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IEA BIOENERGY PROGRAMME

TASK 40

Country report Sweden 2011

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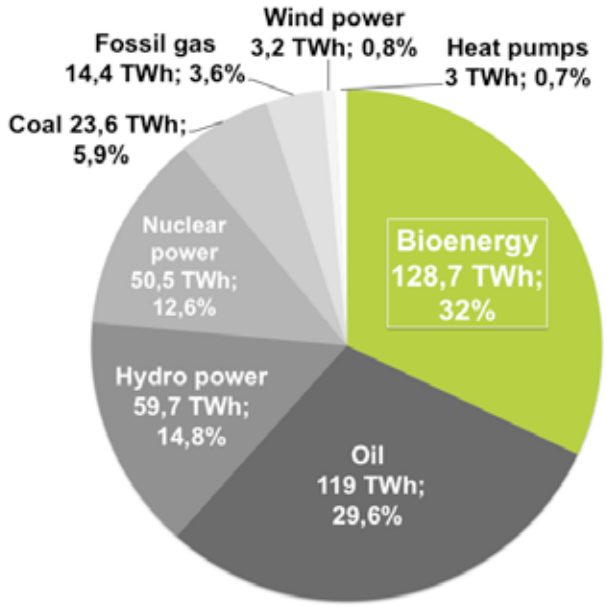
Svebio

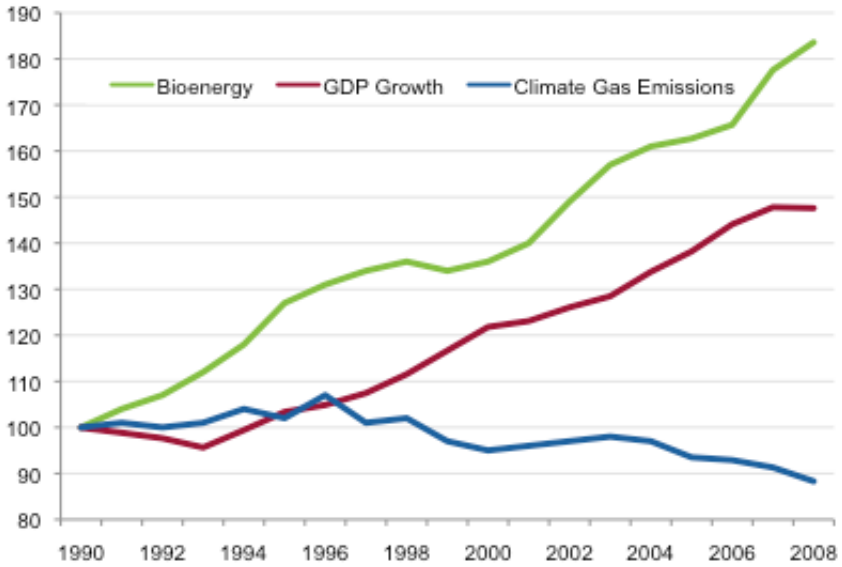
SVEBIO
Swedish Bioenergy Association

BIOENERGY IN SWEDEN IN A NUT-SHELL!



Final energy use in Sweden 2010 – industry, electricity production, heat, transport, etc. Svebio calculation based on Swedish Energy Agency forecasts. The growth of bioenergy in the last two years has been 14 TWh; a stunning achievement.

ECONOMIC GROWTH AND CARBON REDUCTION



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INTRODUCTION

The energy sector of Sweden is in a stage of transformation as a response to several new conditions. In particular, this seems to be true for the sub-sector bio-energy. Thus, a prolongation of trends for the historical data and information in the presented statistical tables and charts in this report would not necessarily be the most appropriate method to predict future development. However, the historical data can be used to determine the starting points for new development trends.

Examples of these new or changed conditions are: some years of extreme fluctuations and lately a rather stable level of the price of oil; an emerging shortage in northern Europe of saw mill residues and other traditional raw materials for utilization in the bioenergy sector, and the price volatility and structural change in the electricity market.

The strong political commitments for transformation of the Swedish energy system towards sustainability and renewables have been reinforced.Gradually the basic ideas behind these political comitments have been accepted by a growing majority of the public.

In the field of bioenergy, the focus of technical R&D has shifted from issues related to utilization of inferior surplus biomass, to comprehensive and integrated planning for rational and integrated use of all available biomass resources. It is pre-assumed that the energy sector will become a major user of biomass and that the biomass resources have to be utilized wisely. Apart from direct heating, this includes CHP (combined heat and power), and bio-refineries for combined production/generation of e.g. pulp, propellant fuels, pellets, heat and electricity.

Three major aspects are taken into consideration in the transformation of the energy sector: long term sustained security of supply, environmental sustainability, and energy cost efficiency. At present, all three aspects are included with more or less equal weight in the policy decisions for future development.

Sweden in brief

Population	9.2 million
Land area of which:	41.3 million hectares
forest	23,0
bogs and swamps	4.5
barren mountains	4.4
agriculture land	3.4
others	6,0

Supply and use of energy in Sweden 2010

Total energy supplied	**TWh**	**PJ**
Crude oil and oil products	187	673
Natural gas, gasworks gas	18	65
Coal and coke	27	97
Biomass derived fuels, peat, waste	141	508
Heat pump	6	22
Hydro power	67	241
Nuclear (incl. heat losses)	166	597
Wind power	3,5	13
Inport/export of electricity	2	7
Total	**618**	**2225**

Source: Energimyndigheten

Use of energy

Total final use per energy carrier	TWh	PJ
Industry	150	525
Transport	95	342
Dwellings, service	166	598
Total	**411**	**1479**

Losses and use for non-energy purposes		
Marine bunkers, and for non-energy purposes	51	183
Conversion and distribution losses		
(excl. nuclear power generation)	49	176
Conversion losses in nuclear power generation	130	468
Total	**230**	**827**

Total final use per sector		
Industry	150	540
Transport (domestic + forreign)	127	457
Residential, services, etc.	166	599
Total	**443**	**1595**

Policy

For a very long time, the Swedish energy policy issues have focused primarily on the pros and cons of nuclear energy. The opinions have been split from mid 1950´s and onwards, more or less in two equally strong sides, one for "high tech" (nuclear), the other for organic growth (CHP, district heating, local energy) Still to-day, when a general consensus is expressed regarding the long term goals – renewable energy – these different views are embedded in the energy policy issues.

