Chapter 1 - Recycling – a Challenge to Forestry and Forest Industry

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Recycling activities today are closely linked with the efforts in many countries to introduce a cycle-driven economy. Driving forces to get more or less closed material flows is the necessity to avoid or reduce wastes and to preserve non-renewable raw materials and energy sources. Particularly in densely populated countries capacities of existing landfills will be exhausted in the foreseeable future and it will become increasingly difficult to set up new deposition sites.

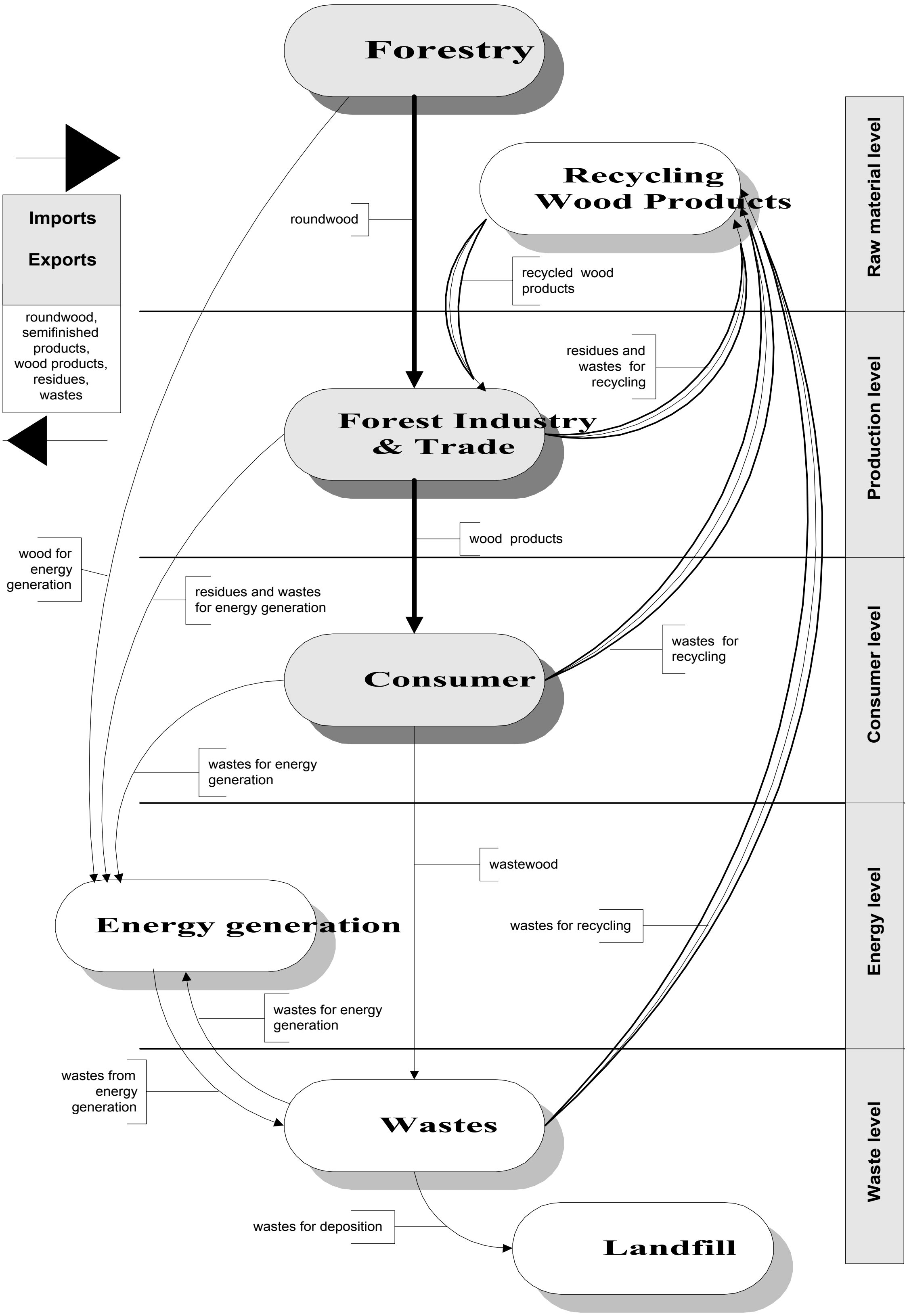
For example in 1993 nearly 80 % of Germany´s existing landfills were estimated to close down within 10 years, if nothing would change in view of the ongoing accumulation of waste supply. The new "Waste Avoidance, Recycling and Disposal Act" that entered into force in autumn 1996 should become an efficient tool to ease the situation.

Among the manifold measures to solve problems with increasing waste supply, recycling plays a key role also in the forest industry sector. The success of recycling activities generally depends on technological innovation (e.g. fast-running waste paper processing), economic incentives (cheap raw materials such as waste paper or wood residues) and ecological arguments (supported by the results of life-cycle-analysis).

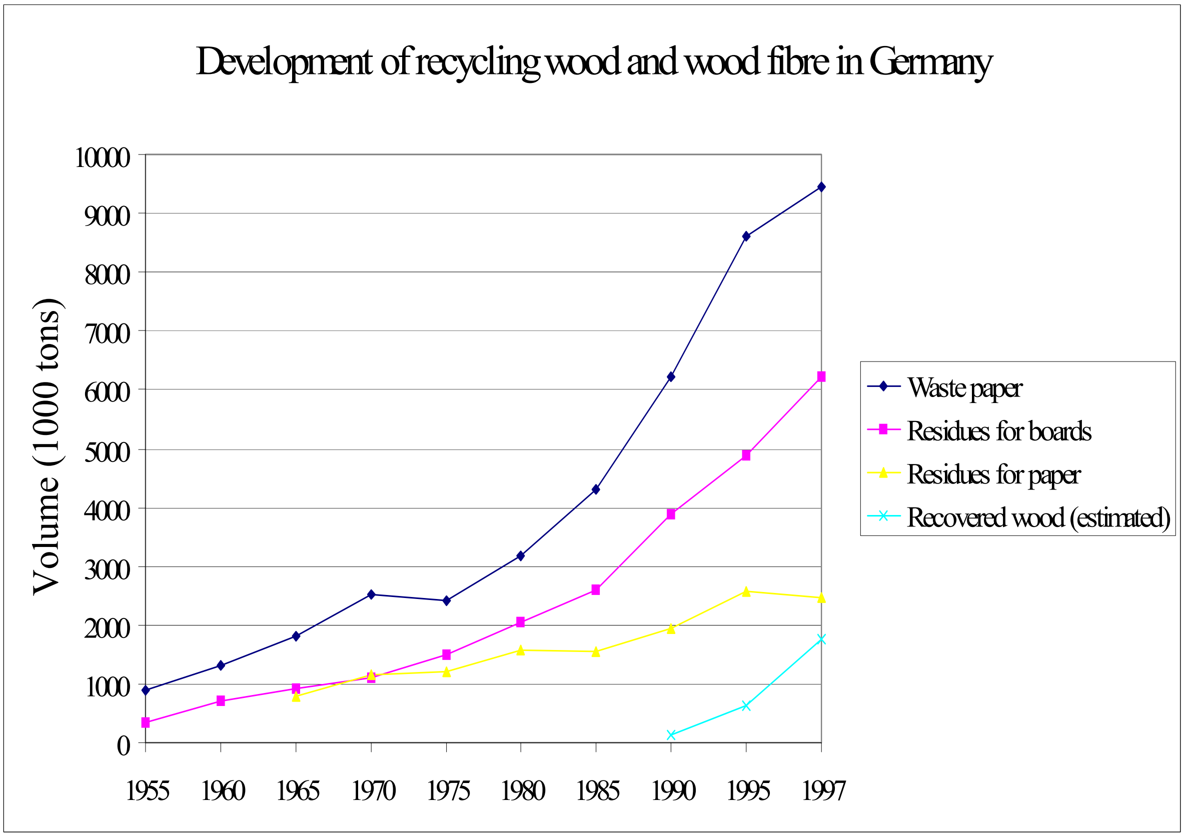
Within the whole forest industry sector recycling is on the victory path **(Annex 1)**. The competition between virgin and recovered materials applies to nearly all levels of the wood chain. Chips from wood processing, mainly originating from the saw milling industry, have been successfully mobilized to produce paper or panel products. Waste paper and packaging materials left by consumers or traders also have been recycled for decades. Even at the "end of the pipe" - on the waste level - pressure is growing to preserve limited space for deposition. Hence wood wastes (e.g. furniture or demolition wood from buildings) will be more and more denied to enter deposition sites in order to fulfill strict waste regulations.

Germany is one of the countries where the volumes of recycled wood and paper products are steadily growing. The recycling of recovered wood as the youngest branch is also clearly pointing upwards. It is estimated that there is still a huge potential of wood wastes ready to be activated for recycling. Technological innovations to improve the re-use of windows, particle boards or furniture successfully entered the market demonstrating that the activities in this field have just been strengthened. Further progress within the next years is to be expected.

Forestry has become strongly affected by this development. Recycling of used wood products led to a loss of market share for forest enterprises. Particularly the demand for small-sized wood has been influenced severely by the competition with waste paper, wood residues and recovered wood.



Forestry
Recycling Wood Products
Imports
Exports
roundwood, semifinished products, wood products, residues, wastes
roundwood
recycled wood products
residues and wastes for recycling
Forest Industry & Trade
wood products
wood for energy generation
residues and wastes for energy generation
Consumer
wastes for recycling
wastes for energy generation
wastewood
wastes for recycling
Energy generation
wastes for energy generation
wastes from energy generation
Wastes
wastes for deposition
Landfill
Raw material level
Production level
Consumer level
Energy level
Waste level



Development of recycling wood and wood fibre in Germany
Volume (1000 tons)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
1997
Waste paper
Residues for boards
Residues for paper
Recovered wood (estimated)

Chapter 2 - "Post Kyoto energy policy strategy" The RES strategy and action plan

by Ms. Mariangels Perez Latorre
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With the recent signature by the Commission of the Kyoto Protocol it is most timely to debate on what our Post-Kyoto Energy Policy Strategy ought to be. In order to do so it is essential to assess the implication for energy of the Kyoto Protocol. First of all the European Commission considers it necessary that everyone has a clear view of the main factors regarding the impact of energy on greenhouse gases. Second, it will be essential to determine how it will be possible to reduce the use of energy sources with high carbon emissions while continuing to encourage the use of energy sources with low or no emissions. It is in this context that the promotion of renewable energy sources, energy efficiency and combined heat and power will be important developments in the framework of the liberalisation process of the electricity and gas markets. Nevertheless, in addition to the Community's strategies proposed by the Commission on Renewable Energy Sources, CHP and Energy Efficiency we need also to see how we can best complement Member States own actions with those at Community level to develop Common and Co-ordinated Policies and Measures (CCPMs) and meet the objectives agreed in the Kyoto Protocol.

Which are those objectives ?

In the pre-Kyoto scenario "business as usual", in total, energy related greenhouse gas emissions (i.e. energy related CO_2, CH_4 and N_2O) are expected to exceed their 1990 level by 8% in 2010 (growing at 0.4% p.a.). The Kyoto Protocol, in contrast, calls for an 8% decrease of greenhouse gas emissions below the 1990 level by 2010 (however for the basket of six gases with an option to choose 1995 as the base year for HFCs, PFCs and SF_6). The technical potential which was identified prior to Kyoto must now be harnessed to achieve the challenging objective of reducing the emissions of these six gases. To do so we need to go beyond a business as usual policy framework. A set of Common and Co-ordinated Policies and Measures (CCPMs) has to be developed (i.e. progressive reduction removal of fossil fuel and other subsidies, tax schemes and regulations which counteract an efficient use of energy, increase of minimum taxation level as a way to reduce GHG emission and improve energy efficiency, RES and CHP programmes and energy efficiency improvement in the transformation, transport, building and heavy industry sectors). In addition to these policies and measures (CCPMs) mentioned there is also a need for new "Kyoto Instruments" of emission trading, joint implementation and the clean development mechanism. These Kyoto flexibility instruments are new supplementary policies in achieving our greenhouse gas commitments.

I have mentioned the proposals made by the Commission on RES, CHP and energy efficiency, that are given in more details, as follows :

Energy efficiency

Improved energy efficiency is judged to be a major potential contributor in our efforts to meet Community Kyoto commitments. It has been shown that it is possible to reduce significantly Community energy consumption in production processes, as well as in transportation, heating, cooling, lighting and other end-users without reducing the quality and quantity of energy services. It is generally accepted that in the framework of the new liberalised market companies have to move from energy producers schemes to energy services suppliers schemes. In the recently adopted communication on Energy Efficiency in the European Community, the Commission outlines the element of a strategy to realise the energy efficiency potential available between now and the year 2010. This potential is judged to be around 18% of 1995 energy consumption. This communication proposes measures covering all energy using sectors including industry, transport, domestic and territory and the energy transformation and distribution sectors. Those measures are intended as a first step in developing a Community strategy for the rational use of energy that will be followed by an Action Plan.

Combined Heat and Power

Last December a Council Resolution following a Commission's proposal was adopted on Combined Heat and Power with the objective of doubling its contribution by 2010 from its present share of 9% in the total gross electricity generation. This indicative objective is considered as realistic and would contribute to reduce CO2 emissions by an estimated 150 million tonnes of the Community's Kyoto Strategy.

The overall impact of electricity liberalisation on co-generation is likely to be positive. On the other hand, the recently adopted gas directive should increase the availability of gas at more competitive prices to larger consumers and thus contribute to improve the economic viability of gas fired combined heat and power plants. Also the White Paper on Renewable Energy Sources refers to the importance of CHP for the success of the biomass implementation objective as far as almost one third of the new additional biomass exploitation by 2010 could fall in this category.

Renewable Energy Sources

The recently adopted Council Resolution on the Commission's Communication "Energy for the future: The renewable energy sources" a White Paper on a Community Strategy and Action Plan highlights the importance of promoting RES to achieve the Kyoto's objectives.

In its resolution the Council considers the overall target of doubling the share of RES by 2010 as a guidance for Member States, encouraging them to build their own strategies and individual targets being the important role of national and regional policies for an effective market penetration. On the other hand, invites the Commission to pursue the White Paper implementation and, more precisely, the Campaign for Take-off. This support to the White Paper is justified by the central role of RES development in the effort of implementing the Kyoto's Protocol and the reduction of greenhouse gas emissions, the economic potential of the RES sector in terms of exports and fuel savings, the opportunities for employment in industry and services and the major role of RES in the development of local resources.

In other terms, the benefits of promoting and developing the market penetration of RES are affecting positively the implementation of the main Community priorities and concerns such as environment, job creation, local and regional development for a strength economic and social cohesion and, obviously, the main energy policy objectives: the security of supply, the improvement of the energy balance and the reduction of energy dependency.

In order to achieve the goals of the RES Community Strategy in a more competitive and liberalised market there is a need of institutional commitment and improved co-ordination at the Union's level, a strong parliamentary support to adopt measures and a widely dissemination to aim the public opinion and increase the demand.

Let me go more into detail on this RES strategy and Action Plan which objective is doubling the part of RES from 6% in 1995 to 12% in 2010.

