Final report

Nordic Energy Perspectives

Wood markets and the situation of the Forest industry in the Nordic countries

March, 2009

Nordic Energy Perspectives

Preface

Nordic Energy Perspectives (NEP) is an interdisciplinary Nordic energy research project with the overall goal of demonstrating means for stronger and sustainable growth and development in the Nordic countries.

NEP analyses the national and international political goals, directives, and policy instruments within the energy area, as well as their influence on the Nordic energy markets and energy systems and the infrastructures and institutional structures. NEP aims at clarifying to decision-makers the consequences of political and strategic decisions for politicians, energy actors and the public. The project is to promote a constructive dialogue among researchers, politicians, authorities and actors on the energy markets.

For further information about the project, please visit: *www.nordicenergyperspectives.org*.

This series of reports are the second reporting from the second phase of the project. The following intermediate and final reports are now presented:

Synthesis report, March 2009:

- Second NEP2 synthesis report *(Responsible: Peter Fritz, Håkan Sköldberg, Bo Rydén)*

Final reports, March 2009:

- Widened view of energy efficiency *(Responsible: Bo Rydén)*
- Technology options for a low CO_2 energy system *(Responsible: Tiina Koljonen)*
- Wood markets and the situation of the forest industry in the Nordic countries *(Responsible: Per Erik Springfeldt)*

Intermediate reports, March 2009:

- Reference and policy scenarios *(Responsible: The NEP model group)*
- Global scenarios *(Responsible: Janne Niemi)*
- Biomass market and potentials *(Responsible: Tiina Koljonen)*
- Nordic perspectives on the EU goals relating to CO_2, renewable energy and energy efficiency *(Responsible: Thomas Unger, Bo Rydén)*
- Prominent strategies for environmental sustainability in the stationary energy sector *(Responsible: Anders Sandoff)*
- The future of the Nordic district heating *(Responsible: Monica Havskjold, Håkan Sköldberg)*
- Trade within the RES directive and related power interconnection issues *(Responsible: Berit Tennbakk)*
- Natural gas in the Nordic countries *(Responsible: Peter Fritz)*

Our intention in NEP is to present all reports in English. Due to lack of time, some of the texts in some of the reports are at this stage still in Scandinavian languages. We apologize for this. These texts will as soon as possible be translated into English. The translated texts/reports will be available on the project's web site, *www.nordicenergyperspectives.org*, soon after the Oslo conference.

Oslo, March 2009
The NEP Research Group

Content

Summary

This paper analyses the competitive situation of the forest industry in the Nordic region.

In this paper, quotes by various industry representatives will be shown inside rectangular boxes. The quotes are either by representatives from the Nordic (Finland, Norway and Sweden) forest industry, or by professor Azar from Chalmers University in Gothenburg, Sweden.

Conditions for the Nordic forest industries have deteriorated in recent years. The prices of products sold by the industry have fallen, while prices of raw materials, such as round wood, have increased (at least before the onset of the current financial crisis, which is the time perspective in this paper). Raw material prices have increased mostly as a result of increased demand for bioenergy. This is especially true in Sweden where the use of bioenergy has grown rapidly in recent years. Demand for bioenergy will probably increase in all Nordic countries in the near future due to new ambitious EU targets for the use of renewable energy and biofuels. By the year 2020, the EU commission wants renewable energy to account for 20% of the energy used in the EU, and biofuels to account for 10 % of energy consumption in the transportation sector.

Raw material prices could increase even further if Russian plans for export tariffs on wood are put into place. Russia has threatened to increase tariffs to 50 EUR per m3 round wood by 2009, which is above historical prices for Russian wood. Increased Russian export tariffs would mainly affect Finland, where approximately 20 % of total wood consumption is accounted for by imports from Russia. Increased export tariffs would lead to higher wood prices in Finland, but there would be knock-on effects in Norway and Sweden as well.

In recent years energy prices and prices of some metals have experienced a so called Chinese effect, where high demand from China has driven up prices. So far there has been no Chinese effect on the prices of products made by the forest industry. Chinese demand for paper products has been growing by about 10 % per year and accounts for more than half of the world wide increase in demand. At the same time however, China has invested in new state-of-the-art paper plants, and now is a net exporter of paper. Today China is the second largest paper producer in the world, following the USA, and by 2015 China will be the largest paper producer in the world. China is highly dependent on imports of fibres (pulp, waste paper and wood) to have enough pulp for its paper production. If Chinese demand for these raw materials were to outstrip supply, there would still be a Chinese effect on paper prices, as increased raw material prices would push up Chinese paper production costs. Coupled with increased use of bioenergy, and tougher climate policies that might restrict bioenergy supplies, this could lead to significant increases in the prices of forest products.

We could also get a situation with higher prices of pulp and wood, but not paper, if for example China continues to be a net exporter of paper. This could reduce the competitiveness of Nordic paper and pulp industry.

Chinese dependence on fibre imports will likely decline as China is investing in its own eucalyptus plantations. However, experiences from countries such as Brazil, suggests that it will take a long time before significant volumes can be harvested from the Chinese eucalyptus plantations. Brazilian plantations date back to the 1970s, and it is only recently that Brazil has become a major player in the world wood and pulp markets

Since pulp and timber from sawmills take up less than half the volume of round wood, and since shipping costs are highly dependent on volume, it is more economical for countries such as Brazil to export pulp and timber rather than wood. Brazilian production of pulp has also increased significantly in recent years. Indonesia is another example of a nation with growing pulp production. Pulp production and other industrial activities in Indonesia and Brazil are major sources of global deforestation and account for approximately 25 % of global CO2-emissions.

The supply of fast growing biomass, such as eucalyptus, may be restricted by future climate and environmental policies, and significant restrictions will result in higher biomass prices. In the last ten years wood prices in different parts of the world have been fairly strongly correlated, indicating that there is a global market for wood, at least for round wood. When transport costs are taken into account, wood prices are lower in exporting nations such as Brazil and Chile, than in importing nations. In 2004, these two countries were the countries with the lowest production costs by far. Since 2004, wood prices in Brazil have increased, and this is probably the beginning of a process where production conditions in Brazil become more similar to the conditions in other countries. Still, most of the growth in pulp and paper production is today occurring in countries such as Brazil, Indonesia, and China. In the traditional paper and pulp production countries, production is either increasing very slowly (less than 1 % per year), or stagnating. It would be fair to say that competition from low-cost countries has increased.

The EU has one third of the world production of paper and paper board (110 M tonnes compared with 80 M tonnes in US). Production in the EU is burdened with costs related to CO2 emissions trading from the EU ETS program, while non-EU production is not.

The EU ETS increases energy costs for European Industry and acts as a powerful incentive for increased energy efficiency and increased use of renewable energy.

In modern pulp and paper plants, costs of wood, energy and capital are the significant costs, while labour costs are less than the costs of fibre. Labour costs are more important in waste paper treatment plants and thus China, with low labour costs, is the by far biggest importer of waste paper in the world.

Forest companies always try to cut costs, including labour costs.

An increased demand for bioenergy in the world could probably be met by a corresponding increase in the supply of biomass, but estimates on how much supply could be increased differ and are uncertain. IEA estimates that biofuel supplies could be increased to 200-400 EJ

at a cost of at least 7 EUR/MWh. Bioenergy production of 400 EJ requires the equivalent of 20% of the area that is presently used for agro production in the world. Other estimations are lower. For example VTT's Global Times estimates that biomass supply could be increased to 200-205 EJ. As a comparison, current global fossil fuel consumption is 390 EJ, and the sum of hydro and nuclear production is about 55 EJ. This gives a notion of the challenges, but also of the possibilities of an increased global supply of bio energy. The level of production that can be achieved depends on many important factors such as the amount of land that can be dedicated to energy production, the availability of water, the use of fertilizers and biocides and competition with food production for an increasing world population. In the long term the impacts of climate change should also be considered.

In an interview to Dagens Nyheter on November 18, 2008 Christian Azar, Professor of Sustainable Industrial Metabolism at Chalmers University of Technology in Gothenburg, said: If corn and wheat production expand in the western world, it will happen at the expense of other crops. These other crops will have to be cultivated somewhere else. Cornfields have replaced soybeans in the United States, which has lead to increased soybean production in Brazil, which in turn has driven farmers to clear rainforest to grow soybeans. In Europe, biodiesel fuels are produced from colza oil. Increased production of biofuels has resulted in increased imports of palm oil, which is contributing to the destruction of Southeast Asia's forests. It is the cumulative demand for crops, for feeding both humans and animals and for use as energy, which will determine the rate of deforestation.

All quotations belonging to Christian Azar are from the November 18, 2008 issue of the Dagens Nyheter magazine "Motor Miliö".

In a scenario with low international prices for biomass, the Nordic countries would be net importers of wood, and would have a comparative disadvantage relative to nations with big forest resources. Russia and Brazil have growing stocks of about 80 Gm3 each, compared with 430 Gm3 globally. However, large infrastructure investments would be required before those recourses could be utilized.

Forests absorb carbon dioxide from the atmosphere and product manufacturing does not release any carbon dioxide into the atmosphere. Therefore manufactured products should be recycled as many times as possible and finally burnt, perhaps using CCS. If this is not done, there will be increased levels of greenhouse gas emissions since decomposition releases both carbon dioxide and methane.

In a scenario with high international prices for biomass, the Nordic countries could be exporters of wood or wood products, and could thus have a comparative advantage in the world market. High prices might result from high demand for bioenergy, a large increase in demand for paper in China and other developing countries, future problems in developing new bioenergy technologies, and climate policy related restrictions in the supply of wood (for example eucalyptus which grows at least ten times faster than Nordic spruce and pine trees). This scenario would be the most beneficial for the Nordic forest industry. However, the net effect on the Nordic forest industry could still be negative, due to fierce competition from big forest nations such as Brazil and Russia.

European imports of paper from both the US and China have increased in recent years.

that the potential for the Nordic forest nations to export bioenergy is unlimited. The 10% share of biofuels in the EU transport sector in the year 2020 represents a huge market. After 2020 the EU may very well move towards an even more ambitious policy for the transport sector. The potential in the EU power sector is also very big. This could affect the wood market, especially if the second generation bio fuels from wood become commercialised.

A wood demand curve has been constructed for the Swedish forest industry. This curve indicates that most domestic buyers cannot afford the wood price increases that have occurred over the last few years. Saw and pulp mills cannot pay today's prices. However, adjustments will occur after one or a few mills have closed down:

1. Supply of wood might be partially reallocated to the energy sector. Wood price will settle at lower levels that the remaining mills can afford. The volumes needed by the energy sector are rather limited due to limited growth of energy demand in Sweden.
2. Supply of wood will be reallocated to export. This foreign demand is unlimited, especially if bio energy becomes an important component in future climate policies. In this scenario the Nordic forest industry will have a comparative advantage vis-à-vis importing nations, and the remaining mills will survive.