After a long period with policy intentions to phase out nuclear power "when possible and feasible", the new policy opens up for maintaining and for a possible expansion of the nuclear program. However, it is clearly stated that no public budget means would be spent for direct support of nuclear energy, and that possible expansion should be carried out in existing sites and be based on commercial decisions. One important issue behind the shift in policy is that nuclear energy is regarded to be carbon dioxide free.

THE CURRENT ENERGY AND CLIMATE POLICY

Sweden's government, a coalition of four parties, "Alliance for Sweden", took office on 6th October 2006. In the government's Statement of Policy, the Prime Minister sets out the government's intentions for the coming mandate period. In its Budget Bill for 2007 (presented to Parliament on 16th October, 2006), the new government presents its proposals on its policy regarding Area 21, Energy:

- The government's objective is to break the historical connection between economic growth and greater use of energy and raw materials, by means of improving the efficiency of energy use.
- Sweden's environmental activities will be determined by ambitious environment and climate targets, accompanied by clear plans of action. Strong actions will be taken in the transport, residential and industry sectors.
- Environmental and energy taxation will be designed in form of incentives for individuals and companies to act responsibly in energy and environmental matters. Taxes and regulations will promote more efficient use of energy aiming at energy conservation measures in industry and in the residential sector.
- Harmonization with the EU Energy Taxation Directive will take place.

• Expansion of combined heat and power generation will be encouraged.

• Small-scale hydro power will be entitled to green electricity certificates also after 2012.

• The government will introduce special funding for development and acceleration of the planning process for new wind power installations.

• Sweden will press for clear targets within the EU for reduction in the use of fossil energy.

• Support for climate investments will be increased, particularly for biomass based motor fuels.

• The budget allocations for research will be increased. SEK 1000 million (Euro 110 million) will be invested in climate research.

Excerpts from Government Policy and Budget Bill (bill no. 2006/2007:1)

In spring 2009 the policy above was amended and complemented by i.a. the following points:

• The "load" on Sweden presented in the Energy and Climate Package of the EU was generally accepted. However, the target for renewable energy for 2020 was voluntarily raised from 49 % to 50%.

• The long term target for 2050 is zero emissions of green house gases.

• The vehicle fleet will be "independent of fossil fuels" in 2030.

POLICY MEASURES AND INCENTIVES

A number of rules and incentives have been introduced in order to achieve the objectives set out in the energy and climate policy. The overall objectives are:

- to ensure reliable supply of electricity and other energy

- to create favourable conditions for efficient use of energy and a cost-efficient supply of energy focussing on a low negative impact on health, the environment and climate, and

- to promote the transformation to an ecologically sustained society.

For several of these overall objectives, it will be important to increase the proportion of renewable energy, to improve energy efficiency, to reduce the use of energy in absolute terms and to reduce emissions. One general means of achieving energy policy objectives, and which is intended to help to meet several of the objectives, is energy taxation, in the form of energy taxes, carbon dioxide tax and sulphur tax.

Other important policy measures and incentives are the electricity certificate trading scheme, the energy efficiency improvement program, policy measures for infrastructure and transport, technology procurement, the climate investment program, and information activities. Emissions trading (ETS), and Research, Development and Demonstration (RD&D) constitute important elements of a long term development strategy.

TABLE 1: MAIN GROUPS OF POLICY MEASURES

Administrative	**Economic**	**Information**	**R&D**
Controls	Taxes	Information	Research
Limit values for Emissions	Support, grants, subsidies	Advisory services	Development
Target values for fuels and energy efficiency	Lodging of securities	Training	Demonstration
Long-term agreements	Emission trading	Opinion formation	Commercialization
Environmental classification	Certificate trading		Procurement

The original objective of energy taxes was to finance the State's public spending requirements, but in later years the emphasis has increasingly been on the need to control the production and use of energy in order

to achieve various energy and environmental policy objectives.

The present energy taxation policy aims at improving the efficiency of energy use, encouraging the use of renewable energy, creating incentives for companies to reduce their environmental impact and creating favourable conditions for generation of electricity. During the oil crises of the 1970s, the aim was to reduce the use of oil.

The environmental element of energy taxation was given greater importance at the beginning of the 1990s, and ever since Sweden joined the EU, there has been a progressive alignment of Swedish taxation with EU regulations. The earlier Mineral Oils Directive and the associated Tax Rate Directive have been complemented by new minimum taxation levels as part of the process of harmonization of taxation of fuels and electricity throughout the EU. Therefore, a new Swedish taxation model is being implemented at present, aiming at a coordinated and consistent taxation structure. The present energy taxation system is complicated.

There are different taxes on electricity and fuels, on CO_2 and sulphur emissions, and a levy system on NO_x emissions. The taxes can then vary, depending on whether the fuel is being used for industial processes, heating or as a motor fuel, whether it is being used by industry, domestic consumers or the energy conversion sector and, in the case of electricity, what it is being used for and in which price zone.