The strategy and Action Plan

A central aim of the Strategy and Action Plan is to ensure that the need to promote renewable energy sources (RES) is integrated in new policy initiatives, as well as in the full implementation of a wide range of policies: energy, environment, employment, taxation, competition, research, technological development and demonstration, agriculture, regional, and external relations policies.

The Strategy and Action Plan aims at providing fair market opportunities for renewable energies without excessive financial burdens. It proposes a list of priority measures and actions aimed at overcoming obstacles and redressing the balance in favour of renewable.

In the context of the Internal Market it proposes: the better and fairer access of RES generated electricity to the network market; fiscal and finance measures; new bioenergy initiatives for transport, heat and electricity, such as the promotion of biofuels, biogas and biomass; improved building regulations to promote the use of RES, by introducing solar energy for electricity, heating and cooling.

It foresees the reinforcement of the “RES component” of different European Union policies. In this context it includes actions such as the strengthening of the competitive edge of the European industry, the investigation of opportunities for the appropriate modifications in favour of RES through the Common Agricultural Policy and the rural development policy. The Commission's proposal for the new Regional Fund regulation includes RES as one of the main priorities with environment and employment. Member States have one year to submit their RES programmes to the Commission, a rate of 12% of energy funding would be considered as a minimum. The promotion of RES through the Common Agricultural and the rural development policy, although the CAP reform is under discussion in the framework of the Agenda 2000, seems to be sure that the compulsory set-aside rate could be 10% instead of zero as proposed in 1997. The promotion of RES in the framework of the external relations with special emphasis to the ACP and associated countries and its new proposal on the Development Fund 7, also establishes RES as a priority with a minimum rate to be funded.

Finally, it proposes support measures, such as the targeted promotion through various EU programmes, consumer information and awareness, improved access to finance and a RES networking including regions, islands and cities aiming at a 100% supply from RES, or the twinning of cities, schools, farms, etc., using RES.

The Campaign for Take-Off

In order to assist a large scale penetration of renewable and make progress towards the objective of doubling their share by 2010, a co-ordinated campaign for a real take-off RES will be planned over a number of years in order to promote the implementation of large-scale projects in different RES sectors. The role of the Member States is critical in this concerted action and the Commission will establish the framework, provide, where appropriate, technical and financial assistance, and co-ordinated actions. Many parties can be potentially active in this campaign including the regions, municipalities, town and country planning bodies, farmers associations and industry associations.

The Campaign foresees four key actions promoted and co-financed by the Union:

- An EU wide initiative to install 500,000 photovoltaic roof and facade systems in the domestic market (schools, public buildings, tourism, sport and recreational facilities) and an export initiative for 500,000 village systems to help start decentralised electrification in developing countries.

- The installation of 10,000 MW of wind farms in locations with favourable conditions. The 10,000 MW of wind farms represent 25% of the feasible overall wind energy penetration by 2010.

- 10,000 MW of biomass installations for combined heat and power plants, which could range in scale from a few hundred kW to multi-MW and combined different technologies. The 10,000 MW of biomass installations represent 1/6 of the total estimated contribution biomass could make by 2001.

- The integration of RES in 100 communities, in order to use these energies in integrated systems for local power supply or in dispersed schemes for regional power supply. A number of pilot communities, regions, cities and islands will be selected from those which can reasonably aim at 100% power supply from RES. They will be of varying size and characteristics.

Member States have invited the Commission to submit a new proposal extended to solar thermal energy systems and a financial plan for the overall Campaign for Take-Off.

The role of the Member States

The overall EU objective of doubling the share of RES to 12% by 2010 implies that Member States have to encourage their increase according to their own potential. Targets set by each Member State could stimulate the effort towards increased exploitation of the available potential. It is important, therefore, that each Member State should define its own strategy and within it propose its own contribution for the achievement of the EU target.

Member States will have a key role to play in taking the responsibility to promote RES, to introduce the measures necessary to execute the Action Plan and achieve the national and European objectives. Measures should be taken at the appropriate level according to the subsidiary principle within the co-ordinated framework provided by the Strategy and Action Plan. Legislative action will only be taken at EU level when measures at national level are insufficient or inappropriate, or when harmonisation is required across the Union. The Strategy and Action Plan will be flexible and updated over time in the light of experience gained and new developments.

In that sense, the Commission has launched an enquiry over Member States on their existing and planned strategies and actions plans, programmes and measures.

Before the adoption of the White Paper only few Member States had established their own strategies or action plans. Now things are progressing and countries like United Kingdom, Italy or France are developing plans on RES.

What is the situation ?

Denmark has an energy action plan (Energy 21) with targets up to 2005, 2010 and 2030 focussed on biomass, wind and PV (IPEC: 11% in 2005, 15% in 2010) (TELECT: 20% in 2005, 30% in 2030).

Finland and Sweden have plans focussed mainly in biomass, wind and hydro.

Austria is developing biomass for heating and electricity, hydro and solar thermal and PV in buildings.

The Netherlands have an ambitious plan focussed mainly in biomass, wind and solar thermal and PV in buildings.

Spain is updating the RES plan in order to meet the objective of doubling the share of RES from 6% to 12% in 2010.

Italy has started a consultation process with regions in order to elaborate a national White Paper. A 10,000 PV system campaign is announced.

France is intended to establish a plan in the coming months.

Ireland is updating its plan that will focus mainly in biomass and hydro.

The United Kingdom has the intention to revise their policy measures in order to meet the White Paper. A possible target for electricity (10%) is also announced.

Greece is building up a plan that focus on solar and biomass.

Portugal will probably elaborate a plan within this year.

Germany has introduced supporting measures and some Länder have established plans.

Belgium and Luxembourg will introduce measures mainly to promote biomass and solar systems in buildings.

The first EU strategy and action plan for renewable energies, 1998-2010

Council Resolution 11 May 1998

- Kyoto climate change protocol, December 1997
- Agenda 21: Action for Sustainable Development
- Commission White Paper on Growth, Competitiveness, and Employment
- Commission White Paper on RES, November 1997
- ALTENER II programme
- RTD & D for Renewable
- Harmonisation of conditions of access for RES-generated electricity on the internal electricity market
- Accepts 12% RES target (doubling) at EU level by 2010 as a useful common goal
- Underlines importance and encourages role of national and local policies for effective market penetration (*bottom-up approach*)
- Exhorts Commission to pursue White Paper implementation process (Take-Off, Altener programme...)

Strategic priorities

- Central role of RES development in the effort against CO_2 (Kyoto)
- Economic Potential (exports, fuel saving ...) of RES for the EU
- Opportunities for employment
- RES as a typical local resource, to be encouraged and facilitated as a priority

Renewable Development - Benefits

- Environment
  - CO_2 reduction
  - other pollutants (acid rain ...)
- Job creation
  - domestic market
  - exports
- Local and regional development : *economic and social cohesion*
- Import reduction
  - security of supply
  - trade balance
- Avoided fuel costs

For a successful RES Strategy - What can we do?

- Institutional commitment and improved co-ordination

- Strong parliamentary support
    - EU
    - national (subsidiarity)
- Win and reflect public opinion (role of individual consumers)

Commission White Paper on Renewable Energies COM(97)599, 26.11.97

- Strategy aiming at doubling RES share in EU energy balance by 2010: from 6 to 12% - based on an
- ***Action Plan***:
    - to provide market opportunities without excessive financing burdens
    - proposes priority measures and actions to overcome obstacles and redress balance

Action Plan

Support Measures
- Targeted promotion (Altener II)
- Market acceptability + consumer protection
- Promotion of RES to the banks
- RES networking

White Paper
- Internal market measures
- Reinforce Community policies
- Support measures
- Campaign for take off
- Improve co-ordination with Member States

Internal Energy Market measures
- Fair access to liberalised electricity market
- Fiscal and finance measures
- Bio-energy initiative for
    - transport (liquid bio-fuels)
    - heat and electricity (*solid biomass, biogas*)
- Improve building regulations

Reinforce Community policies
- Environment
- Growth, Competitiveness and Employment
- Competition, state aids
- RTD & D: Fifth Framework Programme
- Regional Policy
- CAP: Agenda 2000
- External Relations

Campaign for take-off

- 1,000,000 photovoltaic systems
  - ½ roof and facade in EU
  - ½ small local plants for developing countries
- 10,000 MW large wind farms
- 10,000 MW biomass installations
- 100 communities as renewable pioneers

Action Plan: strengthen co-operation between Member States

- Differences between them
  - natural differences (resources, geography, ...)
  - Member States' RES policies
  - different types and use of technologies
- Proposed Council Decision "organisation of co-operation around agreed Community energy objectives"
- Working Group (Commission and Member States)
  - monitoring and evaluation of strategy and Action Plan

Estimated contributions by sector in the 2010 scenario

Type of energy	Share in the EU in 1995	Protected share by 2010
1. Wind	2.5 GW	40 GW
2. Hydro	92 GW	105 GW
2.1 Large	(82.5 GW)	(91 GW)
2.2 Small	(9.5GW)	(14 GW)
3. Photovoltaics	0.03 GWp	3 GWp
4. Biomass	44.8 Mtoe	135 Mtoe
5. Geothermal		
5.a Electric	0.5 GW	1 GW
5.b Head (include heat pumps)	1.3 GWth	5 GWth
6. Solar thermal Collectors	6.5 Million m^2	100 Million m^2
7. Passive Solar		35 Mtoe
8. Others		1GW

Estimated investment costs and benefits of the overall strategy in the 2010 scenario

Total investment energy sector RES: 2010 of which Renewable	249 billion ECU 39 billion ECU
Total investment RES in Action Plan	165 billion ECU
Net investment RES in Action Plan	95 billion ECU
Annual net investment RES in Action Plan	6,8 billion ECU
Additional net investment dur to RES	74 billion ECU
Increase of total energy sector investment 1997-2010	29.7%
Avoided annual fuel cost in 2010	3 billion ECU
Total avoided fuel cost 1997-2010	21 billion ECU
Import reduction (ref. 1994)	17.4%
CO_2 reduction (with respect to 1997)	up to 402 million tn/year
(With respect to the 2010 pre-Kyoto scenario)	250 million tn/year
Annual benefits from CO_2	5 to 45 billion ECU

Current and projected electricity production by RES for 2010

Type of Energy	1995 % of total	2010 % of total
Wind	0.22	2.8
Total Hydro of which Small	13 12	12.4 15.5
Photovoltaics	-	0.1
Biomass	0.95	8.0
Geothermal	0.15	0.2
Total Renewable	14.3	23.5
Renewable Twh	337	675

Chapter 3 - Wood Energy and Changes in Trade Patterns

by Mr. Bengt Hillring
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Department of Forest-Industry-Market Studies (SIMS)

A number of different factors influence the wood and fibre markets. Consumers demand can influence the market as a market pull, and an example of this is the demand for ”green” electricity or electricity produced by renewable energy sources that has started in small scale in some countries. Authorities can also influence the markets, usually with a market push, and the typical example here is from environmental legislation, i.e. recycling systems.

Wood energy is an area that has grown fast in some regions and has even influenced European trade patterns.

Wood Energy

The production potential of the forests of Europe is, on a sustainable basis, some 30 % lower than the annual harvesting[1]. Experience from countries with an industrial use of wood fuels[2] shows that these fuels are produced most cost effectively in integrated systems with forest operations and the forest products industry. In many countries, economy is a limiting factor for harvesting forest stands which means that an oversupply in forest increment not automatically will lead to commercial wood fuel cuttings mainly due to low fuel prices[3].

In a Nordic (Swedish) system for energy production, wood fuels (excluding digester liqueurs and fuelwood for domestic heating) are used mainly by the forest products industry, but are also used in energy generation plants and in fuel plants for the production of upgraded wood fuels (such as wood briquettes and pellets). On forest land, wood fuel can be produced in integrated logging operations as branches, tops or small trees or as direct logging of wood fuels as residues from harvesting operations. Low quality logs and small trees are sometimes used for energy production.

Wood fuels are also produced as a by-product from the forest products industry. In recent years, recycled wood from the rapidly growing recycling industry based on demolition wood, and other wood fibre such as waste paper, has been increasingly used as fuel.

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[1] UN/ECE and FAO. *European Timber Trends and Prospects: into the 21st century*. Geneva Timber and Forest Study Papers, ECE/TIM/SP/11. Geneva. 1996.
[2] *Wood fuel:* Fuel originating from biological material (biofuel), the origin of which was trees or parts of trees. The term “*bioenergy*” is superordinate to the terms “*biofuel*” and “*wood fuel*”.
[3] Hillring, B. Regional Prices in the Swedish Wood-Fuel Market. Paper submitted.

A certain degree of competition prevails between heat plants and the particle board industry for raw materials such as sawdust and other by-products of the forest products industry. Production of wood fibre board and particle board has for different reasons decreased significantly in Sweden during the last decade. Utilisation of wood fuels has increased substantially, on the other hand, in part because of a market surplus and also because of a decline in the real price of wood fuels[4].

The industrial use of wood fuels is heavily dependent on the prices of competitive energy carriers, i.e. oil. It can however be affected by the existence of policy instruments, i.e. carbon dioxide taxes. Oil is traded on an international market, and the energy policy is up to now national. As can be seen in figure 1, the crude oil real prices are on the level at which they stood in the early 1970s.

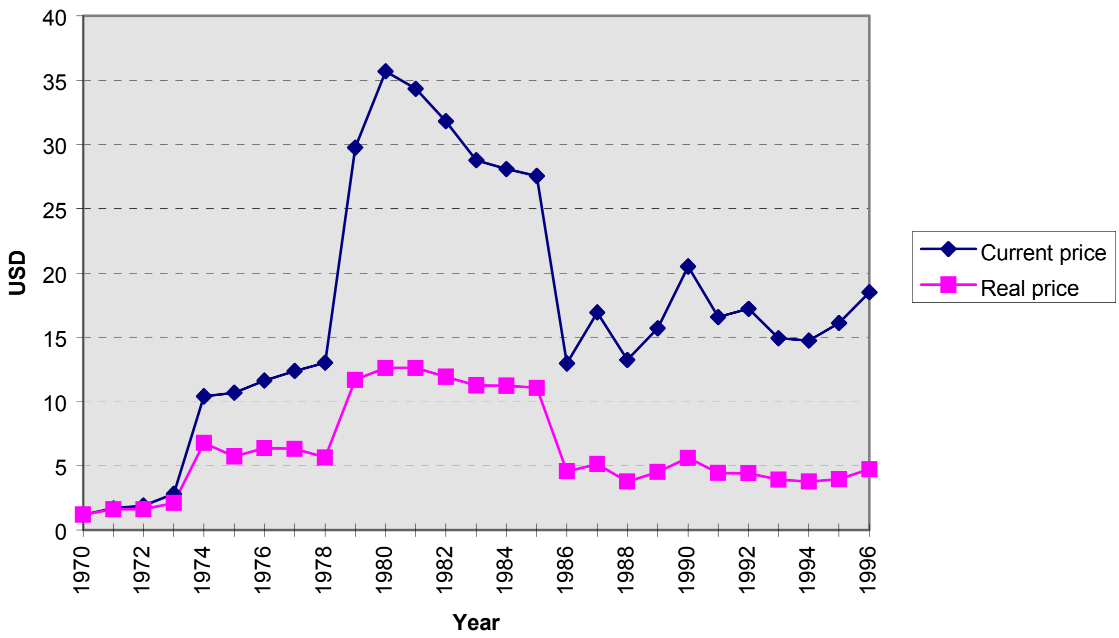

Figure 1 World market light crude oil prices, 1970-1996[5].