So, in practice, high raw material costs will most likely only lead to the closure of a few mills. If difficult conditions persist, such a gradual decline may continue.

This paper considers all these circumstances, but does not take into account the volatility of the US dollar, the idea being that the former circumstances are structural whereas the variation of the US dollar is not. However, if the long term decline of the US dollar should resume, this decline should be added to the list of structural factors influencing the industry. The dollar might resume its long term decline if the US economy becomes less dependent on ever increasing private consumption and more dependent on industries and services geared towards exports. In such a scenario the US could decrease its dependence on the inflow of foreign capital and begin to pay back its huge foreign debt.

The main question in this report is how the future looks for forest industries in the Nordic countries.

1. A new situation for biomass?

Today, the forest industry is under significant pressure. This is especially true for the Nordic forest industry. Even before the present financial crisis, the forest industry faced a number of new threats, such as increasing biomass prices, decreasing forest product prices, increased competition from countries with faster growing wood, as well as old threats such as increasing electricity prices in the region. The current recession may well make matters worse if demand for paper and paper board falls significantly.

This paper discusses the global situation of a number of aspects of the forest industry, with special focus on China and forest nations like Brazil. We use Sweden as an example in some areas (wood price development and the demand curve for wood). We also discuss Russian export tariffs which would affect Finland directly, and Sweden and Norway indirectly.

1.1 Increased Swedish wood prices but stable prices of forest products

Since 2001 prices of timber and pulp wood have increased significantly in Sweden. However, the prices are still only just above 1996 levels. The prices of pulp and paper have been rather stable between 1996 and 2007.

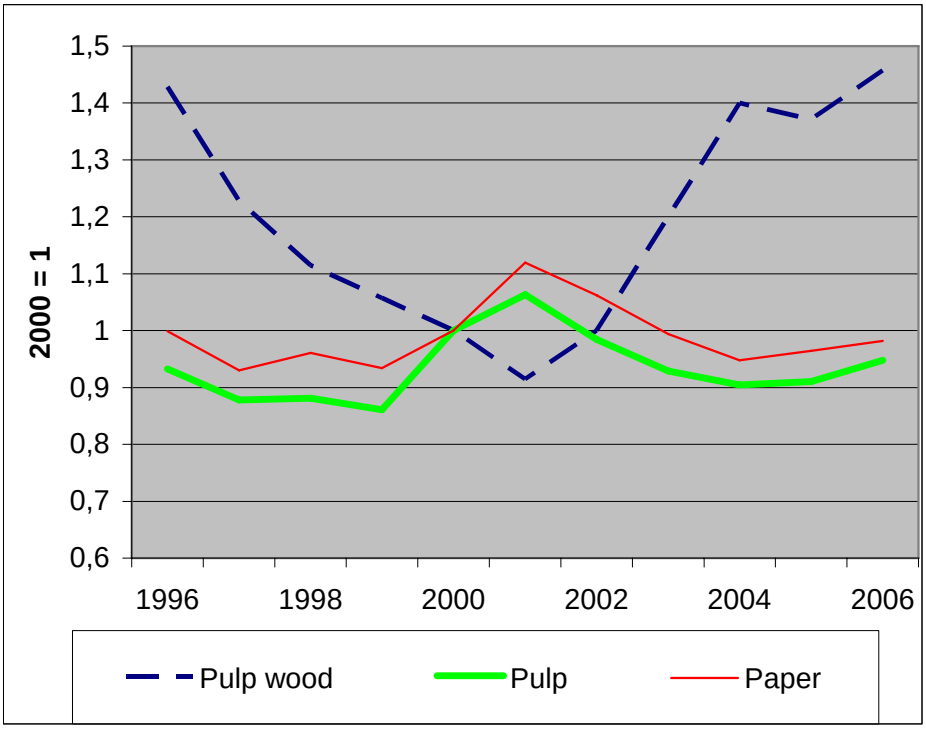

Figure 1: Prices for Swedish paper, pulp and pulp wood prices at mill gate in Sweden

Biofuels are mainly used in areas with a high population. In these locations, a larger share of the wood will be used for energy purposes, and a lesser for the pulp industry. This could represent a disadvantage to the pulp and paper companies located in areas with a high population (for example near the Mälar valley in Sweden).

Depending on transportation costs, and perhaps some supporting systems, scarcely populated areas (such as the inland of the north of the Nordic region) could export treetops and other rest products to areas with high population.

Depending on the extent to which these increases in the price of wood depend on the Elcert system used in Sweden, this is a good example of how supporting systems distort the competitive landscape.

The Finnish forest industry has studied the Swedish Elcert system, and decided not to follow the Swedish example.

The Finnish prices of round wood (all wood species) show a different development. Prices hit bottom in 2006 and the price peak in 2007 depended on high prices for saw log. One explanation for the differences between Sweden and Finland is that the Swedish national market for bioenergy has developed significantly. In 2001 the total use of bioenergy in Sweden was 94 TWh, of which 4,9 TWh were used in electricity production. In 2006 the total use of bioenergy was 116 TWh and the use in the electricity production was 10,9 TWh. The increase depends on different Swedish support systems for bioenergy, for example the electricity certificate system which started in May 2003. The use of biofuels has also increased in areas such as district heating and transportation (ethanol).

Another explanation is that the Finnish tax system has been modified a number of times and that this has influenced the number of fellings in Finnish forests.

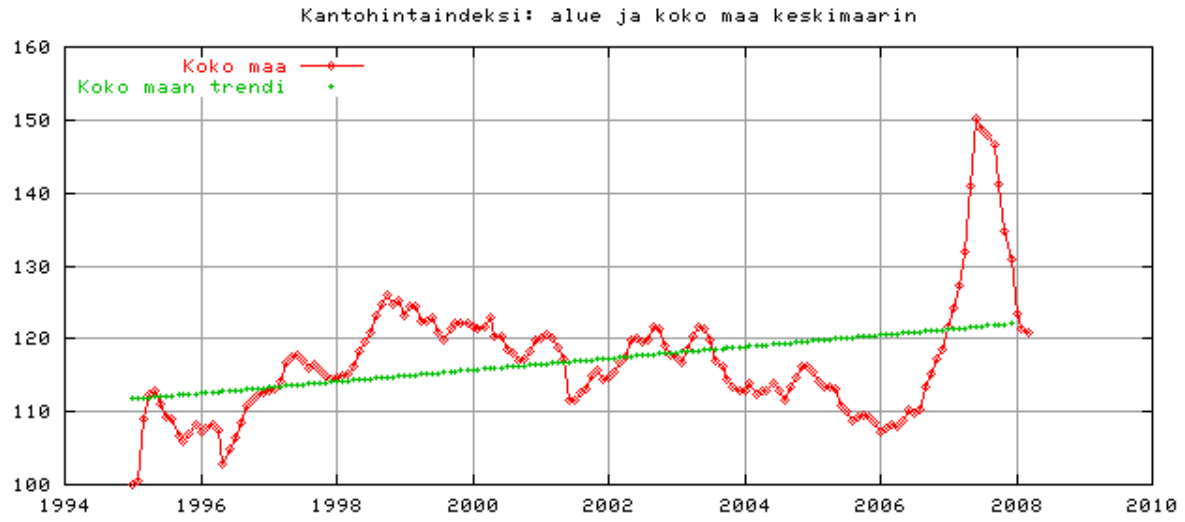

Figure 2: Prices for Finnish round wood (all wood species), cost for felling and transports are not included

A typical Swedish forest owner receives about 70 % of his revenue from sales to saw mills. In recent years it has often been more profitable to sell wood to the energy sector rather than to pulp mills, but sales to pulp mills are still the most important by far.

The saw mills are the forests' engine.

In the near future wood prices will most likely be influenced by export tariffs in Russia, developments in China and the demand for bio energy.

1.2 Increased demand for bioenergy in the Nordic countries and EU

We define energy wood as wood for energy purposes besides wood for pulp and saw mills. Bioenergy is defined as energy wood and other biomass for energy purposes such as for example ethanol made by crops and bio gas. Wood is round wood and the rest products. How much of the rest products that is used is always a economical question. Rest products from saw mills (only ca 50% of the round wood is used as timber) is sold to pulp mills or as bio energy. Other rest products are e.g. tops, branches and stubs.

The demand for bioenergy has increased significantly in Sweden in the past few years. Demand has also increased in other Nordic countries as well as the wider EU, although not as significantly as in Sweden.

In Sweden, increased demand for energy wood is probably the main driver behind the increases in the prices of wood. The trend towards higher prices was broken 2005 by a big storm (Gudrun) that left huge areas of forest with fallen trees, which resulted in a surplus of supply that year.

In the future, demand for bioenergy could expand considerably because of new EU policies that require that in the year 2020, 20% of energy consumption should be satisfied by renewable energy, and 10% of the energy used in the transportation sector should be satisfied by biofuels. This policy could result in significantly higher demand for bioenergy and other renewables in the Nordic countries and the EU. If second generation biofuel technologies that make heavy use of wood become successful, these EU policies could lead to increased demand for wood. In Sweden, which has the largest share of renewable energy of all the EU Members, the share of renewable energy from would probably have to increase from 38% in 2005 to 49% in 2020 (proposal from the Commission).

Christian Azar: *Brazilian sugarcane ethanol is so cheap that demand risks spiralling out of control. At present, sugarcane is only cultivated in a very limited area. However, once the world decides to reduce carbon dioxide emissions, or if the price of oil is high, sugarcane will be an interesting alternative even from an economical standpoint. There is a risk that sugarcane plantations, either directly or indirectly, may drive deforestation. Once you start burning tropical rain forest to produce ethanol, indirect carbon dioxide emissions will be very high.*

How large can the increase in demand for biomass be? Profu has done Markal scenario runs that show increased demand for energy wood for the next 10 years with an ability to pay for energy wood around levels of 220-230 SEK/MWh around 2020. Since the launch of the Swedish electricity certificate system on May 1 2003, the prices of energy wood have increased from 100-110 SEK/MWh to 170-180 SEK/MWh. According to the Markal runs for

the Nordic region there is an upper limit for biofuel prices in Sweden due to limitations in energy demand and the existence of alternative cheap energy sources.

Peat could easily be replaced by bio energy. It could also be replaced with coal and gas, which like peat is included in EU ETS. Since the price most often have been lower than 30 EUR/tonne CO2 these movements have not been so important so far.

At present there is considerable debate on whether the use of different bioenergy resources would benefit the environment, or if their use has adverse side effects. The European Commission wants to modify the EU policy with a certificate type of system that would guarantee that the bioenergy used is favourable for the climate and environment etc. EU import tariffs on ethanol from countries such as Brazil are also being discussed.