TYPES OF TAXES AND TAX RATES

'Energy tax' is an umbrella name for spot taxes on fuels and electricity. They can be roughly subdivided into fiscal taxes and environmental incentives. This latter group of taxes includes carbon dioxide and sulphur taxes. However, there is no distinct boundary between the types, as both groups have incentive effects as well as a fiscal function.

The general energy tax, which has existed for several decades, and with varying purposes, is levied on most fuels, based on various factors such as their energy contents. The carbon dioxide tax, which was introduced in 1991, is levied on the emitted carbon dioxide.

THE ELECTRICITY CERTIFICATE SYSTEM

Since the beginning of the 1990s, several different systems intended to support the production of electricity from renewable energy sources have come and sometimes gone. They have included investment grants for the production of electricity from biomass, wind power and small-scale hydro power, as well as an operational subsidy for electricity generated from wind power, known as the environmental bonus.

In 2003 a support system started for renewable electricity production, based on trading in electricity certificates for renewable electricity. The electricity certificate system is intended to reduce the production costs and support the development of new production in the long-term by creating competition between different types of renewable electricity production. Producers receive one certificate unit for each MWh of renewable electricity that they produce. Qualifying renewables are electricity from wind power, solar energy, geothermal energy, certain biofuels, wave energy and certain hydro power.

With effect from 1st April 2004, electricity produced from peat in cogeneration plants has also qualified for certificates. All electricity users, with the exception of energy intensive industries, are required to buy certificates corresponding to a certain percentage of their electricity use. In 2005, users had to buy certificates corresponding to 15.1 % of their electricity use. The proportion of certificates that users are required to buy (their quota obligation) varies from year to year:

During 2010, the price of one unit of electricity certificate varied around SEK 270 (Euro 24). The system covers only electricity produced in Sweden.

The aim of the certificate trading system is to produce a greater proportion of the country's electricity from renewable sources. In June 2006, Parliament decided on changes in the electricity certificate system. The target for renewable electricity production was raised by 17 TWh for the target year 2016 (as compared with production in 2002), and extending the life of the scheme itself to 2030.

Quota obligations have been set for this entire period, and the number of allocated certificates was adjusted for the period 2007-2010. From 2012 Sweden and Norway will form a common market for certificate trading (final decisions pending).

ENERGY EFFICIENCY IN ENERGY-INTENSIVE INDUSTRIES.

It is possible to receive tax rebate for companies which commit themselves to participation in an energy efficiency improvement program. More than 100 companies participate in the program, operating about 270 separate plants. In total, they use about 30 TWh/year of electricity in their manufacturing processes, which means that they receive a total tax reduction of about SEK 150 million (about 16 million) per year. Most of the companies are in the pulp&paper industry, the wood products industry,and in the chemical industry.

ENERGY IN BUILDINGS

Building regulations

A wide range of policy measures are used in order to reduce energy consumption in buildings. The target for the measures is that buildings must be designed and constructed to reduce overall heat losses and for efficient use of electricity.

Owners of buildings are required to provide information on the use of energy together with certain parameters of the indoor environment, in form of an energy declaration.

TRANSPORT

There are several different types of policy measures affecting the transport sector. Energy tax and carbon dioxide taxes on motor fuels are indexed annually following cost developments. The energy tax is mostly fiscal in its purpose, while the carbon dioxide tax is intended to reduce net carbon dioxide emissions from fossil fuels.

Biomass-based motor fuels are exempted from energy taxation. The intention is to encourage the introduction of new motor fuels, as well as to improve their security of supply in the longer term. Support to domestic production and increase of the security of supply are the purposes of the revised import duties on ethanol, which were introduced on 1st January 2006. The Act also states that larger petrol stations must provide renewable motor fuel.

TECHNOLOGY PROCUREMENT

Technology procurement is a policy measure intended to encourage the development of new energy-efficient technologies. Various technologies are tested and evaluated by an independent party and one or more winners are announced. The winners are given assistance with market introduction, and are guaranteed an initial order.

Technology procurement is intended to encourage the spread of new, efficient technologies in the form of new products, systems or processes. Its main application areas are in the fields of heating and control systems, domestic hot water and sanitary systems, ventilation, white goods, lighting and industry. Since 1990, 56 different technology procurement projects have been initiated and financed.

ENERGY RD&D ACTIVITIES, AND COMMERCIALIZATION

The Government Bill on Research and New Technology for a Future Energy System presents a long-term program for RD&D with the aim of developing technologies and processes for the transition to a sustainable energy system..

Current guidelines call for an overall objective to develop cost effective energy systems based on renewable energy sources, and to develop systems for more efficient use of energy. A holistic approach is important, and special efforts are made to cover the relationships between man, society, technology, economics and the environment.

Activities are structured in six theme areas:

- Energy System Studies
- Energy Use in urban Environment
- Transport
- The Energy-intensive industry
- The Power System
- Fuel based Energy Systems.

Research in the field of **energy system studies** aims at improving knowledge and competence in energy systems and international climate policy issues. The research focus on energy and climate related policy measures, the function of the energy markets, energy-related climate issues, behavioural science, as well as innovation and implementation factors etc.

The research field **energy use in the urban environment** includes the supply and distribution of heating, electricity for domestic and services systems. The work include several different technology areas, such as small scale combustion of biomass fuels, district heating and district cooling, heat pumps, solar heating and energy systems.

The **transport** theme area includes RD&D of biofuels, combustion engines and electrical drive systems. In the longer term, improvements in combustion engines and electrical drive systems should result in substantial reductions in the fuel consumption of cars and of heavy vehicles. Research into electrical drive systems is concentrated on electrical and hybrid vehicles, and on fuel cells.