Swedish experience of an industrial wood fuel (biofuel) market is based on the development of the district heating sector[6] over a period of 20 years, from a low level in the 1970s to a substantial market

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[4] Hillring, B. P*rice Trends in the Swedish Wood Fuel Market*. Biomass and Bioenergy. Vol. 12, No. 1, pp. 41-51. 1997.

[5] *Energy in Sweden-facts and figures 1997*. Stockholm: The Swedish National Board for Industrial and Technical Development (NUTEK). 1997.

[6] District heating is a public heating system intended for supplying heat in networks to mostly residential buildings but also for industrial use. Heat is produced in and supplied from hot water boiler plants and combined heat and power plants in which heat and electricity are produced simultaneously.

in the late 1990s, as can be seen in figure 2. Wood fuels compete on the market with other untaxed biofuels. The highly taxed fossil fuels are not competitively priced.

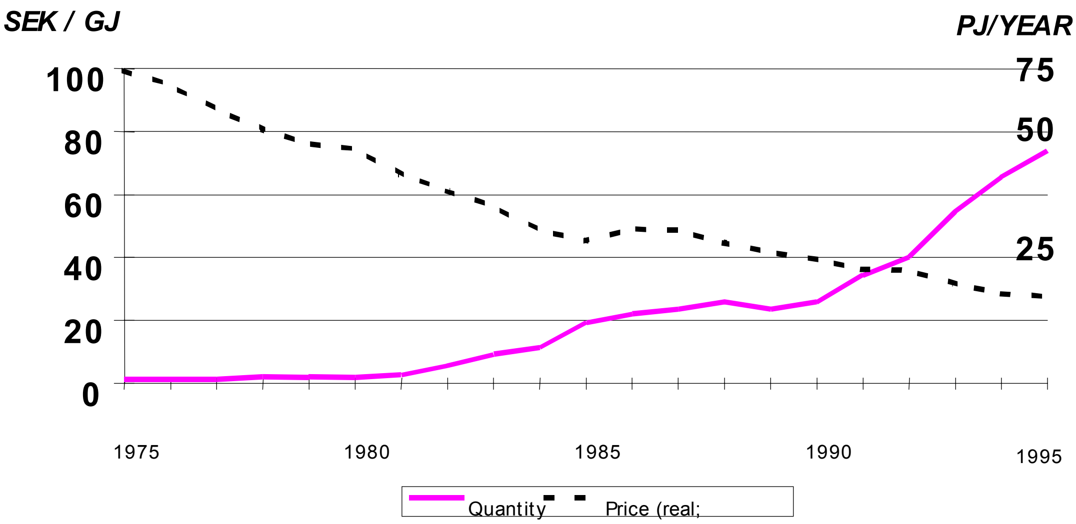

Figure 2 Principal of price development on the Swedish wood fuel market[7].

Production costs dominate price levels, as the physical access to wood fuels vastly exceeds the demand. There are many producers, and there is strong competition between them, showing transparency in their production costs. On such a highly competitive market, buyers do not need to pay a price higher than what is required to cover the producers costs plus a small margin in order to allow producers to continue their operations. The beneficial parts of this market system fall in this case into the hands of the buyers. Producers act on the market in response to the demands of the buyers rather than as independent actors[8].

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[7] Hillring, B. *The Swedish Wood Fuel Market*. Renewable Energy - An International Journal. Vol. 16, pp. 1031-1036. 1999.
[8] Ibid.

The industrial use of renewable energy sources, i.e. wood fuels, will decrease greenhouse gases and other emissions. Reduction of acidification with respect to the decrease in sulphur emissions compared to the use of fossil fuels has a positive influence on the condition of forests. However, compensation must be made for the negative effects on the nutrient content in the forest soil and biodiversity in the forests must be observed. The production of wood fuels should be integrated with regular harvesting operations, and the problems of nutrient re-circulation must be solved with respect to the total forest harvesting system.

New Trade Patterns

The general trend in Europe is that trade barriers are being eliminated between EU countries and trade will increase. Free trade is one of the fundament of the European Common market, and this will certainly develop new trade patterns between different countries. Wood fibre for the pulp and paper industry is traded on a world market. A new situation have occurred the last years when wood fuels of different qualities also have been traded. In this paper, I would like to stress one Swedish example of this new trade pattern based on differences in taxation and legislation between EU countries.

Solid Wood Waste imported to Sweden

Mainly because of high taxes on fossil fuels in Sweden and new more extensive waste legislation in some European countries, i.e. Germany and the Netherlands, the imports of recycled wood fuels and other biofuels have increased dramatically during the past few years. This development has been facilitated by the stronger biofuel purchasing power that Swedish heating plants have in relation to foreign competitors whose use of fossil fuels is not taxed.

The assumption for trade is that the transport system is based on low variable costs for shipping transportation between the regions.

From no trade in biofuels in the early 1990s, the import of biofuels has increased rapidly and was in 1997 approximately 30-35 PJ, or up to 30-40 % of the supply of biofuels for the district heating sector[9].

Waste originating from biological material is classified in the Swedish system as biofuel and is therefore untaxed. In addition to waste produced domestically, in the past few years there has been an import of waste of different kinds. This import may be recovered wood from used furniture, demolition wood from old buildings or even municipal solid waste imported from another country. The amounts of waste imported to Sweden are significant, with calculated quantities for 1997 of several hundreds of thousands of tonnes. The import of recovered wood to the country in 1997 was estimated at 10-15 PJ[10].

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[9] Hillring, B. & Vinterbäck, J. Development of International Wood Fuel Trade. Manuscript.
[10] Ibid.

The import follows EU regulations that divide waste into three main categories: green, yellow and red[11]. The waste that is listed as green is free for trade between countries, and examples are demolition wood, straw from cereal cultivation and rubber tires.

For import from the yellow list, the importer must be registered with authorities; this type of waste consists of products contaminated by arsenic or other hazardous substances. The importer must also have a certificate from the end user concerning destruction of the waste.

Red waste is the most risky, and imports require permission from authorities.

Most of the waste imported is considered green, but discussions are currently going on between importers of waste to Sweden and authorities as to whether the imported waste should belong to the green or the yellow list. Action has been taken to reduce the content of metals and other contamination's in the imported recovered wood. Discussions and investigations are going on between importers of waste and the national environmental authorities on the subject of waste categorisation.

Chapter 4 - State Energy Policy and Generation of Energy from Biomass in Slovakia

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Introduction

The economic transformation in Slovakia, accompanied by the considerable decrease in production within the most sectors of national economy, has caused decrease in energy and fuel consumption. Comparing the year 1989, the total annual energy consumption, in 1994, has decreased in 20 %. Since 1995, as result of gradual increase in economic production, the consumption of energy and fuel has been increasing and the level of their consumption, already reached in the year 1989, has to be reached again round the year 2000, when the total annual consumption of energy and fuel will be at 950 up to 1,000 PJ.

During this decade the gradual change in the structure of fuel consumption is expected Especially, there is the considerable increase in natural gas consumption. More than 25 % of electricity has been produced by coal combustion in thermal power stations equipped by desulphurisation systems.

Slovakia has to import approximately 90 % of the primary sources of energy and reserves of the domestic, non - renewable sources of energy are very limited. Therefore, increased demands of energy have been forcing us towards more rationalised use of non- renewable sources of energy.

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[11] EEG No 259/93; "*The councils ordinance (EEG) No 259/93 of superintend and control of waste transports inside, to or from the European Community*".

Concerning the use of renewable sources of energy, only the very small attention has been paid to until 1991. Main reasons for such situation has been the centralization of the sources of energy, as well as, the considerable financial support and subsidies towards the classical fuels and produced energy.

Except of the water energy, the most important renewable source of energy is forest and agricultural biomass.

At the present, biomass is used for energy only in production of heat. Forestry produces annually, on average, 400,000 tons of fuel wood with the energy value of 3,800 TJ, while more than 90 % of it has been sold for inhabitants. Only in very small quantity, which means approximately the amount of 10,000 tonnes, for the purposes of energy production forest biomass in form of chips has been used, with the energy value of 180 TJ annually. Organizations of forestry sector have their own consumption which is represented by the quantity of 2,000 tons annually.

Within the wood processing industry the quantity of 250,000 tons of waste wood has been used annually for the purposes of energy production. Agriculture biomass has practically not been used for energy.
Total quantity of biomass used annually for energy is 660,000 tonnes, with the energy equivalent of 6,270 TJ, which means 0,6 % of the total fuels and energy consumption.

Majority of boilers used for combustion of biomass, do not meet requirements from the point of view of environmental and energy parameters. The main obstacle to the development and modernization in technology for energy from biomass is lack of financial sources.

State energy policy and utilization of renewable energy sources

Strategic target of the Energy Policy is to supply energy to all consumers, whereby, energy has to be:

- produced at the lowest cost and the minimum environmental impact
- transported to the consumer safely and reliably
- used in the sphere of energy sources, transport and consumption as effectively as possible.

The main goal is to achieve the necessary level of certainty in obtaining energy resources and orientation of the energy sector towards efficient and environmentally acceptable technology for power generation and increased use of renewable and secondary energy sources.
Present energy policy is based on:

- economic development revival strategy
- forecasts of the gross domestic products (GDP) development
- strategy of providing of primary energy resources (diversification of imports, transit, storage capacities)
- strategy of fuel and energy supply to residential sector
- international conventions, declarations and documents (e.g. Energy Charter)
- opportunities and forms of foreign capital input.

One of the goals of the energy policy is to achieve a sufficient level of security in obtaining of energy resources. Following strategic goals will be crucial:

- to secure imports of strategically important raw materials and fuels (crude oil, natural gas, coal, nuclear fuel) on the basis of long - term contracts
- to search for options of diversification of natural gas and crude oil imports
- to provide for sufficient stock of solid fuel for both residential and power sectors
- to preserve domestic extraction of brown coal and lignite
- to change gradually the structure in the fuel consumption in favour of an increased share of environmentally preferable fuel types, particularly by the use of biomass
- to increase the transmission capacity of the transit system
- to establish legislation-type and economic conditions for higher use of renewable and secondary energy sources
- by further development of the transit system to increase transport of natural gas
  to build up transit power links with Austria and Poland.

Fulfilling of these intentions is very demanding from the investment point of view, it will require flexibility in the investment policy, using of combined capital sources and obtaining of suitable loans.

The overall review of the current energy production and energy consumption in Slovakia could be illustrated in the best way by the Energy Balance conceived for the period 1990 -1994, in order to provide history of the development within the sector since the foundation of SR.

Structure and Development of Domestic Energy Carriers

Carrier / year	**1990**		**1991**		**1993**		**1994**	
	PJ	%	**PJ**	%	**PJ**	%	**PJ**	%
Brown coal	54,0	49,1	47,0	56,6	47,7	65,5	48,8	62,9
Crude oil	3,0	2,7	2,9	3,5	2,8	3,8	2,8	3,6
Natural Gas	24,0	21,8	10,0	12,1	8,3	11,4	9,5	12,2
Hydro energy	11,0	10	8,0	9,6	13,9	19,2	16,4	21,2
Others	18,0	16,4	15,1	18,2	0,1	0,1	0,1	0,1
Total	110	100	83	100	72,8	100	77,6	100

Structure and Development of Energy Carriers Import

Carrier / year	**1990**		**1991**		**1993**		**1994**	
	PJ	%	**PJ**	%	**PJ**	%	**PJ**	%
Coal	279,1	29,3	247,4	30,7	213,3	29,7	193,4	27,1
Crude oil	269,3	28,2	207,4	25,7	187,5	26,1	198,1	27,8

Natural Gas	249,6	26,1	202,7	25,1	180,1	25,0	185,6	26,0
Nuclear	131,0	13,7	127,0	15,8	120,1	16,7	132,3	18,5
Electricity	26,2	2,7	21,8	2,7	14,4	2,0	3	0,4
Rest	0	0	0	0	3,7	0,5	1,3	0,2
Together	955,2	100	806,3	100	719,1	100	713,7	100

Distribution of overall energy consumption:

- imported - 73 %
- domestic production - 26 %
- stores - 1 %

The share of energy carriers in overall energy consumption:

- coal - 33 %
- gas - 28 %
- crude oil-petroleum - 19 %
- nuclear - 18 %
- hydro - 2 %

It has to be mentioned that in the table A.2.1 (Energy Balance) electricity generated from nuclear fuel is included in domestic production. Nevertheless, the nuclear fuel is 100 % imported. So in accordance with the tables D.2.1 and D.2.2 the nuclear fuel should be included in the imported energy carriers what means the really domestic production is 10,8 % and import 89,2 %. The only possibility to decrease the import is higher utilisation of domestic renewable energy sources and further implementation of rational use of energy.

Renewable energy sources

The use of renewable energy sources in Slovakia is not very high. The share of renewable energy sources in the overall primary energy consumption is slightly higher than 2 %. However Slovakia has quite a substantial potential, which is expected to be used mostly at regional level.

Data on theoretical and technically utilizable potential vary in different resources not only in terms of numeric data, but also in their structuring. Potential of renewable energy sources described in the Slovak energy policy is in following table:

Source	**Energy potential (PJ)**
Geothermal	7,160
Biomass - (forest and waste)	15,714
Small hydro	2,574
Solar	4,900
Wind	1,100
Industry and municipal waste	3,600

Waste heat	4,500
Total	39,548

Utilization of biomass for energy

Biomass is one of the most important renewable energy sources in Slovakia. The main utilisation is expected on regional level and depends on the development of each region.

The most suitable biomass types for energy generation in Slovakia are:

- forest biomass: wood and wood processing waste
- agriculture biomass: straw and manure for biogas

Expected forest biomass amount in the year 2010 is about 1,260.000 tons which is an equivalent of 11,4 PJ of annually generated energy.

Development of the annually utilizable amounts of biomass by 2010, suitable for energy generation, will depend on annual cut of wood, forest industry orientation and price changes of wood.

Currently, straw is not used for energy generation, only some portion is exported to Austria. The potential of straw depends on the production of cereals, which has decreases currently. The production of cereals in 1993 was around 3000. 10^3 tons, which means some 3200.10^3 tons of straw with energy potential of about 46 PJ. Supposed that 1/3 of straw could be used for energy production, the overall potential could be approximately 15 PJ annually.

Biogas generated mainly from animal manure, household waste and food industry, represents potential of approximately 15 PJ, which means that the realistic utilizable potential could be some 5 PJ. This is course the estimation based on the current situation viewpoint.
Potential sources of forest biomass for energy are in following table:

Biomass resources for energy

	AMOUNT tons/year	ENERGY TJ/year
1. Residues from forestry		
• Small wood<7 cm	250 000	2375
• Residues at landings	90 000	855
• Pre-commercial thinning	13 000	124
• Stumps	20 000	190
2. Fuelwood	440 000	4180
3. Residues from small wood processing plants	150 000	1425

4.	Fast-growing tree species (potential)	300 000	5100
TOTAL		1 263 000	14 249

In conditions of Slovakia there are the following prospective forms of energy production:

(a) Direct combustion of raw material

- central heating of buildings
- production of technological steam
- production of technological heat
- production of electricity (steam turbine, gas turbine) and utilization of waste heat,
- hot–air drying
- forest biomass as main fuel in combustion of communal and industrial wastes.

