nonetheless, the foremost advantage is, naturally, the low emissions when biogas is used as a propellant. The buses are able to cover more than 400 km on one tank of biogas, which corresponds to a 24-hour shift on a normal bus route.

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KULLBERG LARSSON

Energy in Uppsala provides rural employment

■ ■ By rail from the factory to the boiler. A more environmentally friendly way of transporting briquettes from the production site in Sveg (about 300 km north-west of Uppsala) to the customer in the city of Uppsala is difficult to imagine. Most of the production at Härjedalens Mineral AB, HMAB, is destined for heating and electricity production in the co-generation plant in Uppsala. The briquettes contribute one terawatt hour (TWh) annually, which is a large part of the energy supply in Uppsala. The briquettes consist of peat and wood that have been compressed into brick-sized

blocks suitable for large-scale transportation over long distances. The direct rail link makes loading and unloading easy. No reloadings are needed and the system is very efficient. The fuel can be stored in the containers until needed. However, the door-to-door delivery by rail is only one link in this chain. The raw peat is mined from bogs in Härjedalen. The transport system has been optimised so that trucks transporting pulp chips to the pulping factories at the Baltic Coast return with waste products from sawmills within a 250 km radius - not a particularly long distance in the vast area of in-

A large part of the heat and electricity provided by the co-generation plant in Uppsala is produced using peat and wood briquettes from the province of Härjedalen.

land Norrland. Peat and shavings are delivered to the briquette factory where the raw material is processed into briquettes consisting of about one-third wood fuel and two-thirds peat. The raw material must be dried before it can be compacted into briquettes. All this provides employment for more than 300 people. In this rural area of Härjedalen, with a total population of 12 000 persons, HMAB is an important employer. The waste heat from the briquette production in turn supplies heat to the municipality of Sveg via the district heating system.

In Uppsala the briquettes are burnt in a co-generation plant and a hot-water boiler during the winter season. This provides 40 per cent of the energy required by the energy company, Uppsala Energi. The same amount is provided by waste incineration. Before being burnt, the briquettes are ground into powder, which mainly replaces coal.

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equipment. The best factor of all is the price. The customer has no fixed tariffs and only pays for energy consumed. Despite the advantageous delivery conditions, the heat will be less expensive than both oil- and electricity-heating.

Automatic fuel feed allows the boiler to run without supervision. Customers only need to scrape out the ashes about once a month and to order more pellets when required.

Convenient, environmentally considerate and inexpensive - a three-fold bonus!

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Small storage for briquettes

Briquettes from local manufacturers provide more than 99 per cent of the district heating in the Swedish municipality of Floby. Positive experiences of briquettes in the neighbouring city of Falköping resulted in Falbygårdens Energi choosing the same fuel for the smaller district-heating network at Floby. The solid fuel boiler supplies about 9 gigawatt hours (GWh) of heat annually to a nursing home, the local school, an open-air swimming pool, a factory and a number of multi-family buildings. Since the boiler has a greater capacity than the present heat demand there are also plans to extend the district heating system over a wider area.

The briquettes are obtained from nearby manufacturers and delivered to the district heating plant in self-unloading containers that are stacked at the plant and used as storages. A replacement system is used whereby the truck delivering a full container from the manufacturer returns with an empty one.

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The most modern imaginable

■ ■ Brista co-generation plant, located to the northwest of Stockholm uses felling residues from local forest owners as the main source of fuel. Brista started production in 1997 and serves the towns of Sigtuna and Upplands Väsby with electricity and heat. The plant was built to produce electricity and heat simultaneously in the proportions of 40 per cent electricity and 60 per cent heat. In 1997 Brista Kraft AB was the first Swedish company to win the European Solar Award for promotion of solar energy and renewable sources of energy.

Brista is estimated to generate more than 0.8 TWh of energy when fully built. In the future it may be complemented with an additional plant for biofuel-based technology. A plant for atmospheric gasification has been studied, but further developments depend on funding being granted. The building of the present plant received economic support

from the National Board for Industrial and Technical Development.