So far, it seems that the life cycle greenhouse gas emissions of many of the liquid bioenergies used in the transport sector are not significantly lower than those of fossil fuel. In some cases, Life Cycle Analysis (LCA) shows higher emissions for bioenergy than for traditional fossil fuels. Hopefully, these problems will be reduced with the coming of a second generation of biofuels.

Nevertheless, some people maintain that the world's forests could be used as a last resort, if the world's politicians do not manage to bring down greenhouse gas emissions to acceptable levels by other means. An alternative to today's deforestation is to stop deforestation, increase forestation, reduce the burning of biomass to a minimum and instead build houses, furniture, make paper etc. When these products' life cycle comes to an end, they can be burnt using CCS techniques. If the products are not eventually burnt there will be both CO2 and methan emissions (due to decompomosition). This policy would imply the absorption of CO2, but emissions would be reduced to a minimum. Today's deforestation in Brazil and Indonesia is equal to the total greenhouse gas emissions in the US.

Christian Azar: Ethanol from Brazilian sugarcane is cheaper, better from a carbon dioxide perspective and has a higher yield per hectare than ethanol from other sources, like wheat or corn.

The conclusion is that the use of bioenergy in the future in the Nordic region, the EU, and the rest of the world is uncertain. Current policies indicate increased use of biofuels, but with climate and environmental restrictions, at least within the EU. If independence from energy imports gets prioritized in the future, more bio energy might be used. On the other hand, a much more bioenergy-restrictive policy is also a possible outcome in the future.

The bioenergy sector is expanding in several other countries. For instance, the USA has a large production of ethanol produced from maize mainly due to security of supply reasons. Brazil can produce ethanol from sugar cane, which by many is seen as a rather climate-effective way to produce biofuels.

1.3 Export tariffs of Russian woods hits the Finnish industry

Since July 2007 Russian export tariffs on wood has been 10 EUR/m3. Russia earlier announced that these would be raised to 50 EUR/m3 in January 2009. Currently these new tariffs have been put on hold and the new tariffs will be 15 EUR/m3. If Russia were to increase export tariffs to 50 EUR/m3 this would significantly affect wood prices in Finland, and indirectly, also in Sweden and Norway. Around one fifth of the wood used in the Finnish forest industry comes from Russia. In 2005, West European import of Russian wood was 22 million m3[1], of which Finland imported almost 70%. Finland has historically relied on imported Russian wood to build its capacity and infrastructure. According to the Finnish Statistical Yearbook of Forestry 2007, imports from Russia will cease if the export tariffs increase to 50 EUR. Such as loss of supply could be compensated for by increased felling of wood in Western Europe (20-40%), higher imports from other countries (20-30%), and the closure of existing paper and pulp plants in Western Europe (30-40%). The managing director for SCA made these adjustment estimations in April 2008. His opinion is that Russian export tariffs will lead to an increased capacity in Russian paper and pulp plants and sawmills, which is the purpose behind the new Russian policy. Negotiations on this issue are currently underway between the EU and Russia.

Commercial round wood fellings in Finland decreased by 3% to 50.8 million m3 (over bark) in 2006. This was the second year in succession in which round wood fellings declined. The reduction occurred in non-industrial, private forests, where fellings (39.4 million m3) were at a ten-year low. In the forest industries' own forests fellings were exceptionally high: 6.4 million m3, 70% more than in 2005.

Perhaps the difference in the different actors' felling approach depends on contrasting interests. For the non-industrial actors it would be rational to delay some fellings until the expected Russian tariffs are implemented. This is rational as long as the felling reduction gives about the same price for Finnish wood as after the Russian export tariffs have been implemented. In that case the non-industrial actors get higher wood prices directly, and do not have to wait for the new Russian tariffs to be fully implemented. For the industrial actors it would be rational to increase their supply of wood to offset the effect of lower supply from non-industrial actors in the near future. Forest fellings in private forests have also changed in the last few years, because of new tax rules in Finland.

According to the results obtained by the 10th national forest inventory, published in 2007, the annual increment of the Finnish growing stock is 98,5 million m3 (over bark), and the maximum sustainable felling for 2006-2015 is 72 million m3 per year. This is 16 million m3 above the average felling 2002-2006, and is exactly the amount that Finland imported from Russia in 2005. However, such a high felling in Finland would lead to higher wood prices due to increased felling marginal costs compared with 2002-2006. Finland also imports 2.6 million m3 from the Baltic states. Wood exports from Finland have been very low during the last years.

Russian export tariffs of 50 EUR/m3 would undoubtedly result in a significant increase in Finnish prices for biomass. The new tariff would in itself exceed the price Finnish actors have historically paid for Russian wood. Finnish paper and pulp companies will seek wood from other markets if imports from Russia cease. Sweden is one possible exporter, so the new

[1] All wood numbers in m3 in this paper are over bark.

Russian tariffs will also affect the trade of wood between Sweden and Norway. Prices would therefore increase in Sweden and Norway too.

Ripples of the increase in the price of wood at the Finnish-Russian border spread to other parts of Finland - and Norway.

The following figure illustrates schematically how reduced Finnish wood import from Russia could affect the wood balance. With the same production level in the industry raw material have to be delivered from other sources, for example by more extensive use of the Finnish forests, imports from Sweden or imports of eucalyptus. We don't count with any effects on the Finnish energy market in this schematic figure.

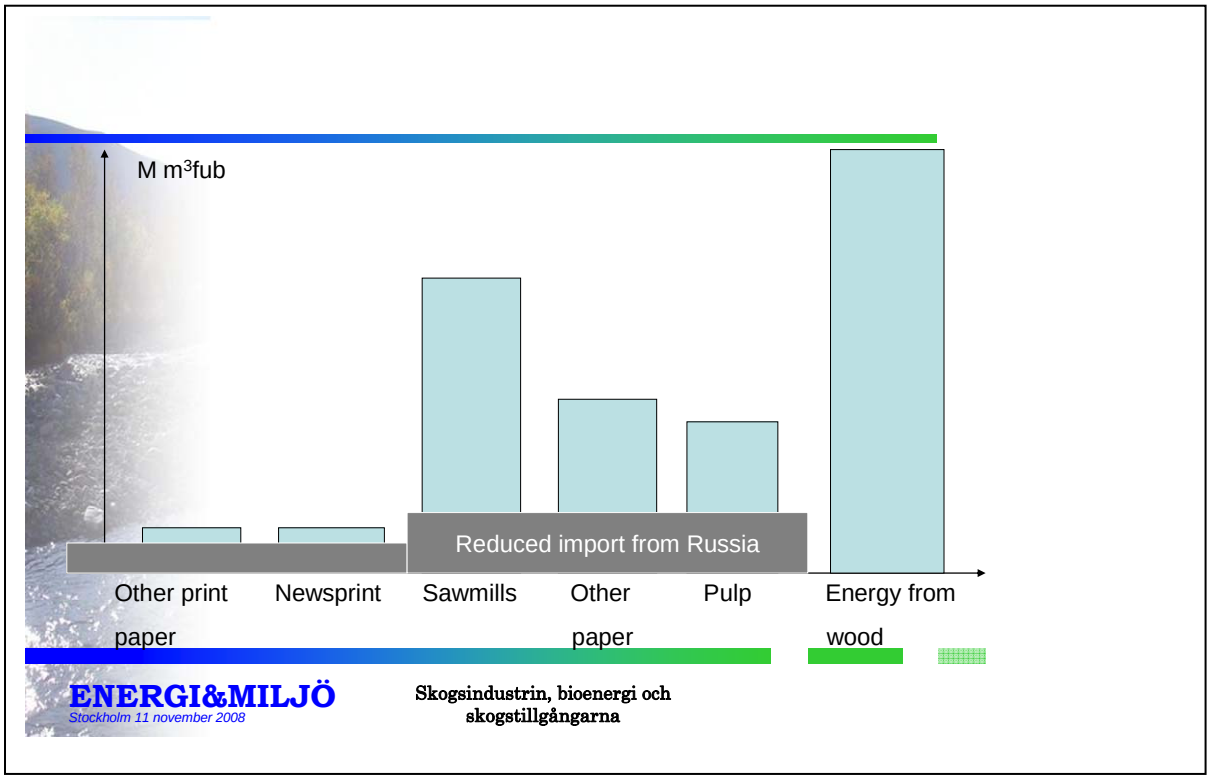

Figure 3: Effects on the wood balance in Finland by reduced wood import from Russia.

2 Increased competition from countries with low prices of biomass

In Finland the forest industry accounted for about 10% of GDP in 2006, while the share is lower in Sweden and Norway. The prospects of the forest industry are therefore of paramount importance to the Nordic countries.

In 2005 the world's growing stock volume (over bark) was 434 billion m3. Brazil and Russia have the largest growing stock volumes, with about 80 billion m3 in each country.

The world consumption of paper and paper board is around 350 million tonnes. World production of sawn goods was 428 million m3[2].

Hawkins Wright has made a cost comparison between the different paper and pulp producing countries. The estimated costs to produce bleached hardwood pulp (BHKP) in 2004 are shown in the following table. We see that the new paper and pulp nations of Brazil and Indonesia had by far the lowest costs. Sweden and Finland, together with other old pulp and paper nations in Western Europe and North America, have higher costs than the weighed world average. The high rate of increase of production in countries with fast growing forests (often eucalyptus) is not surprising, considering the significant cost differences that are shown in the table, even though these types of estimations are very difficult to do.

Cost type	Brazil	Indonesia	US South	Portugal	Sweden	France/ Belgium	Canada East	Finland	World Weighed Average
Wood	71	102	128	188	212	178	158	243	132
Chemicals	28	17	3759	40	60	30	38	41	33
Energy	10	14	23	6	19	13	24	2	14
Variable Costs	*109*	*134*	*188*	*253*	*270*	*252*	*211*	*283*	*179*
Labour	8	13	40	49	51	65	50	41	30
Maintenance	12	13	31	22	15	14	23	16	18
Other mill costs	24	25	50	37	18	35	35	19	31
Operating Costs fob mill	*153*	*185*	*310*	*360*	*354*	*365*	*319*	*360*	*258*
Ocean freight	44	37	53	18	17	17	73	38	43
Marketing & Sales	17	12	10	5	19	11	7	8	12
Total delivered costs cif	*214*	*234*	*373*	*383*	*390*	*393*	*399*	*406*	*313*

Table 1: Costs for Bleached hardwood pulp 2004, USD per tonne, total delivered cif West Europe. *Source: Hawkins Wright*

Price Waterhouse Coopers estimates show that South American producers have 30 % lower costs than Nordic producers for bleached hardwood pulp, and that current price levels makes

[2] 1 m3 sawn good needs about 2 m3 roundwood. About 2,5 m3 roundwood gives 1 tonne mechanical pulp and around 5 m3 1 tonne chemical pulp.

it hard for Nordic producers to achieve profitability, while South American plants are very profitable.