(b) Gasification of dry raw material

- production of electricity (gas motor + generator),
- production of electricity and utilization of waste heat,
- pyrolytic combustion for heating,
- combination of mentioned forms with woodcoal production.

(c) Briquetting of dried–out fine grained waste

- heating of houses, hot–air heating, etc.

Other forms of energetical biomass utilization could be implemented with difficulty considering economically reachable concentrations of raw material and present state of technology development.

Significant factors influencing method of energetical utilization and installed capacity (output) of equipments are as follows:

- qualitative parameters of biomass, mainly moisture and grain size,
- biomass concentration,
- energy consumption.

Moisture of forest biomass after short–term storage varies in the interval 40–45% and after long–term, approx. 1 year, storage in covered stockyards is approximately 20%. The raw material with moisture over 20% can be used effectively in direct combustion in special furnaces. Raw material with moisture below 20% can be gasified. For briqueting material must be with moisture content to 10–15%. Problem of moisture can be solved by an artificial drying which must be calculated into the energetical balance and cost of energy production.

In Slovakia an average theoretical concentration of raw material per one region is 15,500 $t.year^{-1}$ with respect of economical transportation distance up to 25 km. Actually a concentration of fuel biomass in consumption localities will be in range from 300–5,000 tons. Regarding biomass energetical properties brown coal and heating oils can be substituted by biomass. In regions where gas is not available for heating, biomass can be an alternative of natural gas.

Combined heat production and electric power can be applied at outputs over 500, resp. 1,000 kW in industry, or in district heating systems.

For direct biomass consumption it is necessary to have available heating equipments with capacity of 25–1,000 kW. The need of higher outputs will be solved by a design of equipment with greater capacity according to the users conditions or by installation of series of heating equipments. Special technologies will be used for biomass combustion with various waste.

Energetical gasification of dried raw material :

- Production of electricity in combination with using of waste heat in localities with raw material with corresponding moisture. According to energy consumption power stations with capacity 40–80 kW, occasionally their combination will be used. It will be used mainly in small woodprocessing plants.
- Production of electricity with utilization of waste heat in localities which are not within the public networks of energy production. Waste heat will be used partially for drying of gasified wood.

Pyrolytic combustion of fuel wood in the form of bolts will be used for of family houses and other small buildings with a need of thermal output of 20–80 kW. It will be especially applied for users who has a direct access to fuel wood (workers in forestry, forest owners).

Briquettes are ecologically advantageous substitution of coal in classic combustion chambers without necessity to treat them.

In 1993 and 1995 Forest Research Institute in Zvolen proposed the Conception of energetic utilization of forest biomass in Slovakia. The Ministry of Agriculture and the Ministry of Economy of the Slovak Republic have accepted the submitted Conception and it was consequently included in the State Energy Policy of the Slovak Republic by the year 2005 approved by the Government of the Slovak Republic.

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Chapter 5 - Outlook for U.S. paper and paperboard sector and Wood fiber supply in North America

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Abstract.

Consumption of wood fiber in pulp, paper and paperboard increased in the United States over the past century and is projected to increase well into the next century at a decelerating rate of growth. Harvest of pulpwood on forest land is the single largest source of wood fiber, followed by recycled paper and wood residues. In the past decade, wood residues declined in supply while use of recycled paper increased rapidly. Use of recycled paper is projected to increase more steadily in the future with slower growth in paper recovery for recycling. Harvest of pulpwood on forest land is projected to remain the dominant source of U.S. fiber supply through the first half of the next century. Softwood pulpwood harvest on forest land is projected to increase as U.S. softwood residue supplies decline. Pulpwood stumpage values are projected to increase in the United States, based on supply and demand analysis, gradually improving economic opportunities for growing hardwood short-rotation woody crops on agricultural land. Hardwood pulpwood harvest on forest land is projected to increase for several decades but then decline in the long run with increasing fiber supply from agricultural short-rotation woody crops. Canada is projected to remain the principal source of U.S. pulp and paper imports, which are projected to increase. Most Canadian domestic pulpwood supply is projected to remain wood residues, as Canadian lumber production and residue output are projected to increase in the future. Pulpwood harvest in Canada is projected to decrease with modest additional increases in paper recycling.

KEY WORDS. Pulp and Paper, Wood Fiber Markets, Technology, Pulpwood

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Context of analysis

The United States Forest Service has published periodic national assessments of the forest and rangeland situation in the United States under guidelines of the Forest and Rangeland Renewable Resources Planning Act of 1974 ("RPA"). Recent assessments include the 1989 RPA Assessment (Forest Service 1989) and 1993 RPA Assessment Update (Forest Service 1994). RPA resource assessments have been supported by comprehensive economic analyses of the timber supply-demand situation in the United States. Recent RPA timber analyses include the 1979 RPA analysis of the timber situation (Forest Service 1982), the 1989 RPA analysis of the timber situation (Haynes 1990), and the 1993 RPA timber assessment update (Haynes et al. 1995).

In recent RPA timber assessments, analysis of pulpwood supply and demand has been facilitated by an economic model known as the North American Pulp and Paper (NAPAP) Model. The NAPAP Model is a comprehensive economic model of the U.S. and Canadian pulp and paper sectors, developed jointly by U.S. Forest Service, Forestry Canada, and University of Wisconsin (Ince 1994). The NAPAP model simulates competitive evolution of production in the pulp and paper sector by principal product, process and region in North America, computing annual product market equilibria, projected trade flows, and evolution in fiber supply and demand. The model produces fairly accurate projections of trends in paper recycling and production by process and regions. The NAPAP Model was developed further in recent years, resulting in a new version of the model known as the "1998 NAPAP Model", results of which are presented in this paper.

The 1998 NAPAP Model is a partial equilibrium economic model of the North American pulp and paper sector, similar to the earlier NAPAP Model (Ince 1994, Zhang et al. 1995). The 1998 NAPAP Model is an application of the price-endogenous linear programming system known as "PELPS" that was developed for economic modelling at the University of Wisconsin and Forest Products Laboratory (Zhang et al. 1994). The model is run in conjunction with the Forest Service TAMM/ATLAS model, which computes equilibrium trends in lumber and wood panel markets and projects timber growth. The 1998 NAPAP Model has been carefully tested against historical trends and the model computes fairly accurate annual production and market equilibria from a base year of 1986 to the present. Thus, model projections are validated in part by the model's ability to track actual historical market equilibria and technological trends of the recent past. Some of the charts in this paper show how accurately the model tracks annual production and market equilibria of the past decade.

Outlook for U.S. paper and paperboard demand

An integral part of the NAPAP Model is analysis of demand equilibria for paper and paperboard products in North America, including U.S. and Canadian domestic demands and export demands. U.S. demands are by far the largest component of paper and paperboard demands in North America, and therefore U.S. population and economic growth assumptions are crucial in the analysis. As shown in figure 1, slower but steady U.S. population growth is assumed (based on Census Bureau projections) along with increasing Gross Domestic Product (GDP) per capita. Paper and paperboard demand functions in the NAPAP Model are related to population and per capita GDP, historically good predictors of paper and paperboard demands. Demand functions are also modulated by elasticities with respect to price trends in plastic and electronic substitutes (Zhang 1995).

As shown in figure 2, growth in per capita paper and paperboard consumption is projected to gradually decelerate in the future, as markets for most paper and paperboard commodities are maturing relative to GDP growth. The projections reflect anticipated substitution of electronic media for some communication grades of paper. U.S. per capita consumption of newsprint for example peaked in the 1980s and has actually declined in the past decade. Other grades of paper are increasing in per capita consumption and their demands have been complemented by development of electronic technology, for example uncoated free sheet paper used heavily in electronic printers and copiers. Despite decelerating per capita demands, the overall tonnage of U.S. paper and paperboard consumption is projected to increase along with projected population growth, as shown in figure 3.

U.S. production and trade

Since 1970, U.S. production of paper and paperboard increased by more than 40 million metric tons, while imports and exports each rose by about 5 million tons. Although recent UN-FAO projections predict a decline in U.S. paper and paperboard exports to the year 2010 (FAO 1996), U.S. exports and imports are both projected to increase in the 1998 NAPAP Model after a near-term downturn (stemming from the Asian economic crisis). Nevertheless, projected U.S. trade flows remain small relative to domestic production (figure 4). U.S. paper and paperboard imports are projected to increase until around the year 2020 when projected imports level off with slower growth in domestic paper consumption. Imports from Canada, primarily newsprint and printing & writing grades of paper, are projected to remain dominant, but imports from other world regions also increase and are projected to double in the decades ahead (figure 5). Canadian domestic pulpwood supply is projected to increase, but Canadian pulpwood harvest is projected to decline as Canadian wood residue supplies increase. Wood residue supplies are projected to increase in Canada due to projected increases in Canadian softwood lumber production.

U.S. production of both paper and paperboard are projected to increase (figure 6). Paper production is projected to gradually level out with maturing market demand, while paperboard production is projected to increase on a more linear trend. The gradual shift from paper to paperboard production implies a gradual shift toward higher yield pulping and increased use of recycled fiber.

The rate of recovery of paper for recycling (relative to total U.S. consumption) is projected to increase in the future, but growth in the rate of recovery will decelerate as the United States reaches a more balanced equilibrium between recycled fiber demand and supply (figure 7). Paper recovery for recycling and export increased significantly since the mid-1980s, but the 1998 NAPAP Model indicates that paper recovery for recycling is approaching an equilibrium at the upper end of an historical sigmoid growth trend. A sustained recovery rate above 50 percent is projected beyond the turn of the century when U.S. recovery of paper for recycling will be in the range of current high rates of recovery in Japan and Europe, but recovery will climb only very slowly above the 50 percent level.

The distribution of U.S. paper and paperboard production capacity is shifting to a higher proportion of capacity based on processes using 100% recycled fiber, but production capacity based mainly on virgin pulp is also projected to increase (figure 8). The domestic recovered paper utilization rate (ratio of recovered paper use to production of paper and paperboard in U.S. mills) increased significantly over the past decade. The utilization rate is projected to increase much more gradually in the decades ahead with slower growth in equilibrium recovery rates as computed by the NAPAP Model (figure 9). Projected increases in U.S. paper and paperboard production coupled with decelerating rates of paper recycling imply increased demand for virgin wood fiber.

Equilibrium fiber raw material consumption

Figure 10 shows historical and projected roundwood equivalents of wood and fiber raw materials consumed annually in the entire U.S. pulp and paper sector over a 150-year historical and projected time frame. Decelerating growth in equilibrium supply-demand quantities is apparent in the historical and projected trends, attributable to maturing market demands and limitations on fiber supply, but the upward momentum of demand results in robust projections of fiber consumption well into the next century.

Imports of fiber (pulpwood and woodpulp) are projected to increase but remain small relative to domestic sources of wood fiber. Use of recycled fiber has increased and is projected to increase at a somewhat slower pace in the future. Use of wood residues (chiefly byproducts of sawmills and plywood mills) peaked in the mid 1980s and is projected to continue declining as more efficient sawmills and plywood mills generate less wood residues and as expansion occurs in newer composite wood panel products that do not generate wood residues, such as oriented strandboard (OSB) which is replacing plywood. Pulpwood harvest is projected to increase in the future along with slower projected growth in rates of paper recycling and declining wood residue supplies.

Pulpwood market outlook

Historical and projected equilibrium pulpwood supply-demand quantities by region are shown in figure 11. The South has dominated U.S. pulpwood supply and demand in recent decades, and the South is projected to remain dominant in the future. The South Central region in particular has accounted for the largest share of growth in U.S. pulpwood supply and demand, and the South Central region is projected to account for most projected growth in the future (states in the South Central region include Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas).[12]

Increased pulpwood demand in the U.S. South was associated with increased pulpwood stumpage values in recent years, particularly since the mid-1980s. Figure 12 shows historical and projected trends in real pulpwood stumpage prices in the U.S. South, comparing hardwood and softwood stumpage prices. Both hardwood and softwood stumpage prices have increased in the past decade, with the percentage increase much greater for hardwood than for softwood (in real prices, hardwood stumpage has approximately tripled in value since the early 1980s, and now exceeds the market value that softwood pulpwood had ten years ago). Hardwood and softwood equilibrium stumpage prices are both projected to more than double in the U.S. South in the next ten years, according to the 1998 NAPAP Model. This analysis is linked to the TAMM/ATLAS assessment of timber growth and timber supply, and results are sensitive to timber growth assumptions in the U.S. South. The Forest Service is in the process of revising and updating RPA timber growth assumptions for private timberlands in the U.S. South, and higher growth assumptions may result in somewhat smaller projected increases in pulpwood stumpage markets.

The projected increases in pulpwood prices indicate that it will become economically feasible in the near future to grow larger volumes of hardwood short-rotation woody crops (SRWC) on agricultural land. Beyond the year 2010, there is a significant projected increase in U.S. supply of hardwood pulpwood from agricultural lands (hardwood SRWC). Hardwood SRWC supply reaches an equilibrium of 20 percent of total pulpwood supply by the year 2050 in this analysis, substituting for harvest of hardwood pulpwood on forest lands. Figure 13 shows the historical and projected distribution of total U.S. pulpwood supply. Softwood and hardwood timber harvest provide the bulk of projected pulpwood supply, as wood residue supplies are projected to decline.

Hardwood short-rotation woody crop technology has been applied by a number of U.S. forest product companies, primarily growing hybrid poplars on leased agricultural land with harvest rotations of around 6 to 8 years.

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[12]Pulpwood quantities discussed in this paper exclude wood use in OSB.

This analysis suggests that the total agricultural land area devoted to growing such short-rotation woody fiber crops could approach two million hectares by the year 2050 (an area perhaps 50 times greater than the current agricultural land area devoted to hardwood SRWC, but an area which is nevertheless less than two percent of the total land area of agricultural cropland in the United States). These results are sensitive however to alternative assumptions regarding future timber management intensity on forest lands. If the intensity of timber management and pulpwood production from forest lands increase in the U.S. South, there will be less likelihood for significant expansion of hardwood short-rotation woody crop supply from U.S. agricultural land.

Summary

As shown in figure 14, this analysis reveals that fiber raw material use per ton of pulp, paper and paperboard production has declined in the United States since the 1950s, and a continued gradual decline is projected into the future associated with a shifting mix of production technologies and product outputs (gradually shifting toward higher levels of recycling and from paper to paperboard for example). Of particular note is the decline in use of pulpwood per ton of product output, with total domestic pulpwood input (roundwood and residues) declining historically from around 3 cubic meters per metric ton in the late 1950s to just above 2 cubic meters today. Domestic pulpwood input (including timber harvest, residues, and SRWC supply) is projected to be less than 2 cubic meters per ton of product output by the year 2050. Pulpwood input obtained from domestic forest harvest (exclusive of residues and imports) reached 2.5 cubic meters per ton of product output by 1960, but declined historically to only 1.7 cubic meters by the late 1990s, and is projected to decline to 1.1 cubic mters by the year 2050 (excluding projected increases in agricultural SRWC supply). Thus, technological progress, evolution of markets, and fiber substitution in pulp and paper have accomplished great strides in conservation of forest resources in recent decades and are projected to accomplish further strides in the future. However, total consumption of wood and wood fiber raw materials in pulp and paper is nevertheless projected to increase in the future as shown in figure 10, with resulting increases in supply and consumption of pulpwood as shown in figures 11 and 13.