The latest technology for reduction of nitrous oxide emissions is used. Ammonia is injected into the hearth, and the flue gases are cleaned using a catalyst. Plans are also being made to return the ashes to the forest, but more development is needed. Access to felling residues within a radius of 100 km is necessary to cover the requirement of the co-generation plant and other plants in the district. Continued developmental work with investments in biofuel is necessary if the supplies and an acceptable price are to be guaranteed. Different projects on technological development are ongoing with various companies and organisations.

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From the field to the radiator

■ ■ The 19 farmers who joined up to form the company Farmarenergi i Hallstahammar AB all emphasise that running a biofuel plant is a good alternative to growing grain. They operate their plant in the urban district of Kolbäck, to which they also deliver fuel. The fuel comes from their own land, where 200 hectares of arable land now grow short-rotation energy plantations of Salix. The stems are chipped and burnt in a 2 megawatt boiler supplying heat to the school, the indoor swimming pool, certain public premises and a number of multi-family houses. The farmer/owners are all

resident within a radius of 15 km from Kolbäck. The shares in the company are divided in proportion to the area of Salix each farmer is contracted to grow.

Production started in the early 1990s. Initial problems have now been solved. As a result of the high moisture content of the freshly harvested Salix, the combustion temperature and resulting effect were too low. The boiler was redesigned and today the technology is working well, with an efficiency of around 91-92 per cent.

The farmers today deliver about 80 per cent of the fuel and there is only a short period

during the autumn when it is necessary to supplement their deliveries with purchased forest chips.

There are no middlemen to make transactions more expensive and economically the enterprise compares well with grain production. It is also ecological. Deliveries from the local area mean short transport distances and low emissions. The farmers also make use of sludge from the local sewage works and spread it in their Salix plantations as manure. Salix functions as a good purification filter that takes up and binds less desirable substances contained in the sludge. However, the ashes cannot be returned to the fields on account of this. Consequently, at present the biocycle has not been fully closed.

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Heat production plants owned and operated by local farmers, where the boilers burn fuel produced on their farms, can be found in about 20 different places throughout Sweden, one of which is Kolbäck.

New technology twice as effective

■ ■ No longer do we suffer smoky chimneys and complaining neighbours! Today there is equipment that works. New wood-burning boilers for single-family houses are almost twice as effective as old boilers. A modern boiler linked to an accumulator tank allows wood-burning to be environmentally considerate, reliable and convenient.

The new technology has ceramically lined hearths for high combustion temperatures and fans that provide stable operating conditions. They are simple to manage. The accumulator tank takes care of the excess energy and distributes it equally throughout the day, thus offering the same level of comfort as

with heat provided by oil or electricity, but much cheaper. A complete modern turn-key wood-burning plant costs as much as 15-16 cubic metres of villa oil, or corresponds to five or six years' oil consumption in a normal villa.

Pellets can make heating even more convenient. Most of the fuel handling is avoided and the burning equipment operates largely automatically. With an oil-burning boiler converted to a pellets-burner, the villa-owner can save 40 per cent of the oil bill, and with a pellets stove the heating costs can be halved.

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New thinning and cleaning machine

A new thinning and cleaning machine has been developed that makes these operations more profitable, or at least not so expensive. It may mean a revolution for removal of wood fuel from the forest. Wood fuel from thinnings may become an important fuel source in addition to the fuel obtained from clear-cuts.

This machine, developed by a company in Dala-Jäms, has attracted international attention. It can cut and lift out five-ten stems of small-dimension wood in one operation. Since the trees are always held vertically the harvester can work in very dense stands. Thinning and cleaning have been very expensive operations that often have been neglected, leading to silvicultural problems. The new harvester can solve this problem and efficiently supply new biofuel from a sector where interest in this form of energy has been on a low level. As a result of the energy thus obtained giving the forest-owner an income, the conditions have changed.

The device is mounted onto a small terrain vehicle that can be operated conveniently and carefully in the forest. Damage to trees and the ground surface is limited. The harvester package also includes training program for the operator in, e.g. ecology.

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