

SVEBIO

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This Is Bioenergy!

FACT SHEET: 1/98 • Bioenergy - A review

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



The Swedish forest is an important element towards a sustainable energy system.



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Energy Administration

Bioenergy

An alternative for today and tomorrow

■ ■ Developments started to move faster during the 1980s. Today, biofuel supplies almost one-fifth of the total amount of energy used in Sweden. Biofuels not only contribute more energy than the total hydroelectric generating industry but also to reductions in emissions of carbon dioxide to the atmosphere and thereby reducing a global environmental threat, the greenhouse effect. The use of biofuel may also lessen the risk of eutrophication and acidification.

Sweden is strongly import-dependent as regards energy: Three-fourths of all fuels are imported from abroad. Half of all electricity is generated with imported uranium. The imported fuels contribute to global environmental problems through their residual products. They are also

non-renewable. The oil reserves discovered today correspond only to one-fourth of the amount of oil consumed. In the long run, these fuels must be replaced with renewable energy.

If the Swedish energy system is to become sustainable we must use more bioenergy. In order to ensure that we have supplies of energy for everybody, as well as protecting jobs, the domestic sources of biofuels imply additional advantages. If, then, nuclear energy is to be closed down we must find good alternatives to the extensive use of electrical heating that has been introduced since the 1970s.

Bioenergy is not the entire solution to the realignment of the Swedish energy system but is a generous contribution to the sustainable use of energy.

The biocycle

Burning biofuels gives emissions of carbon dioxide, sulphur dioxide, nitrogen oxides and heavy metals to the atmosphere. However, the amounts emitted are not larger than what can be bound again by the regrowth. The point of using biofuel is the biocycle. No new polluting elements are introduced to the environment. Ashes from the burning process are also a resource. They serve as fertilisers and counteract acidification.

● Carbon dioxide

All organic material contains carbon. Biomass is built up with carbon from the carbon dioxide in the atmosphere. When biofuels are burnt the same carbon is released to the atmosphere as carbon dioxide. The amount of carbon dioxide remains constant. When fossil fuels are burnt the carbon released has been stored in the ground for very long periods. The carbon dioxide concentration in the atmosphere increases. Too much carbon dioxide in the atmosphere has the result that solar heat remains around the surface of the globe - it becomes warmer.

The atmosphere functions more or less like a greenhouse; this is a condition for life on earth, but if it gets too hot in the greenhouse the environment becomes threatened.

● Sulphur and nitrogen

Acidification of soil and water is another environmental threat. Nature becomes damaged when the pH is lowered. The acidification is caused by emissions of, mainly, sulphur dioxide and nitrogen oxides. This can be counteracted by using biofuels.

Biofuels contain very small amounts of sulphur and only a part of it goes to the atmosphere in the form of sulphur dioxide when burnt.

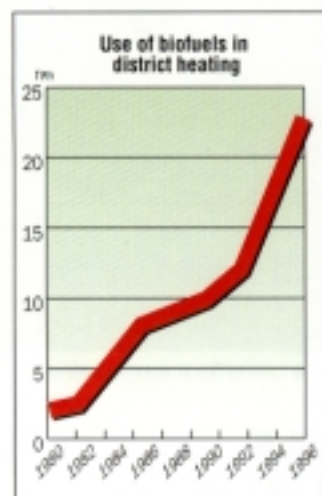
The rest remains in the ashes together with other nutrients. The difference between biofuels and fossil fuel as regards acidifying sulphur is found in the amounts emitted, and that biofuels do not increase the amounts of sulphur in the atmosphere.

A Growing Market for Bioheat and Bioelectricity

■ ■ The use of bioenergy is increasing strongly. Each year biofuels produce 3-4 TWh more energy than in the previous year, which corresponds to the heating of about 150 000 villas. Environmental aspects, availability, the low price, security in energy supply, and the jobs provided by the branch are all pointing to the advantage of bioenergy. Heating is the main market for biofuels but there are also good opportunities for production of electricity with biofuel. In the future it may also be necessary to use biofuel on a large-scale for production of bio-propellants.

HEATING

District heating. So far it has mainly been the municipal



heating plants that have discovered the advantages of bioenergy. During the past five years the use of wood fuel in the district heating sector has increased three-fold, and in 1996 43 per cent of district heating, or 23 TWh, was produced by biofuels. More than 100 municipalities are today heated by biofuels in the district heating network. In year 2010, biofuel may supply us with 40 TWh in the district heating system.

However, this requires a political decision not to introduce natural gas on a large scale. A natural gas pipeline through the forested parts of southern Sweden, where biofuels have their largest market, would imply direct competition with bioenergy, according to a prognosis prepared by the Swedish District Heating Association. With the introduction of natural gas, it is estimated that only 15 TWh of heat will be generated by biofuels.

Villas. For owners of villas it is highly profitable to convert from oil or electricity to biofuel. The costs for heating will be much lower and the investment is generally paid for in a handful of years.