Consumption of wood and fiber raw materials in pulp, paper and paperboard production increased in the United States over the past century and is projected to increase in the future at a decelerating rate of growth (figure 10), based on detailed economic assessment of supply, demand and production technology in the pulp and paper sector. Harvest of pulpwood on forest land in the United States is the largest single source of wood fiber, followed by recycled fiber and wood residues. In the past decade, residues declined in supply while use of recycled fiber increased. Recycled fiber use is projected to increase more steadily in the future with slower growth in rates of recovery and utilization of recycled paper.

Based on supply-demand analysis, equilibrium pulpwood stumpage values are projected to increase in the United States, and particularly in the U.S. South. Projected increases in the market value of pulpwood would improve economic prospects for growing short-rotation woody crops on agricultural land, and fiber supply from short-rotation woody crops is projected to increase. Harvest of pulpwood on forest land is nevertheless projected to provide the bulk of total U.S. pulpwood and wood fiber supply through the first half of the next century (60 to 70 percent of total pulpwood supply) as supplies of wood residues are projected to decline. Softwood pulpwood harvest on forest land in particular is projected to increase as supplies of softwood residues decline.

Most future growth in pulpwood equilibrium supply-demand quantities is projected to occur in the U.S. South, and particularly the South Central region. The South is projected to remain the dominant region in pulpwood supply and in production of pulp, paper and paperboard products. Pulpwood supply-demand quantities are projected to remain relatively static in the U.S. North and U.S. West.

Figures

Figure 1.--U.S. population and annual
Gross Domestic Product (GDP) per capita.

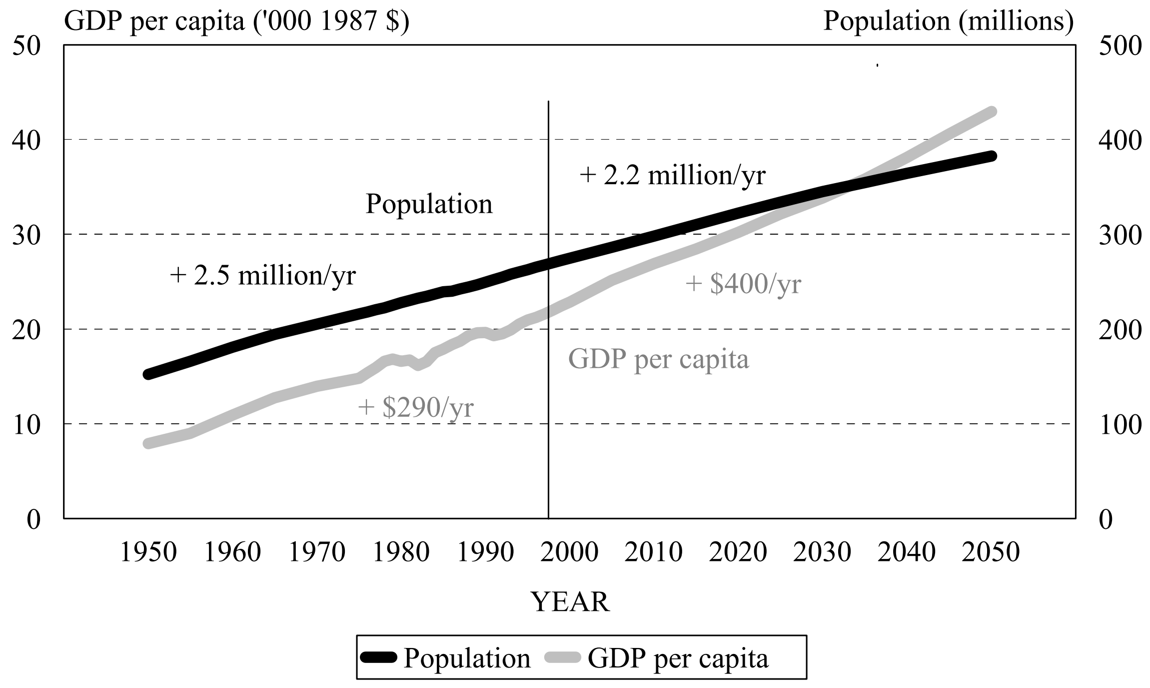


Figure 2.--U.S. annual per capita paper and paperboard consumption.

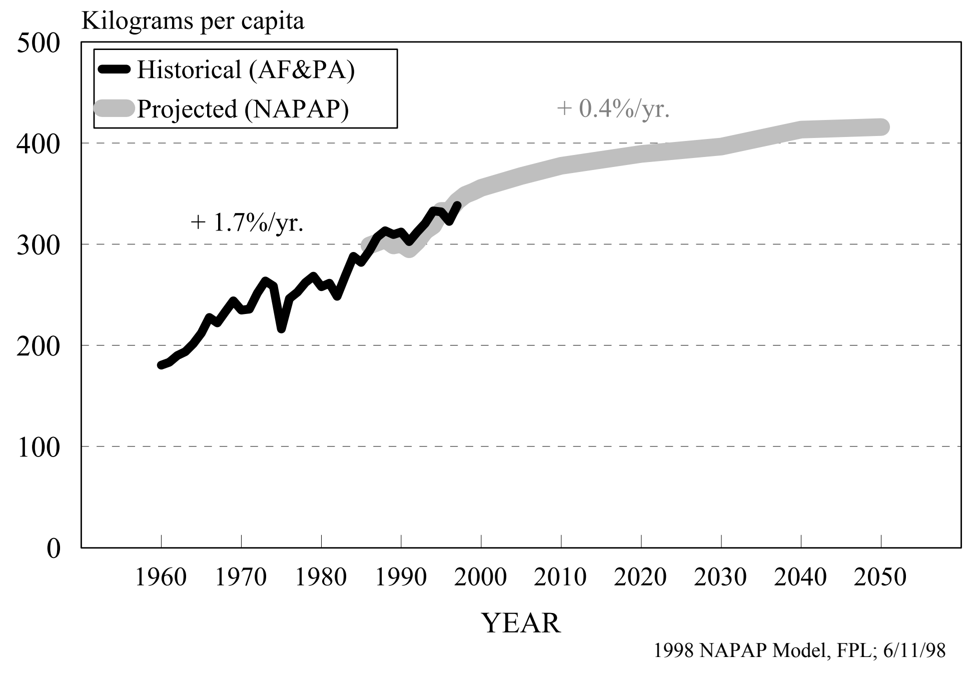


Figure 3.--Annual U.S. paper and paperboard consumption.

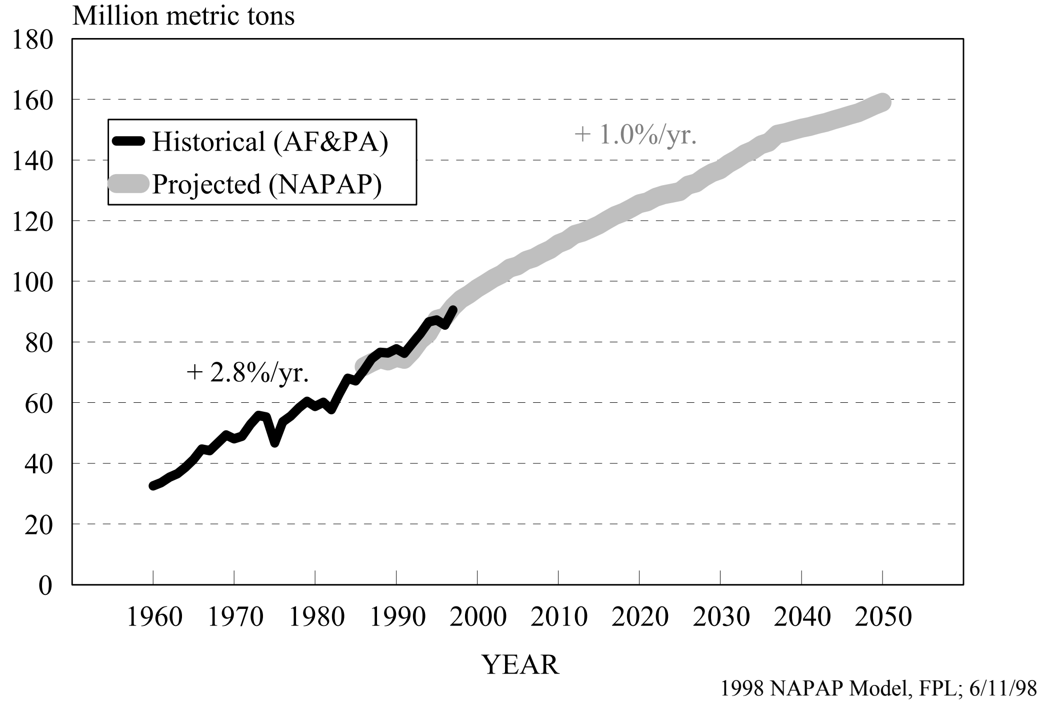


Figure 4.--U.S. paper and paperboard annual production and trade, historical and projected, 1970 - 2050.

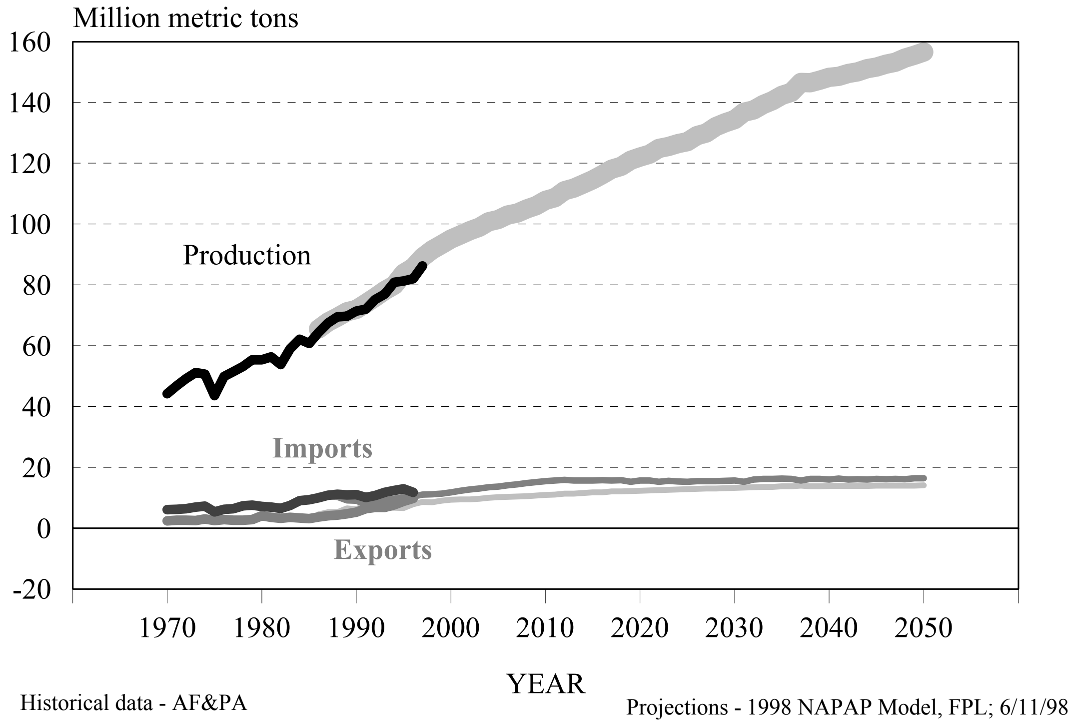
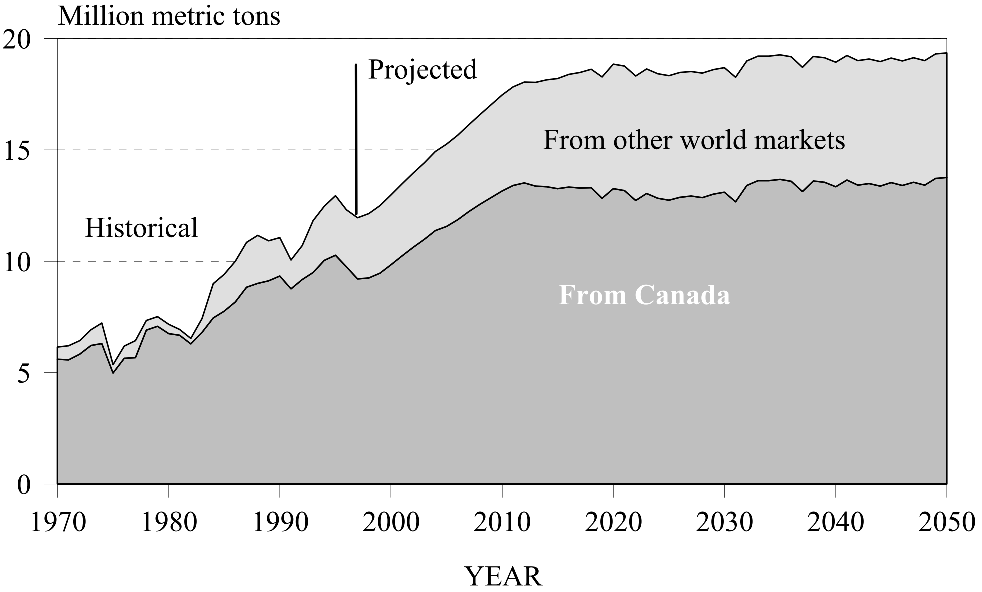
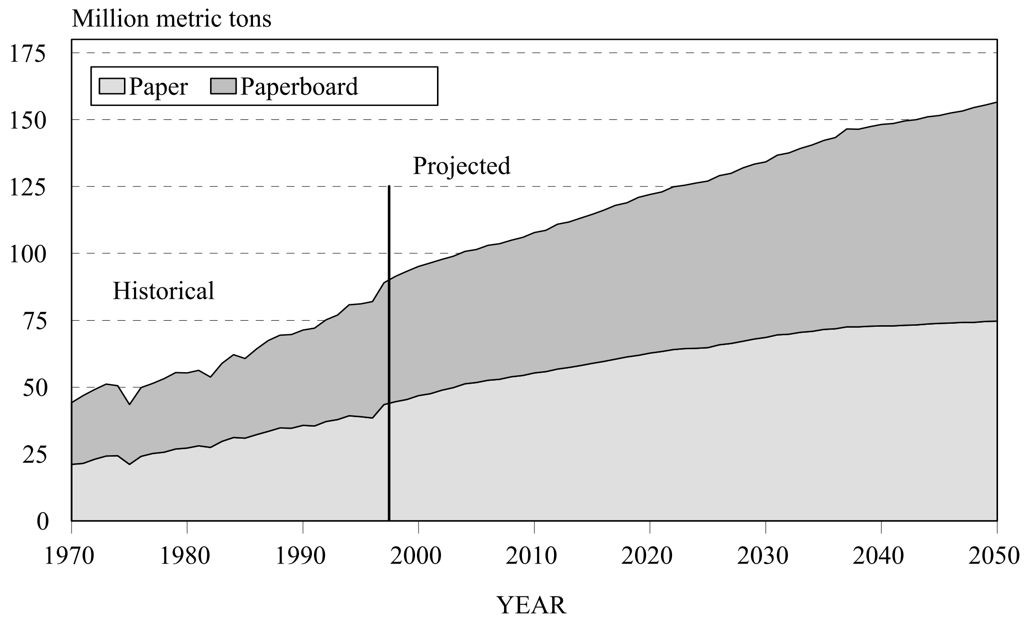


Figure 5.--U.S. annual imports of paper and paperboard, historical and projected, 1970 - 2050.