Canadian pulp and paper producers also have problems since Canadian sawmills are selling less timber to US. This means that pulp and paper producers cannot buy as much cheap spill products from sawmills as they would like, and are therefore forced to buy more expensive round wood instead.

The long fibres that exist in the coniferous forests in the Nordic countries have so far given the Nordic forest industry a comparative advantage (they are for example needed for newsprint). However, new eucalyptus pulp plants are being developed where the produced pulp should consist of more cellulose and less lignin, which reduces the difference between pulp produced from eucalyptus and pulp produced from coniferous wood. The Swedish institute Skogforsk estimates that the length of fibres in eucalyptus plantations will double in the next 40 years.

The costs to produce bleached softwood pulp (BSKP) are shown in the following table. The cost level is higher than for BHKP. For BSKP, Sweden and Finland lie on, or just below, the world average. It is only Chile that has considerably lower costs than the other countries in this estimate, but Chilean volumes are rather low.

Cost type	**Chile**	**Sweden**	**Finland**	**US South**	**France/ Germany**	**Canada East**	**BC Interior**	**BC Coast**	**World weighed average**
Wood	99	246	276	142	270	204	134	134	173
Chemicals	35	36	40	37	44	45	47	50	41
Energy	9	16	8	21	14	21	42	45	24
Variable Costs	*198*	*394*	*401*	*368*	*436*	*410*	*397*	*420*	*378*
Labour	18	50	43	58	56	74	66	104	59
Maintenance	8	19	16	19	20	35	23	35	22
Other mill costs	28	26	17	92	32	31	86	52	58
Operating Costs fob mill	*198*	*394*	*401*	*368*	*436*	*410*	*397*	*420*	*378*
Ocean freight	45	16	35	59	25	60	79	63	52
Marketing& Sales	9	18	8	21	11	5	8	8	13
Total delivered costs cif	*253*	*427*	*444*	*448*	*472*	*475*	*484*	*491*	*443*

Table 2: Costs for Bleached softwood pulp 2004, USD per tonne, total delivered cif West Europe. *Source: Hawkins Wright*

In the estimates for BSKP and BHKP, Sweden and Finland has low transport costs for ocean freights. It is surprising that Brazil and Chile do not show higher costs for ocean freights in these estimates.

The cost of wood explains most of the total cost differences. Brazil, Indonesia and Chile have by far the lowest wood costs while Sweden and Finland lie in the upper region.

3 Declining pulp and paper prices - so far no "Chinese effect"

Breathtaking growth in China, and to a lesser extent in countries such as India and Brazil, has led to significantly higher demand for fossil fuels and metals, resulting in significant price increases for these commodities. So far, there has been no similar development for products in the forest industry as was shown in figure 1.

Pulp prices have declined due to increased use of large scale mills, greater efficiencies, and technological developments. Most new investments have been made in regions with the lowest costs (such as Brazil and Indonesia) and have usually been based on fast growing plantations (such as eucalyptus) or deforestation of rain forests. So far, global capacity has exceeded demand.

3.1 Paper in China

The paper and board *consumption* in China shows a significant increase from 26 million tonnes in 1995 to 49 million tonnes in 2004. During that period annual growth has increased from 5%/year in 1995-2000 to over 10%/year in 2000-2004. Paper *production* capacity has increased even more in China. Chinese paper production capacity exploded between 2002 and 2004 from 37.8 to 49.5 million tonnes (31%), and this expansion is continuing. Chinese production will exceed the production in the US before 2015.

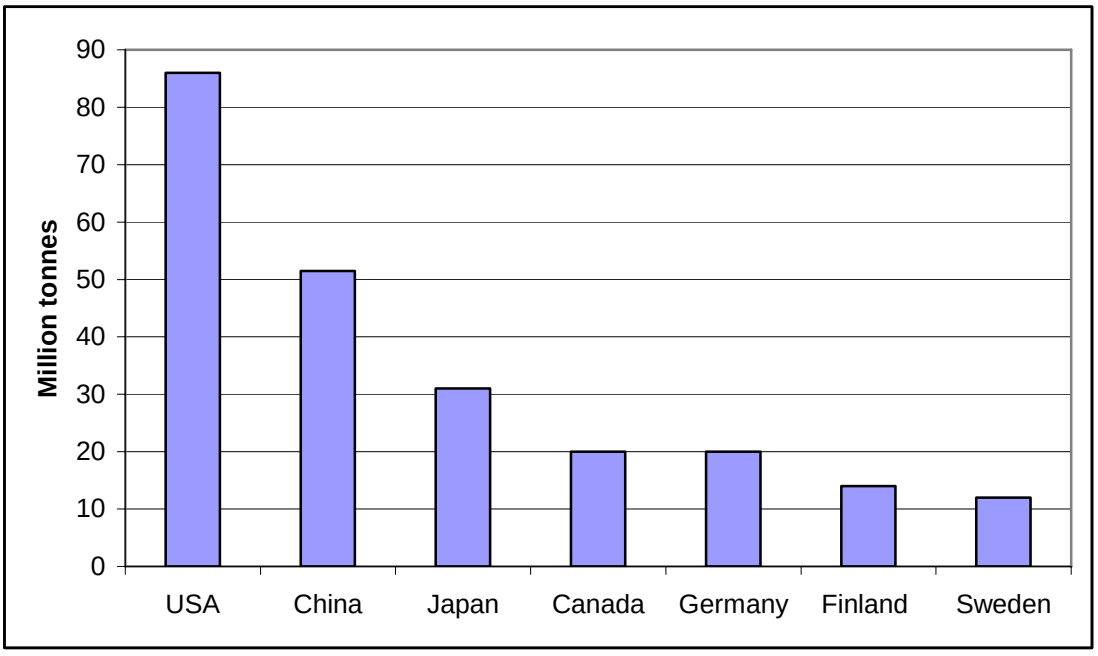

Figure 4 World production of paper and paperboard 2004

In China, production from *older* paper and pulp plants built before 1996 with a capacity below 50.000 tonnes per year, have not increased significantly in the period 1995-2004. The entire increase in production can be accounted for by large scale investments in new integrated pulp and paper plants and paper mills that use imported fibres. *Old* plants are very inefficient and based on very old techniques while *new* plants are often very large and based on state-of-the-art technology.

Joint ventures and foreign investment have been important for the growth of the Chinese paper industry, but most financing for this expansion has been internal. Both Metso and Voith manufacture paper production equipment in China. The low cost of labour has not been a very important factor in the capital and fibre intensive paper production industry.

Since 1999, Chinese imports of paper have increased by 0.4 billion US dollars, but exports have jumped by more than 2.9 billion US dollars. This implies that the "Chinese effect" on the paper industry has so far lead to *lower* prices in world markets. US paper exports to China has been around 600 million US dollars since 1996, while the Chinese paper exports to the US has increased from 300 million US dollars in 1996 to 1600 million US dollars in 2005.

3.2 Pulp wood, waste paper and wood

The high level of paper production in China has made the country highly dependent on imports of pulp, waste paper, and wood. Many older plants use non-wood pulp such as those based on rice or bagass, but use of these sources is declining, even though it still accounts for about ¼ of total fibre usage. Imports of waste paper and wood pulp covered 45% of China's fibre needs in 2004. In that year, China imported 16 million tonnes of waste paper, which is far more than the 2 million tonnes imported by the second largest importer. China has a comparative advantage in the relatively labour intensive procedures that waste paper requires. China's imports of wood pulp doubled between 2000 and 2004.

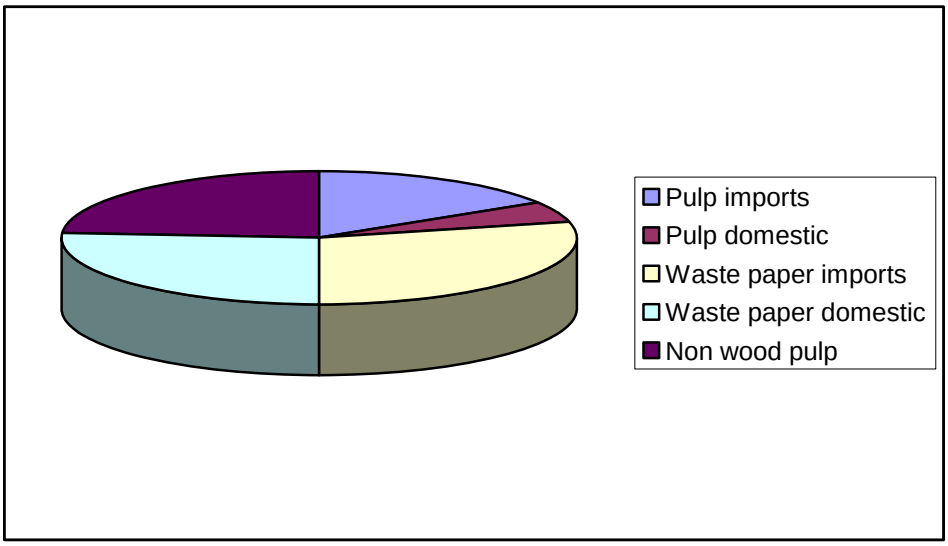

Figure 5 The fibre sources for paper production in China 2004.
Source: China Paper Almanac 2004

China imports mostly chemical pulp. So far, the main pulp exporters such as Indonesia, Canada, and Russia, have been able to meet increased Chinese demand for pulp.

China has also started plantations (mostly eucalyptus) for pulp wood, but the example from Brazil (see chapter 4) indicates that it will take many decades until considerable amounts of pulp can be produced by wood from these plantations. For the time being it is therefore unlikely that China will be competitive in pulp production, and their pulp production will be largely reliant on imported fibres.