The **energy-intensive industry research** area gives priority to improvements in the efficiency of energy use, particularly for energy intensive processes in the pulp and paper industry and in the steel industry. Gasification of black liquor can provide the forest products industry with a fuel for additional electricity production capacity, and may also provide a means of motor fuels production.

The **power system research** area includes hydro power, wind power, solar cells, wave power, power transmission and energy storage in the power system. Research in wind power aims at improving conditions for an increase of the country's power supply from wind, and for reducing costs. The RD&D in the field of solar cells are concentrated on thin-film solar cells and nanostructure cells, as well as on their integration, installation and use in buildings. Research in power transmission systems and energy storage in power systems is deals with the support to new technologies and means of production.

The **fuel based energy systems** research area includes RD&D on sustainable biomass fuel production and energy conversion. Research in the area is intended to reduce costs and to utilize a greater proportion of the overall production potential. Sweden is leading country in terms of production and use of solid forest based fuels, such as pellets. Heating and combined heat and power production technologies are studied in order to acquire knowledge that can be used to improve efficiency.

Particular importance is attached to the development of **larger bioenergy-related pilot plants**, covering the entire chain from research to demonstration. Among these projects are the pilot plant for ethanol production based on ligno-cellulose that is in operation in Örnsköldsvik and the pilot plants in Piteå for black liquor gasification and bio-diesel production from tall-oil.

INFORMATION ACTIVITIES

The fact that increase in knowledge and understanding will influence human behavior in given situations means that information activities occupy an important and central part among the policy measures available to get acceptance for the transformation of the energy system. Here, the local energy advisors constitute a unique network available in local districts throughout the country.

They provide the general public, small companies and organizations with impartial advice, tailored where appropriate to local conditions. These advisors are, in turn, backed up by regional energy offices that provide training and coordinate information activities.

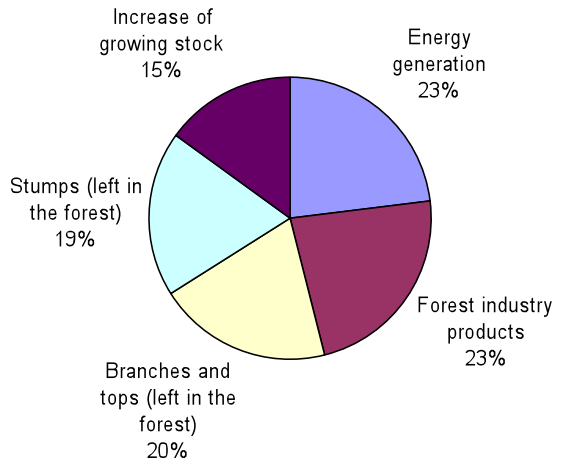
The long and persistent information programme has been successful in the meaning that visions and targets for renewable energy gradually have been accepted and favoured by a growing majority in the Swedish society.

BIOMASS RESOURCES

Biomass from forestry in Sweden

The total annual biomass production in the Swedish forests is estimated to be about 76 Modt (Megaton oven dry substance). It corresponds to about 1.36 EJ. More than half of that quantity is left in the forest site, due to market restrictions and restrictions of technical, environmental, economic, etc. reasons.

THE BIOMASS BALANCE IN SWEDISH FORESTS



Source: Swedish Board of Forestry, 2006

In 2009, the Board of Forestry gave permission for harvesting of stumps at “controlled and responsible” manners.

One example of the predictions of a “realistic potential”, e.g. after considering future restrictions, is listed below. (excluding import)

	TWh	**PJ**
Branches and tops	57	205
Trees from early thinning, etc.	13	47
Split fuel wood	9	32
Wood from non-forest land	3	11
Cull logs and breakage	6	22
SUBTOTAL	88	317
Stumps (est.)	20	72
SUBTOTAL, Forest Fuels	108	389
Woody by-products (bark, saw dust, chips)	27	97
Recycled wood from Swedish sources	4	14
Black liquor from the pulp industry	40	144
TOTAL	**179**	**644**

Source: SLU, P. Hagström. 2006, except the value for stumps, which is estimated by SCA. 2007.

BIOMASS FROM AGRICULTURE

The total annual bio-energy production potential of Swedish agriculture is estimated by the Commission on Bioenergy from Agriculture (SOU 2007:36) to be as follows:

	TWh	**PJ**
Set-aside land	5 -10	18 -36
Land presently used for exported grain	4.5-7.5	16 – 27
Land used for surplus fodder production	5-7.5	18 – 27
Increased production efficiency	4 -14	14 – 50
Total	**19 – 39**	**66 – 140**

It should be noted, that the total potential estimate is based on generic policies regarding the Swedish self-sufficiency for basic food.

CURRENT USE OF BIOMASS FOR ENERGY IN SWEDEN

Consumption of biomass fuels in Sweden 2009, including peat. *(Note! Some double accounting occurs.)*

Industry	**TWh**	**EJ**
• pulp industry, black liquor	36.7	132,1
• pulp&paper industry, other by-products	9,5	34.2
• saw mills, by-products	4.0	14.4
• other industries	0.7	3.62.5
• for electricity generation, all industries	6,5	23.4
Total industry	**57.4**	**207**
District heating		
• recovered biomass fuels	11,3	40,7
• wood fuels	27.7	99.7
• tall oil	0.8	2,8
• peat	2.5	9,0
• others	-	-
• for electricity generation	7,9	28,4
Total, district heating	**50,2**	**180.7**
Pellets		
• small scale users	3.3	11.8
• large scale users	5.9	21.2
Total pellets	**9,2**	**33,1**
Split firewood	9.0	32
Other	1.0	3
Propellant fuels		
• ethanol	2.12	7.63
• FAME	1.22	4.39
• biogas	0.28	1.01

Sources: STEM, SVEBIO

LARGE SCALE USERS OF BIOMASS FUELS

Current users of biomass fuels

CHP (Combined heat and power)

In district heating utilities	44 units
Industry sector (back-pressure)	app. 30 units
District heating distribution networks	264 units

Planned investments for CHP and back-pressure power generation based on biomass in the period 2012-2016 in utilities and industry.