Wood-firing is increasing strongly in Sweden and supplies villa-owners with 12 TWh heat at present. But the



An increasing number of district heating plants are fuelled by bioenergy. Today, biofuels are dominating the district heating systems. About 100 district heating plants utilise biofuels.

really large potential for biofuel in villas is found in converting from oil and electricity to pellets. Today, only about 8 000 villas are heated using pellets, but the actors in the market estimate that the number will increase rapidly to perhaps 20-25 TWh, including wood-firing, if natural gas is not made more widely available. A natural gas pipeline could reduce the use of bioenergy in villas by one-fourth within the distribution area, according to the assessment of the Energy Commission.

Local heating. More than half of Swedish multi-family hous-

Terminology

■ ■ BIOFUEL is defined by Swedish Standard SS 187106, ed. 3, as "fuel where biomass or peat is the starting material. The fuels may have been subjected to chemical processing or conversion and may have passed through other utilisation".

According to the same standard, biomass is "material of biological origin that has not, or only to a minor degree, been converted chemically". Bioenergy is defined as "energy from biomass or peat".

The biofuels are divided into five sub-groups:

● Wood fuel is woody raw material from the forest that has not been subjected to any chemical process.

● Agricultural fuels, or arable fuel, come from agriculture. Short-rotation energy plantations, energy grass, straw and grain for production of ethanol are some examples.

● Biofuel from wastes is produced from organic refuse. Methane from the sewage works and landfill gas are examples.

● Peat fuel is made out of peat, a biological material that is incompletely decomposed and stored in bogs.

● Black liquor is a secondary product from the pulp industry. It is formed when wood chips are boiled to produce pulp. Black liquor contains organic compounds that can be burnt, and chemicals that can be recycled.

es and public buildings are heated by district heating. Together with local heating plants for a smaller number of premises, there are still possibilities to convert 25-20 TWh from oil and electricity to biofuel, without natural gas.

PRODUCTION OF ELECTRICITY

Production of more than 40 TWh of electricity with biofuel is possible in municipal co-generation plants and in the industry, but today only 3 TWh is entering the distribution network. There are two main factors that hinder the expansion of the municipal network: firstly fossil fuels are not subjected to the carbon dioxide tax in electricity production and, secondly Sweden may sooner or later invest in natural gas.

Municipal co-generation. A more effective way to utilise fuel than conventional heat production, is co-generation.

Co-generation plants produce not only heat but also electricity.

The Swedish district heating plants could produce more than 10 TWh of electricity from biofuels in 2010, and possibly 20 TWh after another 10 years, which corresponds to about one-third of today's nuclear power generation. However, current legislation prevents biofuels from entering the electricity market; emissions of carbon dioxide from combustion of fossil fuel are not taxed when such fuels are used to generate electricity. This makes it difficult for biofuels to compete in co-generation plants.

There are also possibilities to use gasified biomass for electricity generation but there will be a delay of 10-15 years before the technology for this has become commercial. The industrial consultant company Ångpanneföreningen as-

sesses the market for natural gas-based co-generation to be 15 TWh, of which half is electricity, 7.5 TWh. That energy could just as well be produced using biofuels.

Industrial back pressure. When heat and electricity are co-generated in the industry it is called back pressure. It is only within the forest industry that biofuels have played a role in this connection, but on the other hand here there are possibilities to produce more electricity than the 2 TWh generated in 1996. New technology to gasify the pulp industry's black liquor is being developed. This could provide 10 TWh.

PROPELLANTS

Several small plants for production of propellants have been built during recent years. Further plants for biogas and ethanol are being planned.

Nitrogen is a nutrient. Too much nitrogen leads to the soil leaching nitrogen into lakes and watercourses, which become eutrophicated and finally die. The process makes the soil more acidic and leads to leaching of other nutrient substances. Vegetation suffers, the flora changes and the soils become impoverished. Nitrogen oxides are formed in all forms of combustion. In addition, other acidifying nitrogen compounds are released into the atmosphere and are sooner or later deposited. In large parts of Sweden the countryside receives more nitrogen than it can cope with. By using biofuels we relieve the environment of excessive nitrogen. By using modern cleaning technology, most of the nitrogen in the biomass can be made to leave the chimney as nitrogen gas, the atmosphere's main constituent, which is largely biologically inactive. The ashes contain no nitrogen.

● Heavy metals

Heavy metals also participate in the biocycle. Biomass contains heavy metals that the plants require. When biomass is burnt these metals will be emitted with the flue gases. The metals are taken up again by the new vegetation. Short-rotation energy plantations can function as purification factories for cadmium. Cadmium is a toxic substance that easily becomes bound to organic matter and accumulates in the nutrient chain. Energy forests take up cadmium from arable land where it has been deposited partly in fertiliser and partly through atmospheric deposition. However, the technology for removing cadmium from the ashes needs to be developed.

● Ashes

The ashes from combustion are a resource that contains all the nutrients, except nitrogen, required by nature for growth. Since they are basic, ashes also counteract the acidification that threatens our environment. It is important that ashes from fuel that is removed from nature are recycled so as to close the biocycle.