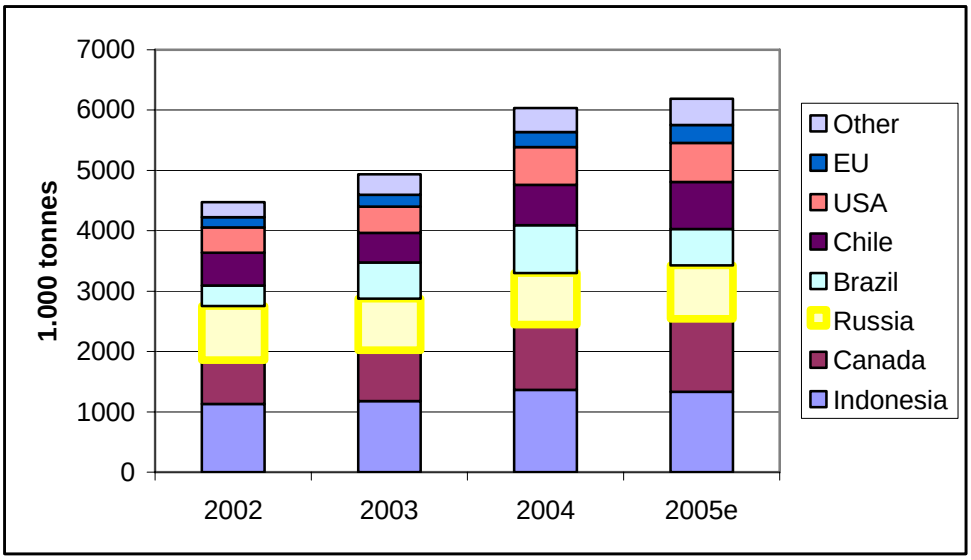

Figure 6 China's import of chemical pulp from 2002-2004 and an estimate for 2005.
Source: Global trade atlas, China import data

Chinese import of wood has increased by roughly 300% between 2003 and 2005 even though 2003 levels were very low (domestic Chinese pulp production is very low – see figure 4). Vietnam was by far the largest exporter during 2005, followed by Australia, Indonesia and Thailand. The wood imported was primarily eucalyptus.

China is a major importer of round wood from Russia and the country will be directly affected by the new Russian export tariffs on wood. Of the Russian export to Asia (25 million m3 per year) China imported 19 million m3 per year. The managing director of SCA expects reduced exports from Russia to Asia as a result of the following adjustments: increased wood fellings by 0-10% in Asia, increased import from other countries by 50-80% and closed plants by 10-20%. His estimates regarding adjustment possibilities in Asia (China) are more positive than those regarding Western Europe (Finland). One reason is that China imports only a minor share of round wood from Russia.

If the global supply of pulp, waste paper and round wood cannot satisfy increased Chinese demand for paper production, global prices of pulp and pulpwood would rise. This could lead to an increase in the price of paper worldwide. However, China has so far been able to buy cheap pulp, wood and waste paper – mostly via eucalyptus as direct imports, or as pulp based on eucalyptus.

The world forecasts for pulp made from eucalyptus are 18 million tonnes in 2010 (10 million tonnes produced in Brazil). Global production in 1990 was 3.5 million tonnes. and 7,1 million tonnes in 2000.

During 2006-2007, the world pulp prices increased while paper prices decreased.

Without eucalyptus, Chinese demand for pulp could not be satisfied. Growing eucalyptus requires a lot of water, and water is becoming a scarce resource in many parts of the world. In the future, new global environmental regulation might cause problems for some eucalyptus plantations.

Following the financial crisis, prices of wood and waste paper have decreased. Brown waste paper has in fact a price close to zero.

Earlier, when Chinese exports to western countries were high, sea transport from Europe to China were very cheap. Ships that came loaded with Chinese goods, sold cheap transport capacity for the return trip to avoid going back empty. Now, after the financial crisis, there are fewer goods shipped to Europe, and cost for transporting wood and waste paper has increased.

4 World market of biomass

The last ten years has seen the emergence of a world market for biomass. Historically, price movements of biomass in different parts of the world showed little correlation, but over the last ten years prices have correlated quite strongly. Price levels differ depending on whether a country is a net importer or a net exporter of biomass and the transport costs for the different distances.

Figure 6 shows that hardwood (leaf trees) prices have been low in Brazil, high in Sweden and Finland and average in southern US and eastern Canada. Since 2003, prices in Brazil and the Nordic countries have increased, while prices in North America have been relatively stable.

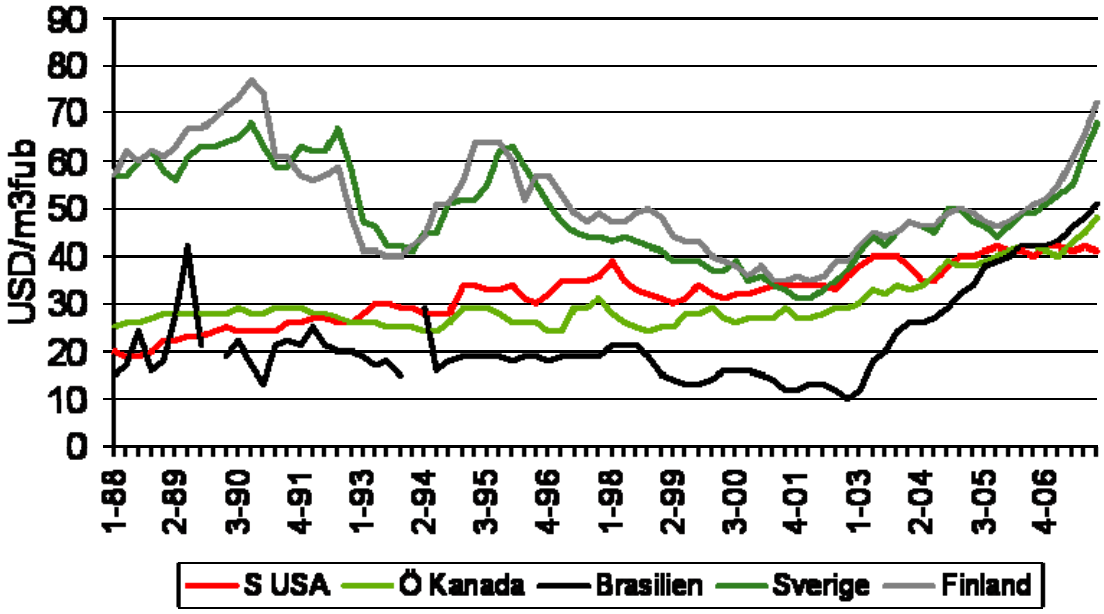

Figure 7 Average prices for hardwood pulp (year) at mill gate, *Source: Wood Resources International LtD*

Transportation costs for biomass depend primarily on volume. Pulp or paper have volumes that are 2-5 times less than those of the round wood required to produce the same amount of pulp or paper. Timber from sawmills has half the volume as round wood. Ethanol has only 30% more volume than petrol per energy unit.

Sea transports with large ships are cheap. Transport cost are the same for 200 km transport on road, 600 km on railway or 10 000 km by sea. (Source: Talloil.) Another illustrative example are Swedish imports of Brazilian eucalyptus, which has a very fast growth rate (200 MWh/ha and year) compared with Nordic spruce and pine trees (15-20 MWh/ha and year), or energy forests (Salix with 50 MWh/ha and year). To produce 1 million tonnes of paper 720 000 hectares of land are needed in a Nordic softwood (coniferous) forest while only 100 000 hectares are needed in a eucalyptus plantation.

	Cost in EUR/MWh
Cost of eucalyptus	3
Sea transport from Brazil to Sweden	7
From wood in Swedish harbour to wood chips in a district heating plant	4
Profit	1
Total	15

Table 3: Costs to transport and cut eucalyptus wood to wood chips for a district heating plant in Sweden. *Source: Talloil where we have assumed in exchange rate 10 SEK/EUR*

Brazilian production of pulp based on eucalyptus is increasing. Transport costs for pulp are considerably lower than transport costs for eucalyptus. This price difference, in combination with a natural trend towards more value added production (from wood exports to pulp and perhaps even paper exports), has resulted in a large increase in pulp production capacity in Brazil. Pulp production in Brazil started in 1978, and it increased to 1.3 million tonnes by 1978 and 4.8 million tonnes by 2003. Current exports by Brazil were made possible by eucalyptus plantation activities that started in 1964 after the introduction of tax incentives. It takes a long time before forest projects yield results.

The following figure shows a similar price pattern for softwood pulp. This is also a market that has become more global during the last ten years. Chile has the lowest prices and that country is also expanding into more value added products.

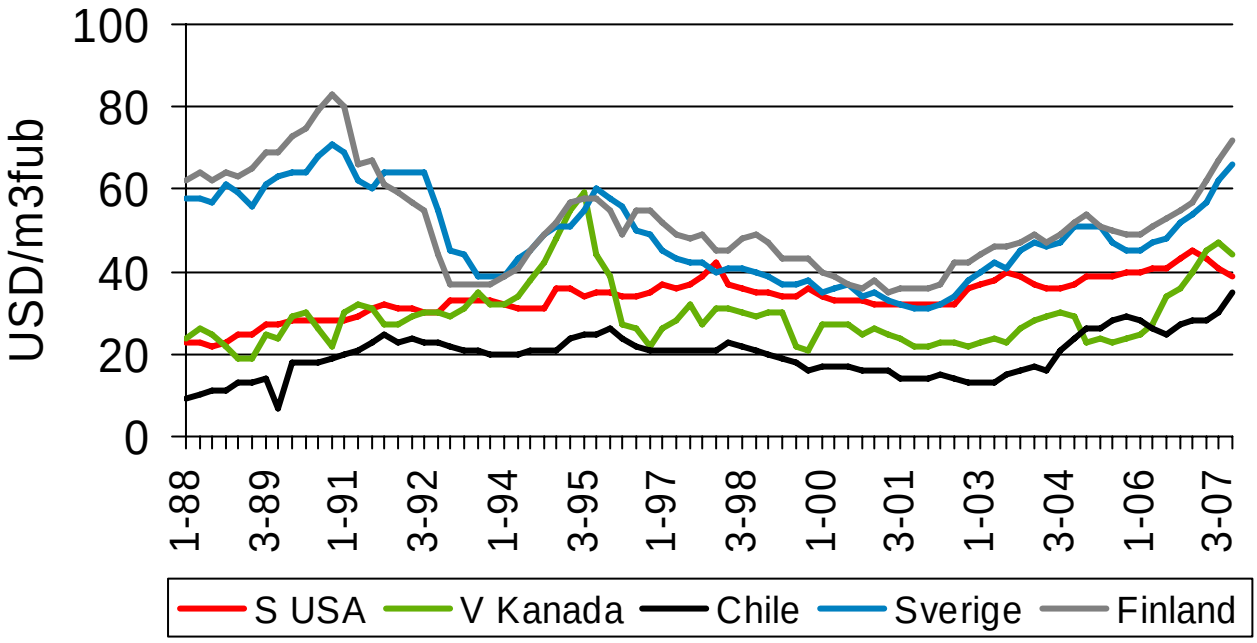

Figure 8: Average cif prices of softwood in Western Europe Source: Wood Resources International Ltd

4.1 Supply and demand of bio fuels in the world

IEA estimates that the current total use of bioenergy is about 45 EJ per year (12 500 TWh or 5.700 million m3 over bark). However, this number is uncertain since most of the use is not commercially traded. Most bioenergy use is local in developing countries for cooking and heating. The commercial trade of bioenergy is about 9 EJ, which also is an uncertain number. These levels can be compared with the global total use of fossil fuels (390 EJ), nuclear production (26 EJ) or hydro power production (28 EJ)

The largest "industrial" use of bioenergy is for heating (ca 2.5 EJ) while the use for electricity production is small (0.6 EJ or 170 TWh). The use of bioenergy is growing rapidly, and most of these numbers have already changed considerably.