1998 NAPAP Model, FPL; 6/11/98

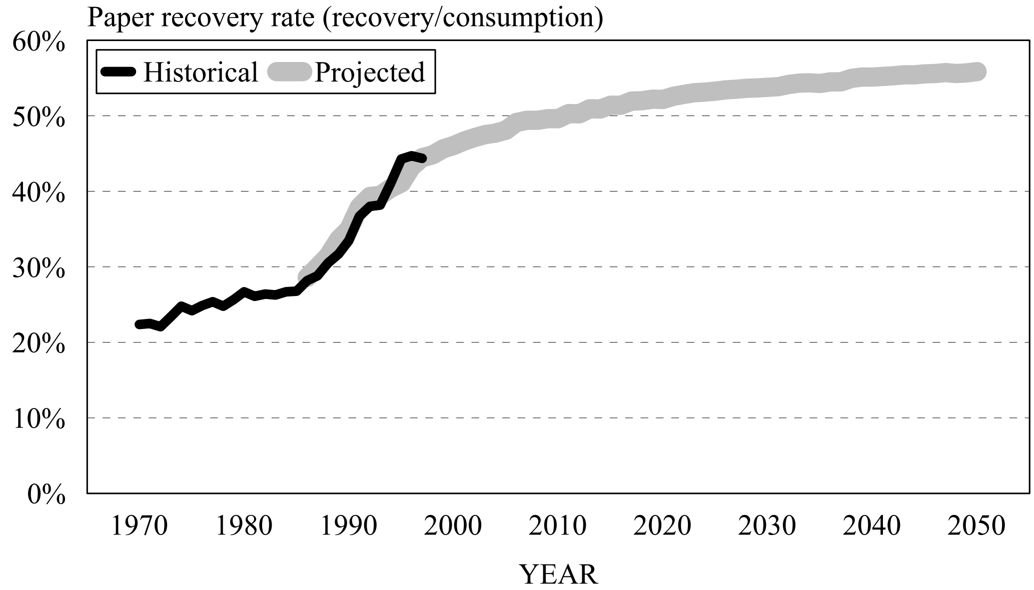
Figure 6.--U.S. annual production of paper and paperboard, historical and projected, 1970 - 2050.



Historical data - AF&PA

Projections - 1998 NAPAP Model, FPL; 6/11/98

Figure 7.--U.S. rate of paper recovery for recycling, historical and projected, 1970 - 2050.

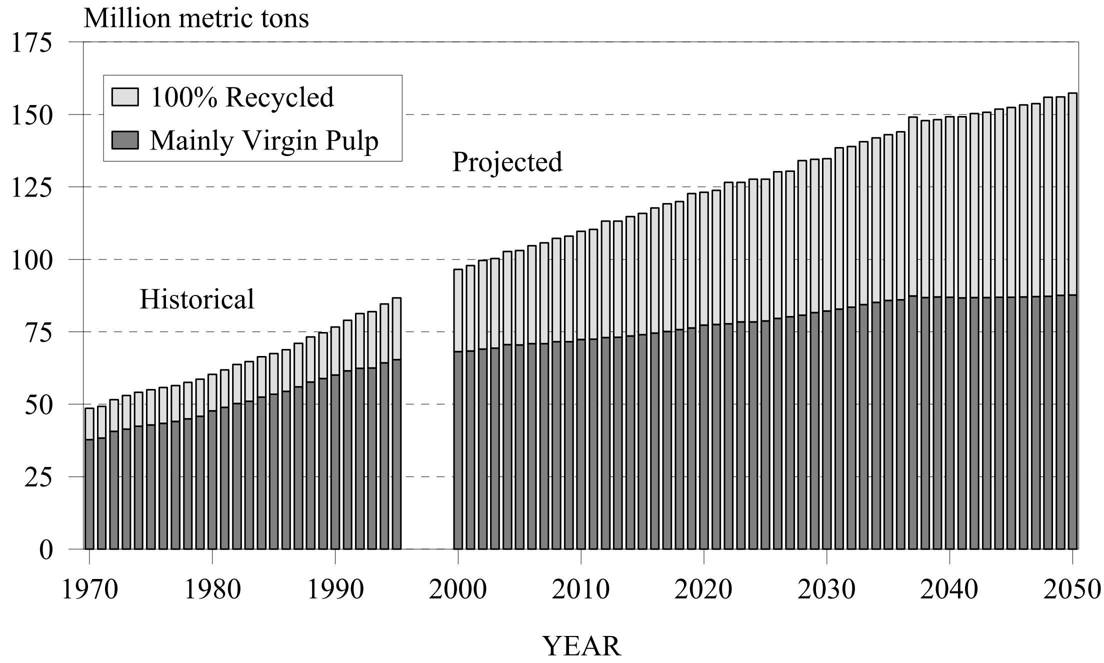


Recovery Rate = Tons recovered / Tons of paper and paperboard consumed

[Historical data include recovery for uses other than paper recycling, ~1% (AF&PA); Projections exclude other uses]

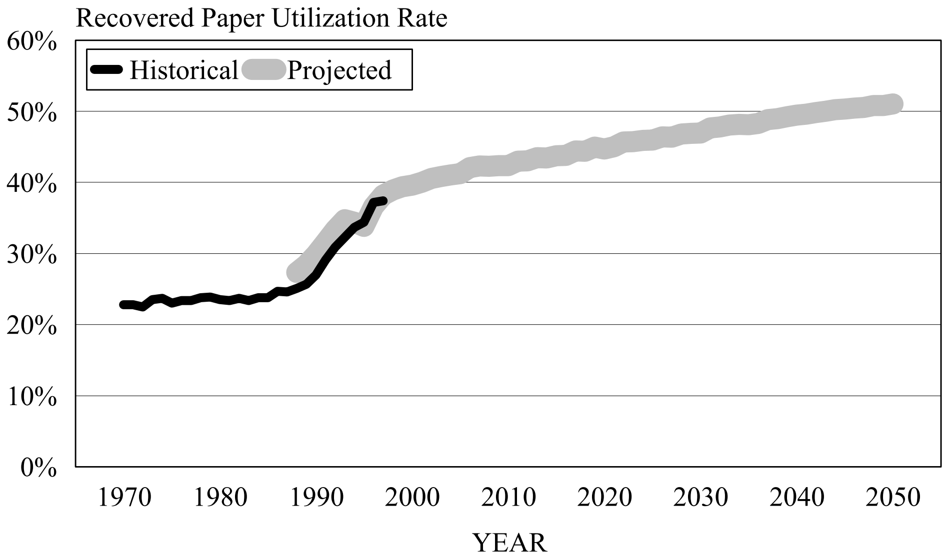
1998 NAPAP Model, FPL; 6/11/98

Figure 8.--Total U.S. paper and paperboard annual production capacity by type of process, historical and projected, 1970 - 2050.



1998 NAPAP Model, FPL; 6/11/98

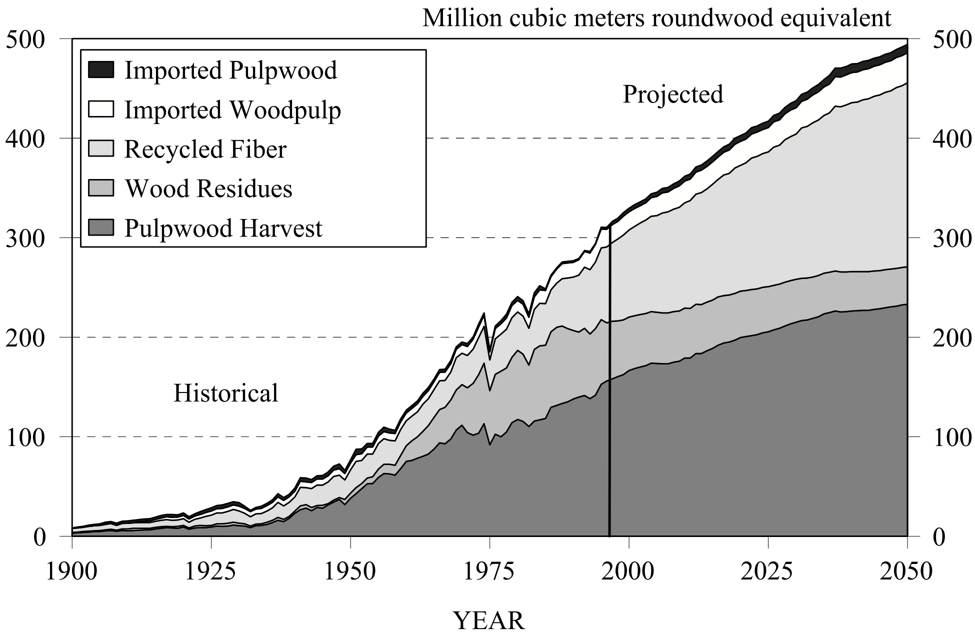
Figure 9.--U.S. recovered paper utilization rate, historical and projected, 1970 - 2050.



Utilization Rate = Tons utilized at mills / Tons of paper and paperboard produced

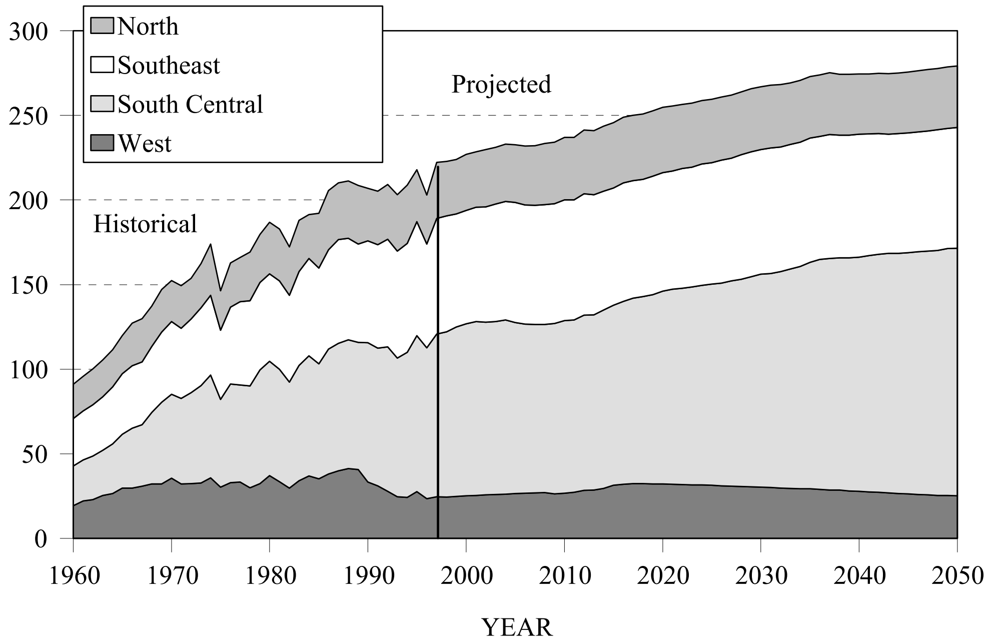
1998 NAPAP Model, FPL; 6/11/98

Figure 10.--Annual consumption of wood and fiber raw materials in pulp, paper and paperboard production in the United States, 1900 - 2050.



1998 NAPAP Model, P. Ince, FPL; 6/11/98

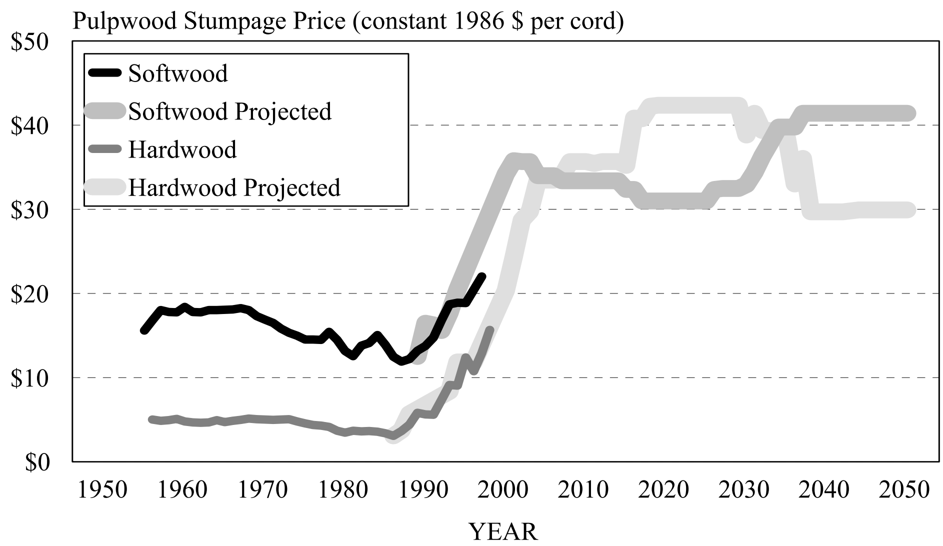
Figure 11.--Annual pulpwood equilibrium supply and demand quantities by region in the United States, historical and projected, 1960 - 2050.



Pulpwood supply includes timber harvest, residues and SRWC supply

1998 NAPAP Model, P. Ince, FPL; 6/11/98

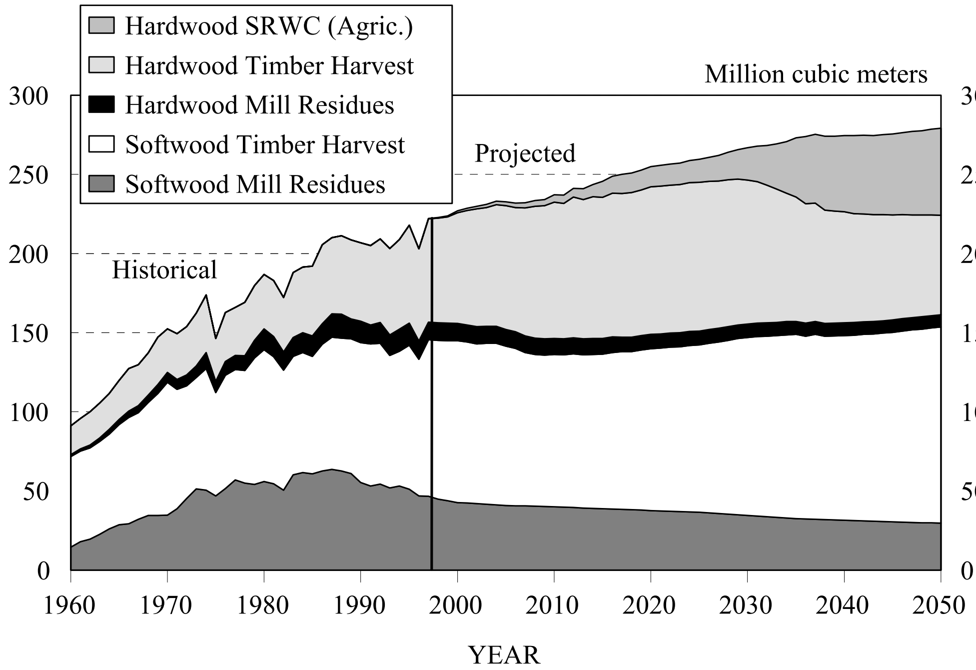
Figure 12.--Historical and projected pulpwood stumpage market trends in U.S. South, hardwood and softwood, 1950 - 2050.