Total investment amount: SEK 33.4 billion (Euro 3.7 billion)

New planned additional electricity generation from biomass up to 2016

- industry (mainly forest industries)	1.5 TWh
- utilities	1.4 TWh
Total	**2.9 TWh per year**

Source: SVEBIO 2011

Prices of biomass based fuels

Published statistics on fuel prices exist for wood fuels. It is based on information from about 200 district heating utilities and about 20 industries. The statistics reflects the costs at the mill site for the various wood fuels per three month periods. The validity of the statistical data is often criticised by the users as it registers the cost irrespective of spot deals or long term contracts.

Wood fuels, SEK/MWh, excluding VAT, at plant site.

	2007	2008	2009	2010	2011 Sept
Forest chips ("grot")					
- to industry (external)	128	146	176	200	205
- to utilities	158	167	181	197	218
Bark, saw dust, etc.					
- to industry	153	160	172	179	187
- to utilities	134	157	170	179	178
Recovered wood ("RT")					
- to utilities	64	69	78	107	119
Pellets, etc.					
- to utilities	244	271	298	300	316

Wood fuels, Euro/GJ, excluding VAT, at plant site. (Conversion 1Euro=9 SEK)

	2007	2008	2009	2010	2011 Sept
Forest chips ("grot")					
- to industry	3.95	4.51	5.43	6.17	6.33
- to utilities	4,88	5.15	5,59	6.08	6,73
Bark, saw dust, etc.					
- to industry	4.72	4.94	5.31	5.53	5.77
- to utilities	4.14	4.85	5.25	5.53	5.49
Recovered wood ("RT")					
- to utilities	1.98	2.13	2.41	3.30	3.67
Pellets, etc.					
- to utilities	7.53	8.36	9.20	9.26	9.75

Source: Energimyndigheten

Official price data for other biofuels are not available.

A pellet price index is available from PIR (The Pellet Producers Association). The index covers deliveries within Sweden.

Price index för 3 ton bulk delivery to households, etc.

År	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sept	Okt	Nov	Dec
2006								100,0	102,6	105,6	106,8	107,6
2007	109,0	109,0	109,0	108,6	108,6	108,4	108,4	108,9	108,9	109,2	109,2	109,3
2008	108,4	105,9	108,6	108,6	107,8	107,9	108,8	108,9	108,6	108,4	112,0	113,9
2009	117,3	118,2	120,4	120,7	121,1	121,8	121,3	121,9	124,8	126,2	126,7	127,0
2010	126,4	126,0	126,5	126,6	126,7	126,7	126,5	126,4	125,3	126,8	126,4	126,6
2011	125,5	125,5	123,3	124,8	124,1	120,6	121,4	119,0	119,9	120,9		

COMPETITION FOR BIOMASS

In the season 2010/2011 the energy sector could successfully compete against the pulp&paper industry for woody biomass from certain forestry operations, e.g. first thinning, road side cleaning, and "long tops" especially in areas far away from pulp mills. This situation has developed in spite of the economic recovery of the pulp&paper industry and higher prices of pulp wood. However, some representatives of that industry have publicly declared that it will not be possible to further increase prices for low quality pulp wood to match the fuel prices, as the industry also feels a strong international competition for bulk pulp from industries located in areas with abundant cheap wood from high yielding plantations. In 2011 the international economic crisis forced the pulp&paper industries to reduce both production and prices of raw material. However, as the traditional forest industry company to a great extent control the harvesting, institutions and organization of the wood supply flow it will probably take a long time until the demand from the energy sector will become a real general threat for the wood supply of the pulp&paper industry. Moreover, with the growing interest of engaging themselves in biorefinery projects, some major forest companies have started planning for internalizing the allocation of their forest raw material to energy and other uses.

The domestic pellet producers face a strong competition for the traditional raw material, e.i. saw mill residues. One newly established pellet production unit recently closed down its operations as the adjacent saw mill terminated production. Other pellet mills base their raw material supply more and more on round wood.

INTERNATIONAL TRADE IN BIOENERGY

Background and brief history

International trade within the bio-energy sector started early in Sweden. Several factors coincided to develop strong drivers for that development of international trade, i.e. public policies, the structural pattern of the end users, and the traditions and contact patterns of the Swedish industry with regard to international trade.

Most cities in Sweden had district heating systems originally based primarily on combustion of imported oil. When the policy measures led to change to solid renewable fuels that structure was also suitable for import of these fuels.

Major companies in Sweden related to the bio-energy sector were and are working in international markets. That is true for enterprises e.g. in the forest industry and in the combustion technology. Therefore, sourcing of raw material, shipping and international trade were already parts of their established businesses, and consequently it was relatively easy in the emerging bio-energy trade to mobilize competence to carry out economic analyses and to go on with practical handling.

In a comparably small scale the import of bio-energy took place in the period 1975-1990. It was mainly cheap fuels in form of waste from the food industries, e.g. olive kernels and other similar fuels which could compete with coal in a direct price comparison.