Liquid bioenergy in the transport sector amounted to 1.5 EJ in 2006, which was 1.5 % of the total fuel consumption in the transport sector. Production of ethanol, which is the most common liquid biofuel, has doubled since 2000.

High fossil fuel prices, goals to reduce greenhouse gas emissions, and increasing concerns about security of supply, are the main drivers behind more ambitious bioenergy targets in many countries. To make increased use of bioenergy a reality, it is necessary to considerably increase the supply of bioenergy.

4.2 Potentials of increased supply of bioenergy to 2050

Estimates of how much the global supply of bioenergy can increase vary greatly, from only 40 EJ to over 1 000 EJ. The level depends on many factors, many of which have long term effects; Factors include the amount land that can be used for energy purposes, the supply of water, the use of fertilizers and biocides, the impact of climate change and competition with food production for an increasing world population.

The IEA has estimated that (IEA Bioenergy ExCo:2007:02) bioenergy production levels between 200-400 EJ per year are reasonable. Production levels up to 200 EJ could be realized at a cost of 2 EUR/GJ (7 EUR/MWh) in old agro areas that are used in a more efficient way. A further 100 EJ could be realized at higher costs by using areas that are not currently used for agroproduction or forestry. The last 100 EJ could be realized by using rest products from agro and forest production, such as dried manure. These estimates, which are optimistic compared to other estimates, are estimated for the years 2050.

To produce a further 400 EJ of bioenergy requires land areas equivalent to 20% of the land area that is currently used for agroproduction.

4.3 Traded bioenergy and transport costs

An extra 400 EJ of bioenergy would mean that the level of bioenergy use would match today's use of fossil fuels. A large share would be used locally, but large amounts would be traded. Already today large amount of biomass are traded for use in industry and the energy sector.

	Total volumes 2004	International trade 2004
Round wood	1 646 Mm3	121 Mm3
Wood chips	197 Mm3	37 Mm3
Saw mill timber	416 Mm3	130 Mm3
Palm oil	37 Mtonnes	23 Mtonnes
Ethanol	41 Mm3	3,5 Mm3

Table 4 Total use and international trade with some biomass products in 2004
Source: FAOSTAT 2006

Higher demand for bioenergy naturally requires increased supply. If it is possible to increase supply close to the demand, transports will not need to increase significantly. However, some countries have a comparative advantage to produce biomass. One example is ethanol produced from sugarcane, another example is eucalyptus. This factor, in combination with low sea transportation costs, could result in a large increase in international trade of biomass. Costs for bioenergy will increase due to competition for water supplies and land required for agroproduction to feed growing populations, as well as from general salary inflation in biomass exporting countries. Growing middle classes in developing countries consume more meat and fewer vegetables than before. Since meat production requires more land than vegetable production this leads to increased competition for land.

4.4 Transport cost in the Nordic market of biomass also creates price differences

Factors such as transportation costs cause the price of biomass to vary across the world. There should even be price differences in the Nordic region since transportation means vary inside the region.

Sea transport costs explain why wood prices in the Nordic countries correlate with prices in countries such as Brazil, albeit on a higher level. Since transportation costs are very high in the Nordic region regional price differences will occur. This will be especially true in Finland if the new Russian export tariffs become a reality. Increased demand from Finland will probably lead to increased exports of wood from Sweden to Finland, and decreased exports from Sweden to Norway. If increased Russian export tariffs lead to a situation where all Nordic countries increase imports of eucalyptus, the prices in the region would be similar, at least for pulp qualities (chemical pulp) that can be made from eucalyptus.

The figure below illustrates the consequences of a situation where long range transportation costs are very low and short range local transportation costs are very high. Low long range sea-based transportation costs should create favourable conditions for a global market for biomass.

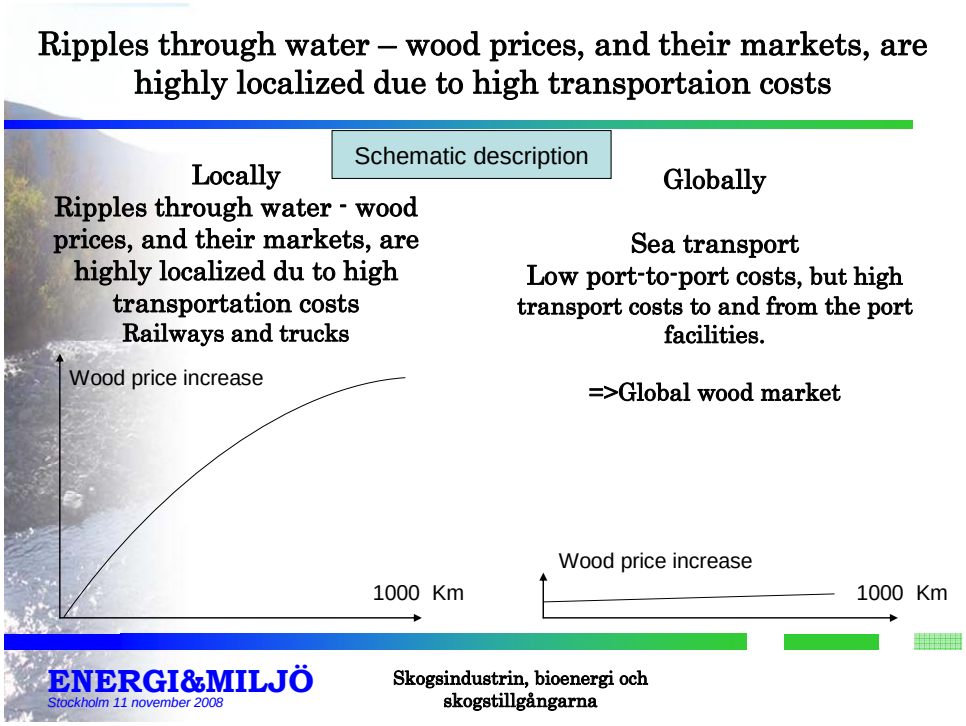

Figure 9: Differences in transport cost between ground an sea transportation creates both local and global wood markets

Global price changes for wood and forest products should not affect the competitiveness of the Nordic forest industry. Regional price changes are more important since they have a direct impact on the competitiveness of the Nordic forest industry. In the worst case scenario, wood prices increase in he Nordic region, but not elsewhere. Low global prices for forest products are of course negative for the Nordic forest industry, but also for forest product producers elsewhere. A situation with low product prices should also be balanced by lowered supply.

Ripples of the increase in the price of wood at the Finnish-Russian border are not only going to spread to other parts of Finland – they will also reach the rest of the Nordic region.

5 Possible biomass price scenario

Here we will discuss three different scenarios. In the first scenario international prices of biomass are the same as in the Nordic countries, with regard to transport costs. Here we do not take into account neither imports nor exports. In the second scenario we assume that the price of biomass is low, and that the Nordic countries will be able to import cheap biomass. In the third scenario we assume high international prices of biomass. A significant part of Nordic wood is sold on the international market, for example to substitute coal in German power plants. All scenarios have been supported by Profu's Markal-runs, but they will not be explicitly shown in this paper. The calculations have focused on Sweden, but Profu's Markal-version is on a Nordic level.

5.1 Scenario with no trade of wood

Markal gives an equilibrium price level of 21.5 EUR/MWh for bio fuel in 2015, which corresponds to 47 EUR/m3 round wood (over bark). Price estimates for 2025 are 15 % higher. The calculations have been done assuming rather high rates of development in the Swedish pulp and paper industry. In this paper we have had, and will have, discussions about this industry's situation, that make weaker development more probable. In that case the prices of wood fuel would be lower. This scenario does not assume any large use of biofuels in the transport sector which together with second generations of biofuels based on wood could lead to increased demand for wood.

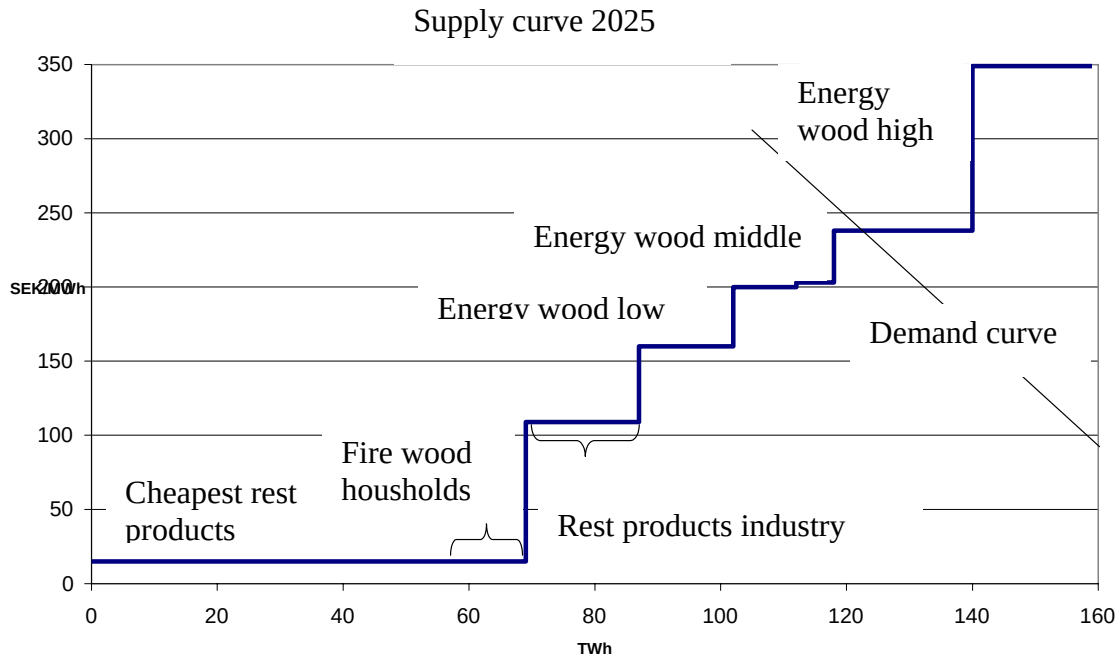

Figure 10: Supply of bio fuels in Sweden 2025 according to the Swedish Energy Agency and a demand curve according to Markal. *Source: Biokonk for Elforsk, 2008*

We have not assumed that high wood prices in Sweden, will lead to large-scale imports of biomass since international prices of biomass will also be high. This would mean higher

prices for pulp and paper which could be an argument for a higher development in the Swedish (and Nordic) pulp and paper industry and consistent with the scenario conditions. However, since it is more economical to transport pulp, paper or timber compared with round wood, countries such as Brazil and Chile could increase their pulp and timber production considerably. This would be a threat to the Nordic forest industry. Countries such as Brazil have a comparative advantage over Nordic countries, the exception being long fibre pulp that cannot yet be produced from eucalyptus wood.