Historical data: US Forest Service and Timber Mart-South (Southwide Avg.)

1998 NAPAP Model, FPL; 6/11/98

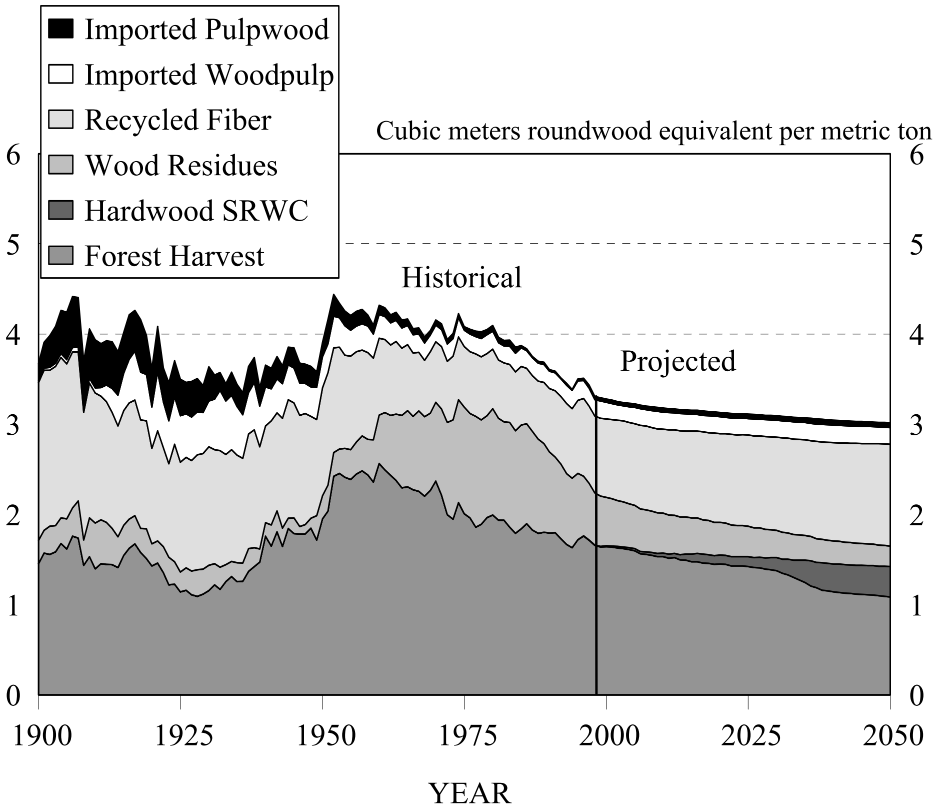
Figure 13.--Annual pulpwood equilibrium supply quantities by species group and category in the United States, historical and projected, 1960 - 2050



Includes timber harvest, residues, and SRWC supply

1998 NAPAP Model, P. Ince, FPL; 6/11/98

Figure 14.--Average fiber raw material use per ton of pulp, paper and paperboai produced in the United States, historical and projected, 1900 - 2050.



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Chapter 6 - FACTORS INFLUENCING CAPACITY INVESTMENTS

IN FOREST INDUSTRIES

by Mr. Johan Stolp
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Abstract

Since the early seventies the minimum efficient scale (MES) of the forest industries, i.e. the average annual production capacity needed to produce at lowest long run per unit costs, has increased considerably. Especially the MES of wood-based panels and pulp industries showed large increases. Driving forces of these increases are the (new) environmental requirements which the production processes have to comply with, the increasing use of small diameter roundwood, wood residues, waste paper, and waste wood. The lower the quality of used raw materials, more complex production processes need to be employed which to be profitable require large scale production. So, ironically the cheaper the raw materials used, the bigger the mill, and the higher the investments needed to build the mill that is able to use these raw materials as furnish.

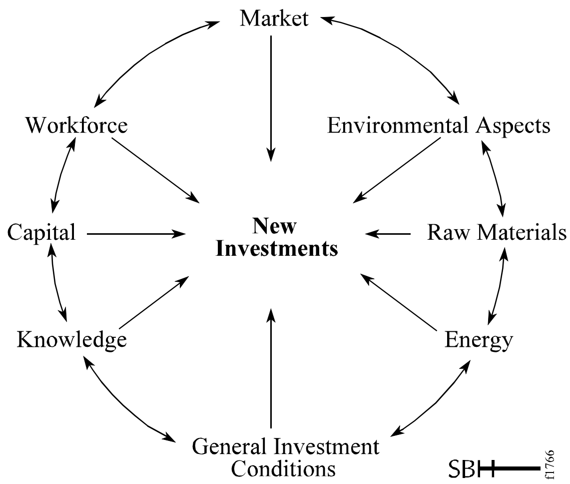
Larger capital outlays, especially in projects with large hard to recover investments in installations, are associated with greater aversion to risk. The ongoing concentration within the forest industries resulting in an increased influence of “outside” shareholders and banks, combined with an on average low profitability of forest industries, have also an intensifying effect on risk aversion in the decision to invest.

For the forest industries an important risk factor is (un)certainty of supply of raw materials of the quality and quantity the mill was designed for. In spite of increasing demand for wood products in all industrialised countries, a decline of production capacity is taking place in countries in which the availability of raw materials is declining or becoming more and more uncertain due to the harvesting behaviour of forest owners. Increases of production capacities are occurring either in countries with a 'certain' supply, or for other types of raw materials (wood residues, waste paper, waste wood). This results in an enormous "over-supply" of small diameter roundwood in regions/countries which are not 'preferred production sites' of the forest industries. Forest owners in those over-supply areas, can make their region more attractive as place of business for forest industries if they remove the uncertainty of raw material supply by changing their harvesting behaviour.

INTRODUCTION

Factors affecting investments in new production capacity are illustrated in Figure 1. As shown these competitive factors are strongly linked to each other. However, the main barriers to new investments are access to raw materials, either primary 'fresh' wood (fibres) or secondary wood (fibres), and high investments outlays required to create new capacity. These two barriers are influenced by the factors: environmental aspects, raw materials, and capital.

Figure 1
Factors affecting investments in production capacity
Source: Nilsson, 1988 (adapted)



ENVIRONMENTAL ASPECTS

The effects of environmental regulations on investments are twofold. One direct effect is that due to these regulations considerable investments are needed to reduce pollutants of the production processes. Decades ago the production processes of pulp and paper industries and to a lesser extent also of wood based panels industries, had as feature to be highly energy-intensive and highly polluting. Liquid effluents contained large amounts of waste materials, such as fibres, spent chemicals, etc., and accounted for a large share of total water pollution. In addition some chemical-pulping processes contributed significantly to air pollution due to emissions of sulphur gases and particles. At the moment, closed systems are standard, and production processes which are also far less consumptive of water and energy. However, 'clean technology' does not come cheap. Pollution abatement expenditures in the pulp and paper sector are capital intensive and often involve changes in production processes and as tied to capital expenditures in general (Johnstone, 1996). Up to one third of total investments in new production capacity in pulp and paper industries can be related to fulfilment of environmental regulations.

One important characteristic of these environmental impact reducing technologies is that they need to be installed at a certain minimum scale, which can not be increased or decreased continuously. As these technologies have no marketable (end-)products as output, they will always increase production costs of the end-products. However, the contribution to per unit costs of the end product decreases continuously until total installed 'cleaning technology' is utilised. To produce at lowest long run per unit (end-product) cost, the pulp, paper, or wood-based panels mill has to be designed at such a scale that the least common multiple of Minimum Efficient Scale (MES) of the production processes and MES of 'environmental processes', dovetail.

Figures 2-7 illustrate that this combined MES for pulp-and wood-based panels mills must have increased considerably in the last 25 years. The graphs show the development of the average installed production capacity of the respective mill types. This average is used as no time series are available of development of MES per type of pulp or wood-based panels mill. However, as not all existing mills will immediately adjust their production capacity to the 'MES-standard of the moment', it is likely that MES of pulp and wood based panels mills is larger than the average production capacity shown in the graphs.

Figure 2
Investment costs and capacities for new pulp mills in Scandinavia
Source: Croon, 1996

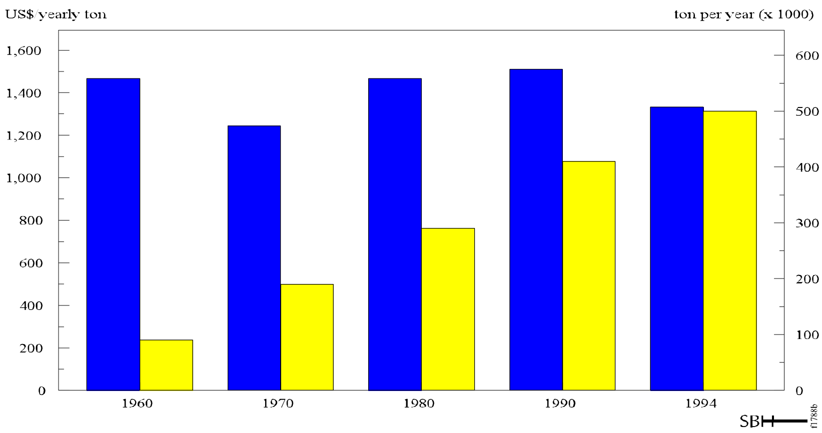
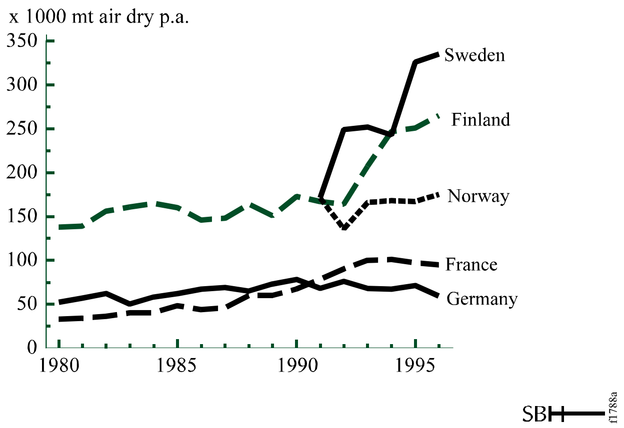
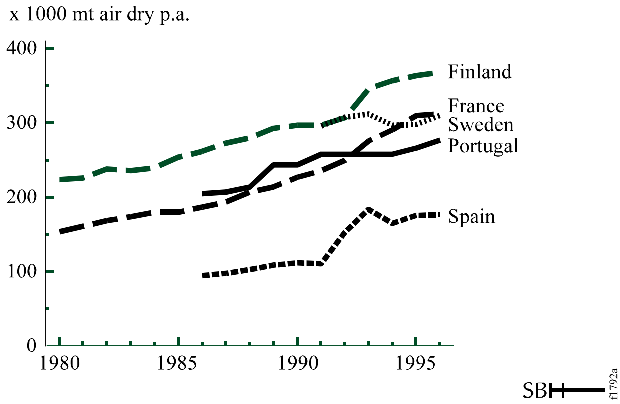


Figure 3
Average installed production capacity of (thermo-)mechanical pulp mills in European countries with a share of total production exceeding 5 percent.



Source: CEPI, CEPAC, FFRI

Figure 4
Average installed production capacity of sulphate pulp mills in European countries with a share of total production exceeding 5 percent.



Source: CEPI, CEPAC, FFRI

Figure 5
Average installed production capacity of particleboard mills in North-America
Source: Spelter *et al* (1997

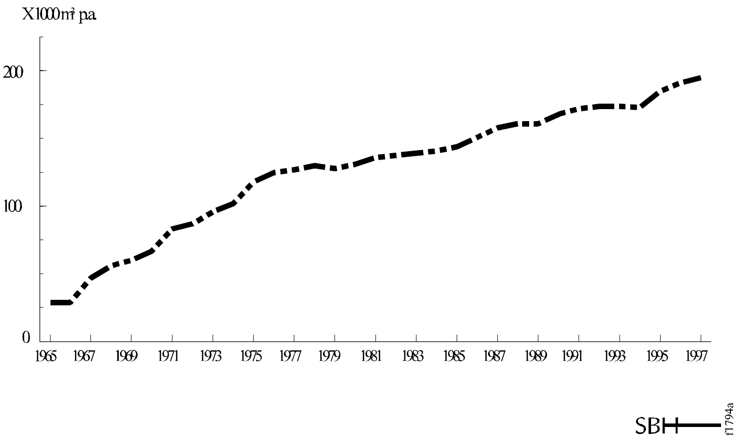


Figure 6
Average installed production capacity of MDF-mills in North-America
Source: Spelter *et al* (1997)

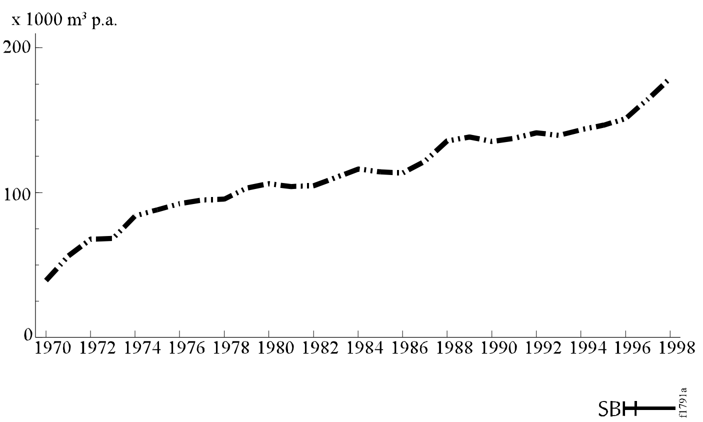
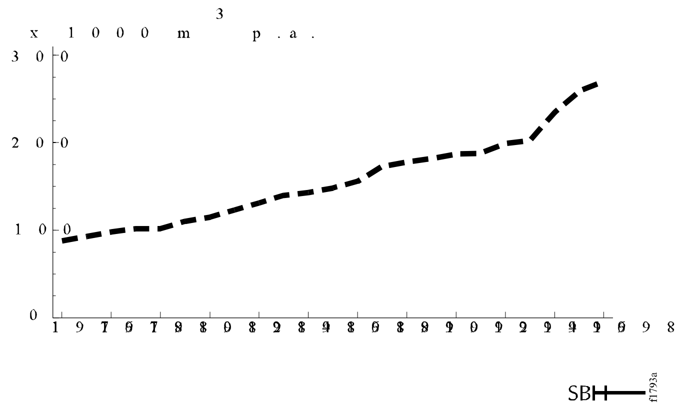


Figure 7
Average installed production capacity of OSB-mills in North-America
Source: Spelter *et al* (1997)



The second effect of environmental regulations on investments is more indirect. In Europe as well as in North-America, issues of (packaging) waste, avoidance of its disposal in landfills, recovery, reuse, recycling and incineration, with or without energy recovery, are leading environmental topics. Although legislation aimed at reducing waste and encouraging recycling vary greatly from country to country, most countries are following a two-track approach in implementation of waste management.