After 1990 the import grew due to introduction of stronger incentive measures in favour of biomass fuels and to the development of new sources: (1) the opening of direct access to cheap biomass in the Baltic states, and (2) the stricter rules for wood waste handling and combustion in Germany and Holland which led to a flow of very cheap fuel from recovered wood ("RT-chips") to those existing plants in Sweden which already had feasible combustion technology for those fuels.

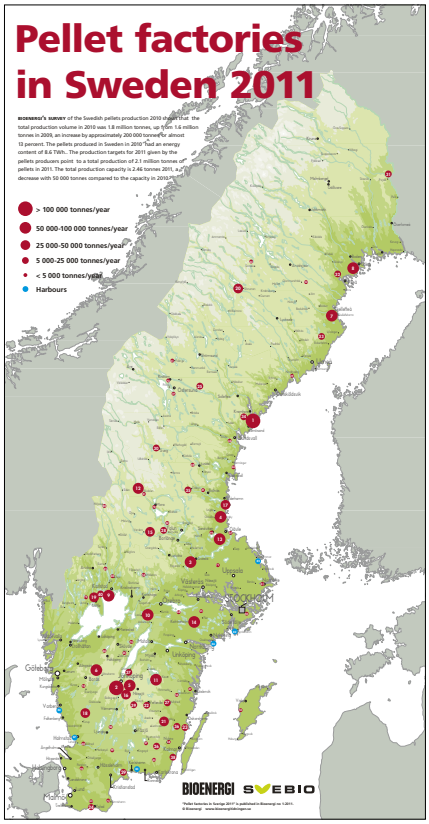
BIOMASS FLOWS AT PRESENT

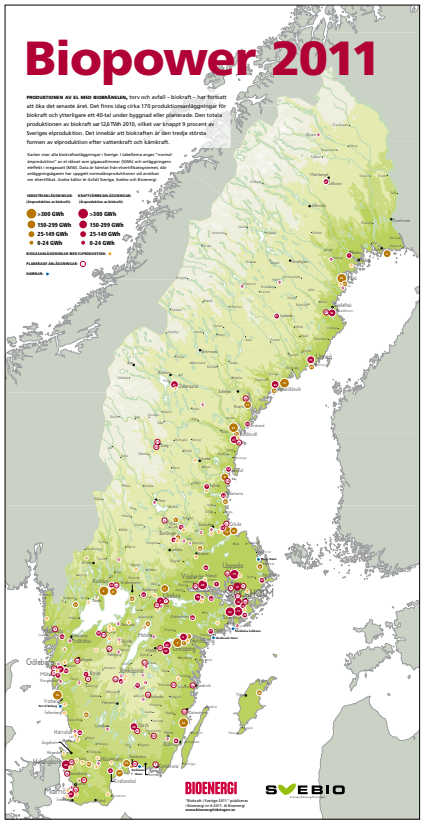
The user pattern differs with the various biomass products. Imported fuel such as chips, bark, saw dust, and fuel chips from imported round-wood are utilized primarily in large and medium sized district heating utilities The typical importing utility plants are located at or near suitable ports. The same pattern is true for industrial users. The map below shows the general city pattern, which corresponds to locations of utility plants and industry plants. Thus most plants are located at sites with suitable logistics for import of biomass fuels.

With the introduction of electricity certificates and tradable emission rights, the process industries, in particular the forest industries increased their use of biomass fuels and several industries also increased their use of imported wood fuels.

In free and open competition with domestic biomass fuels, imported wood, pellets and briquettes are also used in district heating utilities. In an increasing rate these types of imported fuels, in particular wood pellets, are also used in small and medium scale burners in individual households, small energy heating units, schools etc.. In these cases fuels are imported by middle men or distributors.

Propellant fuels, e.g. ethanol are used by the main oil companies either as low mix (5%) in petrol or as 85% ethanol fuel (E 85).





QUANTITIES AND TYPES OF BIOMASS

The official statistics is a poor source of information for biomass import. Biomass is imported under different definitions and it is often mixed with other categories of products. This is especially true for wood in unrefined forms.

Round wood in form of pulp wood and saw logs is normally imported in un-debarked form, and as the bark is used for energy purposes it could be classified as "imported biomass". The same could be the case for saw dust and other residues from imported logs.

Moreover, a portion of the round wood import consists of energy wood for direct use (after comminution) for energy generation. However, the import statistics does not separate round wood directly used for fuel.

A rough estimate of the bio-energy portion of that import can be carried out based on the total import of wood.

Total import of wood (Board of Forestry)

	2009	2010
Round wood, million m^3 solid under bark	7.4	6.3
of which coniferous	48 %	49 %
broad leaved	52 %	51 %
and		
saw logs	12 %	9%
pulp wood	88 %	91 %
Chips, million m^3 solid,	1.6	1.6
of which coniferous	83 %	84 %

broad leaved	17 %	16 %
Wood residues million m³ solid	0,65	0.8

Total export of wood (Board of Forestry)		
	2009	**2010**
Round wood million m3 solid under bark	1.3	1.3
of which coniferous	99 %	99 %
broad leaved	1 %	1 %
and		
saw logs	57 %	46%
pulp wood	33 %	45 %
other	10 %	9%
Chips, million m³ solid,	0.6	0.3
of which coniferous	100 %	91 %
broad leaved	0 %	9 %
Wood residues, million m³ solid	0,1	0,04

The bioenergy portion of the wood trade can roughly be assumed as follows: “Direct” refers to the portion that directly is used for fuel, “indirect” to secondary fuels like bark, saw dust, black liquor, etc. from the portion that is used in industrial processes. (2010)

Import		
	Direct	**Indirect**
Round wood	7 PJ	18 PJ
Chips	1 PJ (est.)	2 PJ
Wood residues	5.8 PJ	-
Total	**214PJ**	**20 PJ**