5.2 Low international prices of biomass

In this scenario we assume rather low international prices for biomass. Supply of woods such as eucalyptus (from countries such as Brazil and China), and Russian and Indonesian forest products will be high, and global demand for bioenergy will be low. For Sweden and the other Nordic countries, this would lead to cheap imports of biomass since most Swedish supply would be more expensive. Competitive prices would allow the Swedish energy sector to use more biomass without any risks of price hikes due to local conditions. According to the Markal scenario, the use of wood would increase in Sweden in the coming ten years due to the needs of the Swedish energy sector during that period. At the same time, the Markal-runs indicate that there is a roof for demand of energy wood. That roof is reached after 2020.

Low international prices of biomass will be problematic for the Swedish and the Nordic forest industries. In spite of low biomass prices – wood is the most important cost factor for the forest industry - the Swedish forest industry would encounter difficulties. Plants in other parts of the world, for example in Brazil and Chile[3], would have even lower biomass prices. Although total costs would be low for the Swedish forest industry, the relative competiveness could be lower in this scenario than in the two others. Since the competitiveness of the Swedish forest industry is low in this scenario, and there is a limited demand for biofuels in the energy sector, the import volumes of biomass would probably be rather low.

This is of course a rough analysis. It does not address the fact that the forest industry and the energy sector need different qualities of biomass. The energy sector is able to use most biomass qualities. If the global supply of lower-quality biomass increases fast, it is possible that the price differentiation between wood for the forest industry and wood for the energy sector would be higher. However, today most of the lower-quality bioenergy is a side product of production in the forest industry, such as saw dust and bark, and therefore such supply of cheaper biomass will be reduced in this scenario.

5.3 High international prices of biomass

High international prices of biomass could be good news for the Swedish and Nordic forest industries. The reason is that it could result in higher international prices for timber, pulp and paper. At the same time, it would reduce demand from the energy sector. Sweden could be an exporter of wood, which would give Sweden a comparative advantage against the importing nations. On the other hand, imports from countries with low wood prices, such as Brazil and Indonesia, could lead to a situation where the net effect is a comparative disadvantage for the Swedish forest industry.

[3] For example Indonesia also has low prices of biomass in this scenario, but the transport distances to other markets like China is shorter than to Europe.

To test the impacts of large exports of wood from Sweden (assumed to be 15 TWh (7 Mm3)) Markal runs have been performed. The Markal runs yield an equilibrium price of bio energy in Sweden of 32 EUR/MWh. Since Sweden could be an exporter of wood in this scenario, the world prices of wood are higher than 32 EUR/MWh, which is considerably higher than the forecasts of IEA (reference).

The high biomass prices in this scenario could be the effect of increased Chinese demand for pulp and wood, poor development of the Russian forest industry, high global demand for bioenergy (before price effects) or political restrictions on the use of various types of biomass such as eucalyptus.

5.4 High prices of wood could be better for the Nordic forest industry

To conclude, low global prices of biomass would mean that the Nordic region would become a net importer of wood. This means that other countries could be able to produce forest products at lower costs. High global prices of biomass could result in exports of wood from the Nordic countries, thus giving a competitive advantage to the Nordic forest industry. However, if the exports from countries such as Brazil and Russia outweigh the other positive effects for the Nordic forest industry, the net result could still be negative.

6 The ability to pay for biomass in the Swedish Forest industry

We have tried to do a rough estimate of the willingness to pay for wood in the Swedish forest industry. The industries we have studied are sawmills and as many of the pulp and paper industries that are covered by statistics from the Central Bureau of Statistics in Sweden (SCB). These statistics have been used at the most disaggregated level as possible. The economical statistics from SCB have been compared and analysed with physical statistics in tonnes and m3 from the Swedish Forest Industries, and other economical statistics.

It is possible to calculate how much an industry can pay for wood in order to get a positive cash flow. The formula for the willingness to pay for wood is estimated as:

- Ability to pay for wood = (Profit – Investments + Wood costs)/Use of wood

All the used statistics are plant level data, and do not include costs that only exist at the company level. The profit estimations are made before dispositions in closing of the books and taxes. The numbers do not include capital costs. Instead, we subtract the investment costs from the ability to pay for wood (ATP) in the formula above. This is the same as demanding one year's pay-off time for the investments. It is also a requirement to get a positive cash flow for the plants.

The reason we have added the wood costs to the ATP is that we seek the wood price that gives ±0 in cash flow. Otherwise we would be counting the cost of wood twice.

The cost of wood in Sweden during 2003-2007 is shown in the following table. There are a number of statistical problems regarding wood prices. These numbers are for wood qualities that have lower prices. Thus, the price figures could be underestimated.

On road	**2003**	**2004**	**2005**	**2006**	**2007**
Wood for pulp, average , EUR/m3 (over bark)	24	25	22	23	28
Wood for saw mills, average, EUR/m3 (over bark)	42	43	37	43	48
Transport costs to industry per m3 (over bark)	9	9	9	9	9
At industry gate					
Wood for pulp, average , EUR/m3 (over bark)	***33***	33	31	32	36
Wood for saw mills, average, EUR/m3 (over bark)	51	52	***46***	52	57

Table 5 Swedish prices of wood for pulp and saw mills
Source: Swedish Forest Agency and Swedish Environmental Research Institute (transport costs)

OBS! 1 EUR = 9.3 SEK

In the following table the ground data for the calculations of ATP are shown.

	Benefits	Wood use 2004/2005	Wood cost 2003/2005	Raw material cost 2005, SCB	Costs 2005
	MEUR	Mm3	MEUR	MEUR	MEUR
Saw mills, 2005	3822	37,61	1727	2097	3494
Pulp, 2003	2226	17,70	577	1062	1969
Long fibre printing paper, 2003	1045	4,26	139	387	828
Other print paper, 2003	1710	4,82	157	707	1445
Other paper and paper board, 2003	5490	20,85	679	2327	4923

	Profit 2005	Investments 2005	Wood price 2003/2005	ATP
	MEUR	MEUR	EUR/m3	EUR/m3
Saw mills, 2005	328	189	46	50
Pulp, 2003	257	245	33	33
Newsprint etc, 2003	217	86	33	63
Other print paper, 2003	265	73	33	72
Other paper, 2003	567	387	33	41

Table 6: Figures for calculations of ability to pay for wood (ATP).
Sources: Statistics Sweden, Swedish Forest Industries Federation, Swedish Forest Agency and own calculations.

1 EUR = 9.3 SEK
Profit = Benefits – Costs. No regard to capital costs and taxes. The profit estimations are made before dispositions in closing of the books.
Wood use in Mm3 is calculated from Swedish Forest Industries Federation's (SFIF) statistics together with own estimations discussed with SFIF.
Wood cost = Wood use * Wood price
Ability to pay for wood (ATP) = (Profit – Investments + Wood cost)/Wood use
I m3 wood (over bark) = 2,2 MWh

For sawmills we could use statistics from 2005, but the latest statistics for paper were from 2003, as there are restrictions in the publication of company statistics.

We have assumed 2.2 m3 wood (over bark) per tonne mechanical pulp and 4,62 m3 per tonne chemical pulp. Together with the use of paper waste and filling material, where we have distributed the Swedish Forest Industries Federation's (SFIF) total numbers to different paper sorts (in discussion with SFIF), we get the same total use of wood as in SFIF statistics. In 2005 the sawmills used 37.6 Mm3 and pulp and paper 47,6 Mm3 (of which 11,4 m3 from side products from the sawmills and 36,2 m3 round wood). In the Swedish forest industry the total use of wood was 73.9 m3. All numbers are over bark, as well as all statistics from SFIF.

The purpose of these exercises is to construct a demand curve for wood for the Swedish forest industry. Among other things it could be interesting to study how much wood could be released for energy production (energy wood) if the wood prices are higher than what the forest industry is able to pay (ATP). If we sort table 6 by diminishing ATP we get such a demand curve.

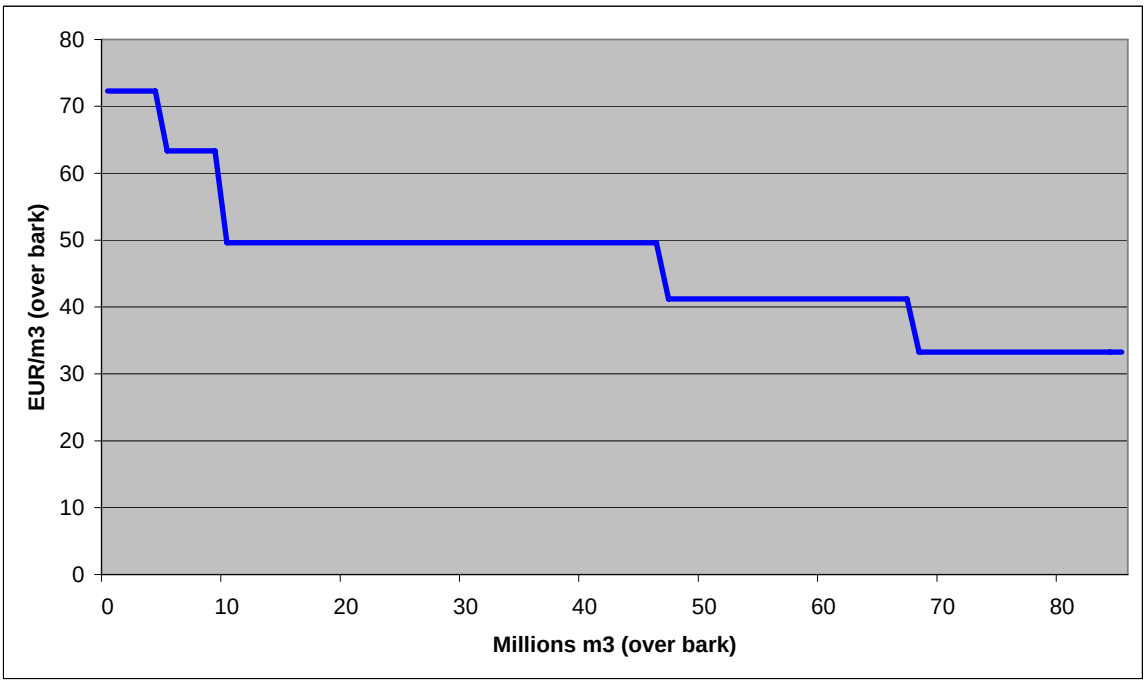

Figure 11: Demand curve for wood in the Swedish forest industry before adjustment measures

We have made calculations of the profitability for our different mills. Our calculations fit well with the picture of the ability to pay for wood you present here, and also the ability to pay for electricity that your conventional DoS model shows. Our mills might be threatened by the wood prices or the electricity prices – or both.