A source of energy

■ Sweden is lucky as there are good opportunities for Swedish society to be self-sufficient with most of the energy it requires. More than half of Sweden is covered by forests. During the past century the standing volume of wood has more than doubled. Our highly productive agriculture creates opportunities to grow energy crops on some of the arable land.

Today we utilise only a minor part of the natural resources that could be used to produce energy in a sustainable manner. At the same time, Parliament has decided that non-renewable sources of energy shall be gradually phased out of the Swedish energy system.

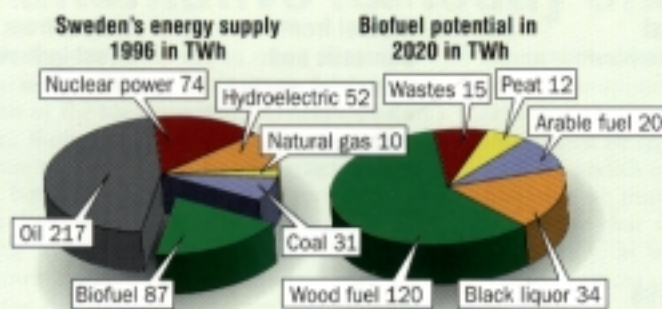
During 1996 a total of 87 TWh was produced by biofuels, of which 76 TWh came from the forest, if we include black liquor from the forest industry. It is in the forest that opportunities lie to extract considerably more energy raw material, foremost as residues from forestry.

The use of wood fuels could be increased almost three-fold up to year 2020. With 120 TWh wood fuel and 34 TWh black liquor from the forest industry's pulp processing, it would be possible for forest fuels to supply Sweden with more energy than that supplied by oil today. Altogether, biofuels could contribute more than 200 TWh by year 2020.

The actually available amounts are one thing, where-

as the assessment of what may be realistically used in 20 years time is another. Here there are a number of factors that influence the situation, e.g., price and profitability, political decisions, what happens elsewhere in the world.

SVEBIO assesses that we can use 154 TWh bioenergy in 2020. Thereby, bioenergy will be able to supply 30% of the Swedish energy requirement within a couple of decades.



Already today biofuels contribute a considerable part of Sweden's energy supply. SVEBIO estimates that in year 2020 it will be economically and ecologically possible to extract 201 TWh from biofuels.

Large gains for society

■ ■ Sweden can gain greatly by realigning the energy system towards biofuels. By far the largest part of the biofuel price is made up of costs for labour and vehicle operation that give large tax revenues. By creating new jobs, society obtains money through salary taxes and employer taxes. The costs of unemployment support will decrease simultaneously. Theoretically, society could gain almost 65 million SEK annually for each and every new TWh provided by bioenergy, or 0.065 SEK/kWh of the full price of 0.11 SEK/kWh.

TAX ON BIOFUELS

Also biofuels are taxed. The proportion of tax in the price of biofuel is negligibly lower than the corresponding proportion in, e.g., coal. As regards production of electricity, the proportion of tax for

biofuels is even higher compared with coal.

Since biofuels are work-intensive in comparison with fossil fuels, society will receive more revenues from labour taxation than from fossil fuel. On the other hand, biofuels are not liable to the environmental taxes that fossil fuels have to pay - at least when they produce heat.

Calculations made by SVEBIO show that 67 percent of the price of a MWh of heat from biofuel consists of tax. In production of electricity, the total tax is 81 percent of the production price.

THOUSANDS OF NEW JOBS

In places where we extract fuel it grows up again in a never-ending biocycle. If this is to function properly then work must be done. Biofuels create jobs - permanent jobs. New opportunities in place of

those that disappeared. There will be many employment opportunities if biofuels become used on a large scale.

Increased removal of biofuel may create new jobs in the forest in the same areas as where increasing mechanisation in silviculture has earlier led to unemployment. The raw forest material has to be processed and transported, equipment must be manufactured. Biofuels create a chain of activities that generate work.

If 300 people for each newly produced terawatt-hour of bioenergy become employed, which is assumed by researchers to be a reasonable figure, then SVEBIO's prognosis on development of the biofuel market suggests that more than 20 000 new jobs can be created within the next few decades. Manufacture of combustion equipment may provide jobs for an additional 8 000 persons.

In comparison, it may be mentioned that the forest industry employs 100 000 persons.

● Biological diversity

There is concern that the removal of biofuel will vacuum-clean the forests so that they will be impoverished of their biological content. However, this opinion has no support in science. Removal of felling residues from conifers does not affect the forest's ecology. The decisive factor is that Swedish forestry is conducted in an environmentally considerate manner so that biodiversity can be guaranteed. The handling of biofuel utilises residues from forestry and thus does not increase the pressure on the forest's natural values.

● Energy efficiency

There is a common misconception that biofuels yield a minor amount of net energy; that energy consumed in acquiring the fuel represents a large part of the energy it provides.

With a life cycle analysis of pellets conducted at Linköping University, it could be demonstrated that the energy input for production and distribution corresponds to 4 percent of the energy content. With better technology and coordination, the energy input can certainly be reduced further.

Fact Sheets on the following subjects have been published



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