Export		
	Direct	**Indirect**
Round wood	3 PJ	3 PJ
Chips	0.9 PJ	
Wood residues	est. 0.3 PJ	-
Total	**0.3 PJ**	**4 PJ**

The production and trade of pellets are recorded by the Swedish Pellet Association (PIR).Published values, not adjusted for estimated activities for non-members (about 10 % of production), are for 2009 and 2010 :

	2009		2010	
	K ton	PJ	K ton	PJ
Import	430	7.4	695	12.0
Export	88	1.5	64	1,1

The official import statistics for propellant biofuel is not in conformity with the data presented by other sources, e.g. oil companies and vehicle companies. According to the latter, import of liquid biofuels, mainly ethanol was about 240 000 m3 in 2010. The major portion was imported from Brazil, either directly or via transfer trade..

Other liquid biofuels, such as tall-oil and Fame were imported in 2010 to an estimated amount of about 7 PJ.

ORIGIN

The main part of the imported round wood and the chips in 2010 had its origin in the Baltic states and in Russia. To a large extent it was integrated in the harvesting and in the flow of wood to the Swedish forest industries.

Some years ago, wood residues, especially recovered wood fuels (RT) came from Germany and Holland. In later years, the major part of the flow of residues to Sweden emanates from UK and the Baltic states.

In 2010, pellets were imported mainly from neighbouring countries; Russia, Estonia and Latvia, Finland and Germany. Previously, the main single supplying country has been Canada.

Origin	**Kton (2010)**
Latvia	88
Russia	88
Estonia	88
Finland	60
Germany	60
Others	16
Total	445

Source: Swedish Board of Forestry

For 2008, pellet import is reported to come from the following countries, listed after import quantities: Latvia, Russia, Finland, Estonia, Canada, Poland, and Portugal. Thus, Canada has lost her leading position since 2006. The Latvian top position can be explained by the fact that a substantial share of the Latvian pellet industry is owned and managed by Swedish companies.

Propellant biofuels, mainly ethanol have their origins in Brazil and in southern Europe. The ethanol from southern Europe is based on the wine industry while the Brazilian supply emanates from the sugar industry.

TRADE STRUCTURE

The trade is organized and carried out in a variety of forms and patterns. There are several examples of long term contracts. Seasonal contracts are also common and so are spot contracts.

As mentioned above, some of the trade in round wood, chips and wood residues is captive, meaning that the entire chain is controlled by the end user or the national distributor. But other portions of the trade are performed in form of fob or CIF contracts, etc. either directly between producer and end user or involving one or several agents or other middle men.

Two different trends of emerging patterns could be noticed, namely (1) that the major users of imported biomass fuels tend to prefer buying biomass fuels in the same manner as they buy other types of fuel i.e. from established trade channels and based on well defined quality norms and classifications and (2) major producers and large end users sign contracts for biomass fuels that are suitable for the specific requirements of that particular end user. When the resource base for raw material widens due to increased general demand of biomass fuels, this trend would be further explored.

Drivers and barriers for and against trade

A number of drivers have created favourable conditions for trade of biomass for energy i.e.

- Differences in policy incentives between countries
- Cost structures
- Drivers from a procurement perspective

Policy incentives have until recently been more favourable in Sweden then in most exporting countries (in the Swedish case, trade has up until now been dominated by import) making it attractive to move biomass from none or low bioenergy incentive countries to Sweden with high incentives.

These positive policy incentives have been paired with a favourable cost level in the Baltic countries as well as in Russia. This and changed regulation in Holland and Germany has turned the focus of biomass sourcing toward east.

However, in the last year several of these conditions have changed. Supply of biomass raw material has tightened in the Baltic states, Finland and Poland, and the prices have increased to levels over and above the prices in the Swedish domestic market. The Russian export levies on round wood have been implemented although the final increase is not yet implemented. These factors have obviously directly and indirectly reduced the biomass fuel import to Sweden, but there are still no published statistical data available to illustrate the quantity and structure of that change.

From a procurement perspective there are severalfactors that are positive with import:

COMPETITIVE FUEL COSTS

Risk distribution

NEGOTIATION POWER

The third point has been an important (but not transparent) factor for biomass import. Many forest industry companies and the major utilities are interested in keeping the prices of biomass as low as possible in the Swedish market. The forest industries want to safeguard their supply of cheap pulp-wood; the utilities want cheap biomass for fuel. Thus, import from other independent market has been a rational choice, even in cases when prices are higher for imported biomass. However, the turbulence regarding supply, prices and currencies, that has been experienced recently, has made most of the strategy logics above redundant.

BARRIERS AND OBSTACLES

In the Swedish perspective three main types of barriers related to bioenergy trade are identified:

- Technical barriers
- Transport, mainly shipping barriers
- Quotas

Technical barriers have their roots in difficulties to describe and measure quality and energy content in adequate and efficient ways. As uses and applications for biomass fuels has widened and become more diversified more technical issues have been included, e.g. regarding contamination, durability, storability, and health risks. One specific issue is the measures applied in the biomass trade. In forestry and agriculture it is part of the professional skill to be able to handle a range of various measures, developed for different purposes. However, these measures have proven to be confusing, when applied in the energy sector. A need to simplify and to increase the transparency of the measure systems is apparent. “Energy content” and/or “dry

substance base" (Am. odt) seem to be the solution for the future.

There are a number of cost driving aspects of **shipping** biomass for energy. The harbour facilities are often not equipped in fashions that enable cost efficient handling and storage of the products. In addition to that, there are only few units of the shipping fleet, which are specially designed for efficient shipping of biomass for energy. These problems are less severe for liquid biofuels as existing technology for oil, etc. can be used.