On the right, with an ATP of over 30 EUR/m3, we have the pulp industry. According to table 5, the prices of pulpwood had already reached 36 EUR/m3 by 2007, indicating that the Swedish pulp industry cannot even afford today's prices. Sawmills show a high demand for wood at 50 EUR/m3. According to table 5, today's prices are at 57 EUR/m3. Together these two industries demand more than 55 Mm3 (over bark), more than half of the wood used by the Swedish forest industry.

Newsprint has the second highest ATP for wood at 63 EUR/m3. On the other hand, newsprint has some of the lowest ATP for electricity and is threatened by increasing electricity prices. The ATP for electricity has been around 30-40 EUR/MWh for newsprint. However, in this paper we will not discuss electricity prices.

Does this mean that important parts of the Swedish forest industry will be forced to close down and that large amounts of wood will be destined to other areas such as energy? We think that one conclusion is that that the Swedish forest industry is already facing problems today. This is rather obvious when you read company statements and witness the closure of plants in Sweden (and in the other Nordic countries). However, several important adjustment measures on the forest market can be undertaken in order to stop such a drastic closedown as the demand curve suggests:

1. After a mill has closed down, some of the wood that is not consumed by the Swedish forest industry will be supplied to the Swedish market for bioenergy, after the price of wood comes down in Sweden. But that demand is much less than 55 Mm3 (if all saw and pulp mills would be closed down), which corresponds to more than 120 TWh bioenergy.
2. Unlimited volumes could go for export. This could also happen after the price of wood has decreased in Sweden. However, if Sweden exports wood it would get a comparative advantage over foreign competitors.

The conclusion is that the closures of Swedish mills will be limited to one or a few mills. The demand curve is only an indication that the Swedish forest industry has problems, and might show small reductions now and then during the coming years (instead of the small increases of the last years - compared with the rapid expansion of the Brazilian pulp industry or the Chinese paper industry).

The Nordic forest companies are relatively small players in the global market, which is a competitive market with regard to transportation costs. However, they can affect the wood prices in the Nordic region as described above.

The industry that has an ATP of more than 60 EUR/m3 is newsprint. They use mechanical pulp or waste paper and therefore do not use large amounts of wood. That is the reason why they have a high ATP for wood. On the other hand they are very electricity-intensive. With the DoS model calculations for electricity, newsprint has a low ability to pay for electricity (30-40 EUR/MWh based on the statistics until 2005).

Today no Nordic pulp and paper company will invest in a new mill. Even reinvestments in major repairs are questioned.

In chemical pulp, the energy share of the investments is already 60% in some cases. This might increase to 80%.

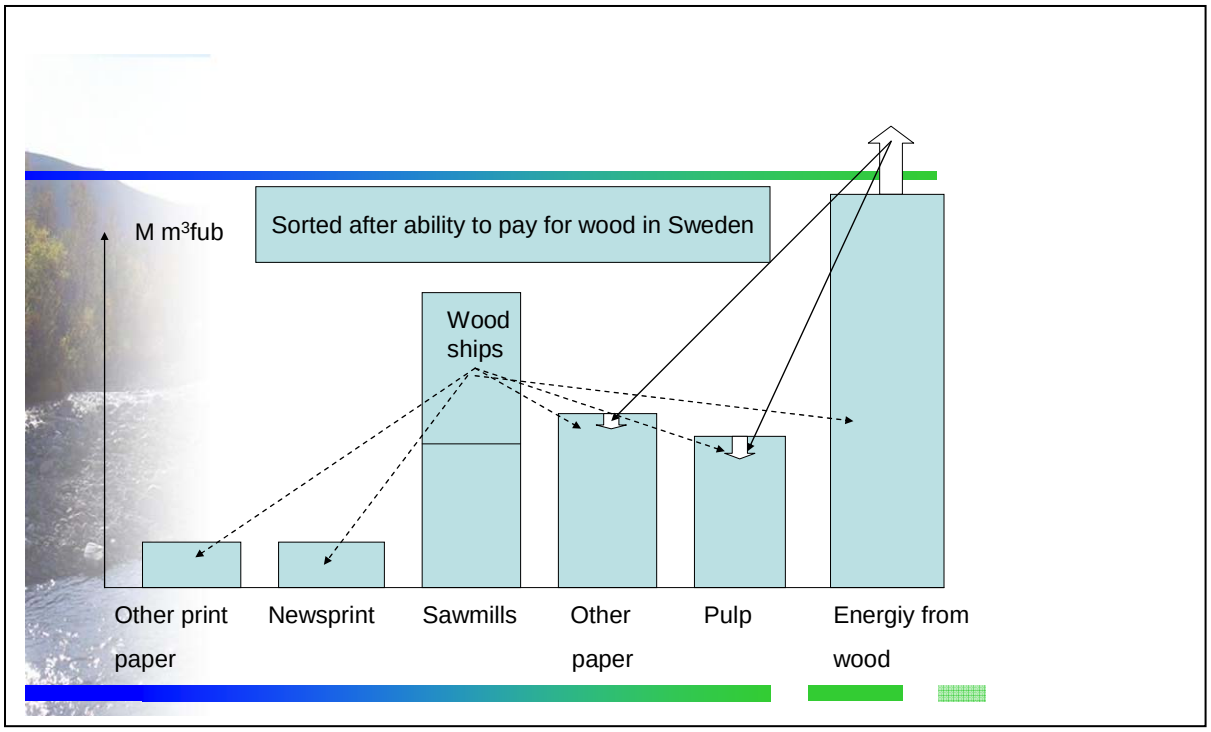

Figure 12: An illustration of interaction between different forest industries.

Saw dust and bark from sawmills are used (about 50% become rest products and 50% become timber) in pulp production and in the energy system. In Canada, the pulp industry has problems due to lower production in their saw mills and thus higher costs to buy round wood instead of saw dust etc.
An increased use of energy wood will interfere with pulp and paper production. Those with the lowest ability to pay for wood, in this example pure pulp production and other paper producers will stand to lose. Production will decrease because of increasing competition from energy wood.

7 Some conclusions for the Nordic forest industry

It would seem natural that existing forest resources in the Nordic region will be used in some way or another, at least partially, regardless of developments in the rest of the world. However, according to some industry representatives, this may not necessarily be the case.

As we have stated earlier, the timber, pulp and paper markets will be influenced by the following factors:

- High global use of bioenergy might lead to higher round wood prices for the forest industry. If global prices for round wood increase, this perhaps will not affect the competitiveness of the Nordic forest industry (the prices of forest products could increase around the world). However, regional price differences will have an impact on the competitiveness of the Nordic forest industry.

- A high increase in demand (about 10% per year) in developing countries such as China and India may be expected.
- A low increase in demand in developed countries (so far some per cent per year). In the US, demand for newsprint has actually already declined and after the financial crisis increases are not probable in Europe.

- Even though sea transport costs are low per km, local production is an advantage. For instance, it is very difficult for Nordic pulp and paper companies to compete on the Chinese market with products produced in the Nordic region. Instead the Nordic forest industry builds production plants in China.

- Today countries that have rain forests (Indonesia) or the capability to grow eucalyptus (Brazil) exhibit the strongest pulp production development. Production increase in the Nordic countries has been around 1% per year. Now plants are closing in all the Nordic forest countries.
    - Eucalyptus grows some ten times faster than forests in the Nordic countries. This has given countries with possibilities for such plantations a comparative advantage over the Nordic countries. However, Brazilian wood prices have increased compared with North American prices in the last few years.

    - There is a time lag of decades between the start of eucalyptus plantations and production of pulp.

    - Transportation costs for pulp are less than those for wood. This is an argument for pulp production in countries with fast growing forests, as it means lower transportation costs. However, it takes money and time to build up an infrastructure for mills, harbours etc. China has shown good capability to build state-of-the-art paper plants. If countries like Brazil and Indonesia are also able to build new pulp plants they could reduce their transport costs. Pulp production in these countries has already increased significantly. If they also build up their paper production capacity they would get the benefits of integrated production of pulp and paper.

- Climate and environmental policy might restrict future expansion of woods such eucalyptus. This would reduce the world supply of wood and pulp and would result in higher prices for forest products – especially if demand for bioenergy is high. This would probable imply higher pulp prices and could also imply higher prices of paper and products from saw mills.

- The Nordic countries normally have integrated production of pulp and paper. This constitutes an advantage, as it allows for more energy effective production. Other advantages of the Nordic forest industry are shorter distances to the west European markets and the possibility to produce long fibre pulp. Long fibre pulp cannot be substituted with pulp from eucalyptus in some paper products such as newsprints – at least not yet. High salaries are not a problem for paper and pulp production as salaries are not a significant cost factor.
    - If countries near the equator would increase their production of pulp, and perhaps also their production of paper, they would not only have the capability to satisfy increased demand from developing countries, but also to take market shares from the traditional paper producing countries, currently with the exception of products that demand long fibre pulp. An expansion of the Russian forest industry, which also has a huge potential, would give a similar effect. It could even be worse for the Nordic industry since Russian pulp producers are able to produce long fibre pulp. All these developments constitute threats to the Nordic forest industry.

    - A key question is whether China will succeed in importing fibres for its paper industry at reasonable prices. This is the case today, and we are still seeing low prices for both pulp and paper. However, if Chinese demand cannot be satisfied, the prices of pulp, and thereby perhaps paper, would increase considerably. The quantities China that requires are well above the quantities that are traded in the world, and could easily result in substantial price hikes for pulp and perhaps paper. If paper prices would indrease this would benefit the Nordic forest industry, just as the "Chinese effect" we have witnessed in the energy and some of the metal industries. Wood could also be released to the energy sector.

    - A partial analysis gives a very high elasticity (price sensitivity) for wood prices in the Swedish forest industry. The pulp and sawmill industries are having problems with present-day prices of wood. The conclusion, before considering adjustment measures, is that whole industries could be driven out of business. However, a closure of one or two mills would imply rather high increases of wood exports. With wood exports Sweden would get a comparative advantage against the importing countries. Wood could also be released to the energy sector.

So in practice the price elasticity of wood is much less, and closures would be expected to occur "one mill at the time". However, the calculated price elasticity (the demand curve for wood in Swedish forest industry) shows a direction of development, and this is worrisome for the Nordic countries.