Bioenergy trade is generally carried out within unrestricted and free trade principles. One exception from that policy is the import of fuel ethanol to Sweden which for a long time was regulated in form of **quotas**, which of course limited the possible import volumes. At present the rules regarding import of fuel ethanol are subject to intensive political discussions. On the policy level Sweden's position is trade liberal. One example of that is the bilateral ethanol agreement with Brazil. However, the need to follow EU rules, and the existence of strong internal pressure groups, who argue for protection of internal production, may lead to modifications of the general policy. The difference between the parts could be explained by the notion that ethanol traditionally is regarded to be an agricultural product and consequently should fall under the Common Agriculture Programme (CAP)

However, the Swedish long term policy is to establish free trade within the entire energy sector, including propellant fuels. At several occasions representatives of the Alliance Government have taken initiatives e.g. within the EU to get support for that policy.

Trends and development

Four major trade trends are identified, namely:

1. From local to regional and now more international
2. From demand in Sweden to demand in other parts of Europe
3. Increasing quality concern
4. "Free" competition for biomass

FROM LOCAL TO REGIONAL AND NOW MORE INTERNATIONAL

The bioenergy sector in Sweden started as local demand/supply in the late 1970-ies and 1980-ies. In the 1990-ies energy utilities started regional markets for biomass e.g. by shipping biomass from surplus areas in northern Sweden to plants in the major cities. That trade developed soon to import of cheap recycled demolished wood from Holland and Germany and thereafter to import of wood chips from the Baltic states. Now steps are taken to an international market in which prices of biomass for energy are set in competition with products from sources far away, e.g. from south of Europe as well as from North and South America.

FROM DEMAND IN SWEDEN TO DEMAND IN OTHER PARTS OF EUROPE

Some years ago Sweden was pretty much alone when it came to demand for imported biomass for energy. This created a favourable situation with low prices and reliable sourcing. Now, as the demand in other parts of Europe are emerging and the cost structure in the east Baltic region is rising, the low cost arguments for imports are diminishing. The imported biomass is often more expensive than domestic biomass.

INCREASING QUALITY CONCERN

The process of increased use of bioenergy in various applications and a simultaneous process of widening the resource base to other types of biomass have led to focussing on quality issues. This is generally appearing in all applications of biomass fuels but varying with different combustion technologies, size, requirements for accessibility, etc..

For example, the number of user of wood pellets for small scale domestic heat generation is increasing rather fast. In the early stages of that application most users were enthusiasts and hence prepared to handle minor disturbances themselves, and to identify an adequate pellet quality to suit their equipment. However, now new users are expecting to get similar technical performance from their pellet burning equipment than from oil or electricity heaters. They also want cheap fuels, which sometimes mean that their chosen pellets are unsuitable for their application. Similar examples are abundant for chips and demolition wood.

For ethanol, however, the quality norms have been very strict already from the start of the import for fuel applications. In the introduction of new fuel and in the further development of existing bio-energy systems, quality aspects nowadays form an integral part of the work.

"FREE" COMPETITION FOR BIOMASS

For many years the forest industry companies have applied a strategy aiming at protecting their pulp wood supply from competition from the energy sector. This was done in various ways: by lobbying, by using their harvesting and acquisition organizations, by development of supply technology and organization for harvesting of non-industrial biomass ("grot", branches and tops) and by PR-activities towards forest owners and the public.

In recent years, led by independent forest companies like Sveaskog and Skogssällskapet, but also some forest contractors, technologies and organizations to harvest forest biomass solely for fuel have been developed, disregarding the fact that some of that biomass comprise traditional "pulp-wood".

In spite of the fact that these methods in certain applications have proven to produce cheaper wood-fuels with higher quality, the methods have not been generally applied, notwithstanding the rapid increase in demand for forest fuels. Most pulp&paper companies now seem to accept that the "fibre surplus" in the Swedish forests would be utilized by the energy sector rather than being a potential base for expansion of the pulp&paper industry.

Contributing factors for the change in thinking is of course the new predictions of lower future demand for virgin long fibre wood pulp, and the fact that pulp&paper companies make good profit from their internal "green energy" generation. Thus, even if the forest resource market also in future will be oligopolistic it will become more competitive and liberal. It will increase opportunities for biomass trade, especially from south Sweden to Western Europe.

General policy towards biomass trade

In Sweden, the policy towards import and export of biomass for energy is trade liberal. There are very little of quotas and other limitations to imports. In addition to a trade liberal policy the general energy policy is very much pro-bioenergy. This has enhanced the competitiveness of biomass for energy compared to competing fossil energy sources and other energy generation technologies. Especially the CO2 taxation has had a decisive impact.

Pro-trade and pro-bioenergy policies have created the needed framework for trade of fuel from biomass. So far the flows have predominantly been inwards but with increasing demand in the rest of Europe and higher costs emerging in the eastern Baltic region and Russia, drivers might be on the edge to shift the direction of the trade.

Key issues for further development

Four key elements are identified that need to be in place in order to facilitate an increasing international trade of biomass for energy, namely:

1. Increased demand for bioenergy
2. Liberal trade policy
3. Efficient logistic systems
4. Prevent powerful actors, potential losers, to block or disturb a viable development.

REFERENCES AND SOURCES

For further and more detailed data on Swedish Bio-energy, see the following home pages:

www.energimyndigheten.se	The Energy Administration
www.svo.se	The Forestry Administration
www.svenskfjarrvarme.se	The Swedish District Heating Association
www.svebio.se	The Swedish Bioenergy Association