On the one hand there is an attempt to reduce the amount of waste by limiting its creation as much as possible. To achieve this goal, legislation is created concerning the composition and volume of waste from packaging for (consumer) goods. Although this kind of legislation might have an effect on investments in the forest industries, its effect on the decision to invest in new production capacity is probably (very) limited.

However, the second track that is followed to reduce the amount of waste has considerable effect on investments in production capacity. The second track consists of rules for processing waste. Various waste components -- glass, metal, batteries, waste paper, waste wood, wood residues, compostable waste, etc.-- must be collected separately. Collectors of 'non-polluted' waste are responsible for organizing a product reuse or material recycling-oriented processing of this waste, for example by offering waste paper to the paper and paperboard industries for recycling.

The costs of this collection, handling and offering/selling these secondary raw materials for reuse and recycling, including eventual losses, is completely covered by the waste sanitation tax consumers and industries have to pay. As society is an 'in-exhaustible' source of waste, of which separate collection and reuse or recycling is mandatory and with the costs totally covered, supply of these secondary raw materials like waste paper, waste wood and to a lesser extent wood residues, has become price in-elastic. These two features of waste, almost unlimited supply at no or low costs, make it a very attractive raw material for forest industries, even if investments in production technologies that are able to use these raw materials as furnish, are much higher. The lower the quality of used raw materials, more complex production processes need to be employed to produce the same quality end-product. To be profitable these complex production processes require large scale production, which in itself means already higher investments. So, ironically the cheaper the raw materials used, the bigger the mill, and the higher the investments needed to build the mill that is able to use these raw materials as furnish.

The graphs in Appendix A of the use of waste paper by the paper industries as percentage of total wood input (= exclusive of secondary wood fibres), show for most countries a considerable increase of this percentage since the early nineties. The graphs also show that the pulp and paper industries have concentrated their investments in technologies geared at the use of secondary fibres as raw materials in densely populated countries where supply of this raw material is highest.

RAW MATERIALS

One characteristic of investments in production capacity is that once the investment is made and the mill built, it is hard to recover. Nilsson (1988) illustrates this by showing, Table 1, that in the pulp industry, with by far the highest investment costs, the cheapest way to increase capacity is to take-over a competitor. So, to earn a return on the investment it is important that installed capacity is used. Although it seldom happens that capacity utilisation drops due to deficient supply of raw materials, to prevent this the industry will rise prices, the high utilization rate (upper eighty percent) of the pulp and paper industry needed to break-even, illustrates the importance of sufficient and certain supply of raw materials.

Table 1
Investments in new pulp capacity, expressed in relative terms based on cost per ton

New investments	100
Mill expansions	65
Take-over	45

Source: Nilsson, 1988

In general, the data show that mills are increasing in average capacity, see Figures 2-7. Because larger capital investments are generally associated with greater aversion of risk, and bigger losses if not utilized up to break-even point, we are observing a tendency to avoid construction and expansion of such mills, related to uncertain supply of needed (round)wood as raw material. This phenomenon occurs in the USA as well as in Europe.

In particular, in the US West, timber supplies have become less certain due to decline in availability of timber from publicly owned forest lands ('spotted owl effect'), Figure 8, and there is a decline in woodpulp and OSB capacity (Ince, 1998). Figures 9 and 10 show that MDF and OSB capacity have increased substantially in the (South-)East of the US. Likewise pulpwood consumption at woodpulp mills has declined by 41 percent in the West in the last 8 years. Overall pulpwood consumption in the United States has increased and all of the increase has occurred in the East. It seems that while investment in pulp, OSB and MDF, all of which are (partly) dependent on small diameter roundwood as raw material, is attractive in the East, it is declining in the US West. This results at the moment in an enormous "oversupply" of small diameter timber in the US West. However, due to uncertainty about future allowed harvesting rate on public land, the forest industries are moving to the (South) East of the United States. Here a larger share of the forest is privately owned and these private owners have a more predictable harvesting behaviour.

Figure 8
Federal timber sold in Pacific Northwest region in U.S.A.
Source: Murray and Wear (1998)

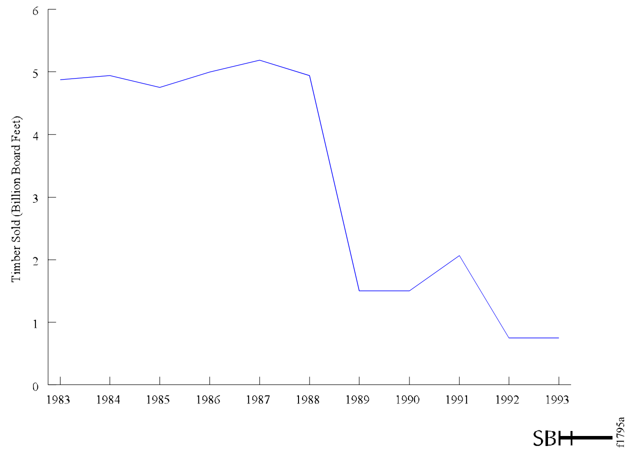


Figure 9
Production capacity of OSB-mills per region in U.S.A.
Source: Spelter *et al* (1997)

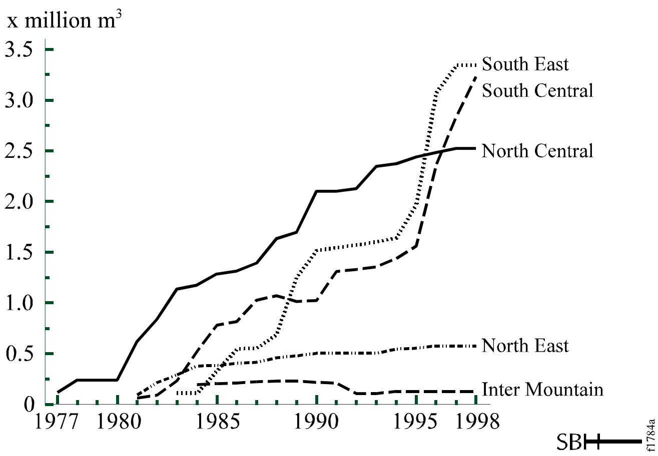
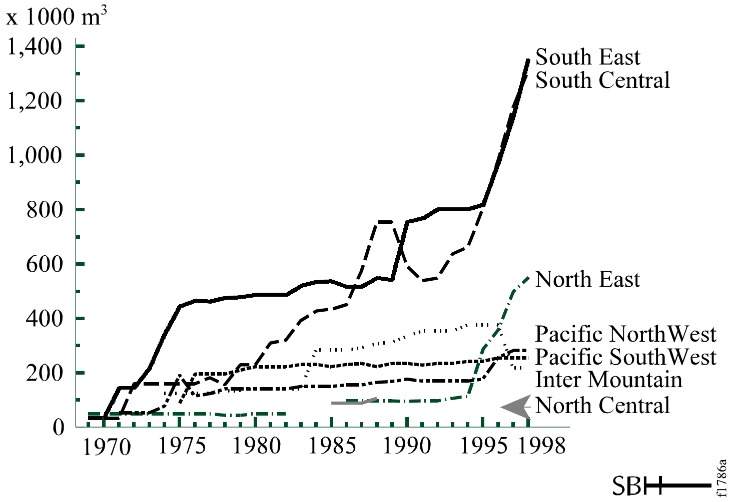


Figure 10

Production capacity of MDF-mills per region in U.S.A.

Source: Spelter *et al* (1997)

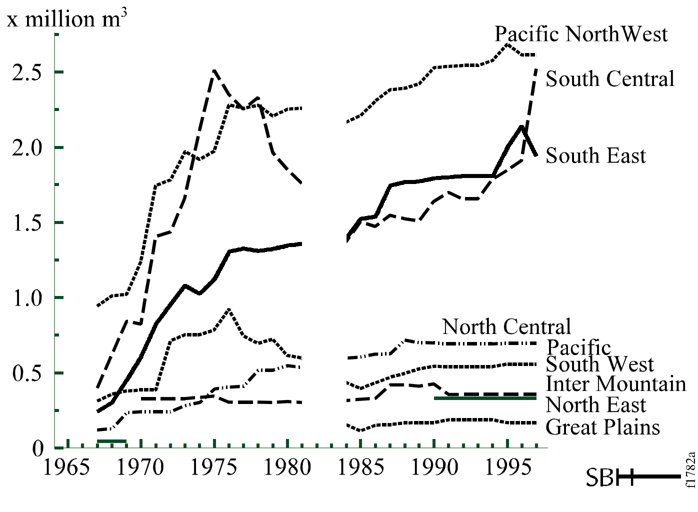


Particleboard mills seem less sensitive to this uncertainty of (round) wood supply, see Figure 11. However, raw material for particleboard mills has lower quality demands and the mills can produce on a 100 percent sawmill residues furnish, without a loss of quality of their end-products. As the sawmill residues are "automatically" created the moment roundwood is sawn, particleboard mill owners have 'transferred the worrying about raw material supply' to the sawmill owners. As the delivery of sawmill residues to particleboard mills earns the owners of the former an extra income, particleboard mills have a certain supply of raw material. So the particleboard mills in the US West face no restrictions concerning construction and expansion of such mills.

Figure 11

Production capacity of Particleboard mills per region in U.S.A.

Source: Spelter *et al* (1997)



Although 'the proof' that the same phenomenon -- (un)certainty of (round)wood supply is determining capacity investment -- is also happening in Europe is more anecdotal, there are certain patterns in locations where new construction and expansion of capacity takes place. We see also switches in raw materials consumed in the pulp and paper industries from (integrated) pulp production to secondary pulp. This happens mainly in densely populated countries with a high environmental awareness and a less developed forest industry structure.

There is a tendency in European pulp and wood based panels industries to increase the share of wood residues in their 'fresh wood' furnish. Although the statistics are not unambiguous if this is caused by an increased availability of wood residues of the right quality, due to introduction of new sawing technologies at sawmills, or because of price, or because of higher certainty of supply. Most likely it has been a combination of these three causes.

That harvesting behaviour of forest owners and certainty of supply matters is illustrated by the fact that still no decision is taken to build a new 'state-of-the-art' sulphate pulp mill in Eastern Germany. Potentially the forests in that region are able to supply the 2.6 million m^3 per year of pulpwood needed as furnish for this mill. However, the potential investor and operator of this mill has so far been unable to get a long-term guarantee of the forest owners that they will supply this amount of pulpwood.

Experiences in the Netherlands, although on a much smaller scale, have shown that potential investors in new capacity looking for a place of business, demand a long-term (at least 10 years and preferably an evergreen) contract with forest owners in which supply is guaranteed of minimal 80 percent of their foreseen raw material furnish. Without such a guarantee they move their business elsewhere.

Construction of new and expansion of capacity in Europe takes mainly place in countries with already well- established forest industries, which consume large amounts of (round)wood. In these regions there exists ‘an infrastructure’ of delivering roundwood from the forest to the industry, harvesting behaviour of forest owners is known. The forest owners have 'certainty' of the quantity of wood the industry will demand (and thus 'certainty' of income) and can take that into account in their forest management plan. Based on this mutual influence, forest industries are prepared to invest in production capacity in those regions, even if other regions have a much larger 'gap' between potential and actual removals from the forests.

CAPITAL

There are few entrepreneurs left in the forest industries who actually own their business. Even family-owned companies are getting rare and are mostly limited to sawmills. Recently, large mergers have taken place between already 'top ten players' in the forest industries in Scandinavia. In other countries we see also an ongoing concentration trend within the forest industries. The pulp and paper industries seems to be the front runner in this trend. So, the influence of 'outside' shareholders and banks is increasing. The high volatility of capital on stock exchanges, combined with on average low profitability of forest industries (see development of stock price indexes in Figure 12) and the shortening of business cycles (Figures 13 and 14), have all an intensifying effect on risk aversion in the decision to invest.

So, every aspect that can contribute to reducing the risk of loss on an investment, is getting more and more important for the board of directors of forest industries. As shown in this paper, certainty of raw material supply has developed over the last decades, as such an important aspect for the forest industries. Especially as investments in capacity are very large (and getting even larger) and hard to recover. The forest industries have as commodities producers only a small profit margin, which evaporates quickly if production and capacity utilization drops.

Figure 12
Industrial Stock Price Indexes in the USA, monthly closing price.
Source: MSN

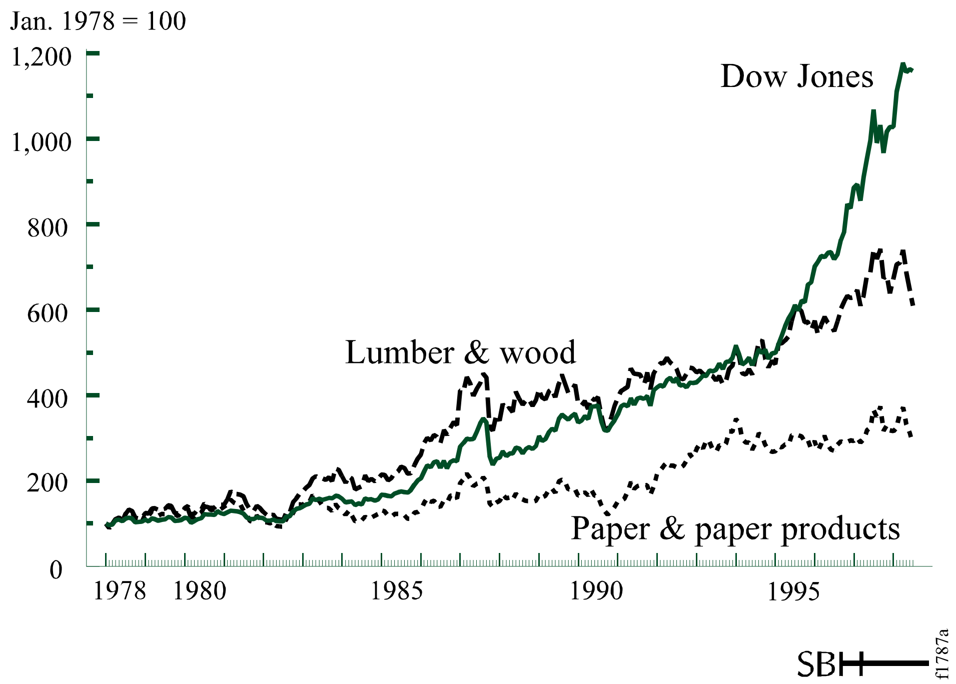


Figure 13 *Price Index domestically produced particle board in Germany*

Source: UN-ECE/FAO

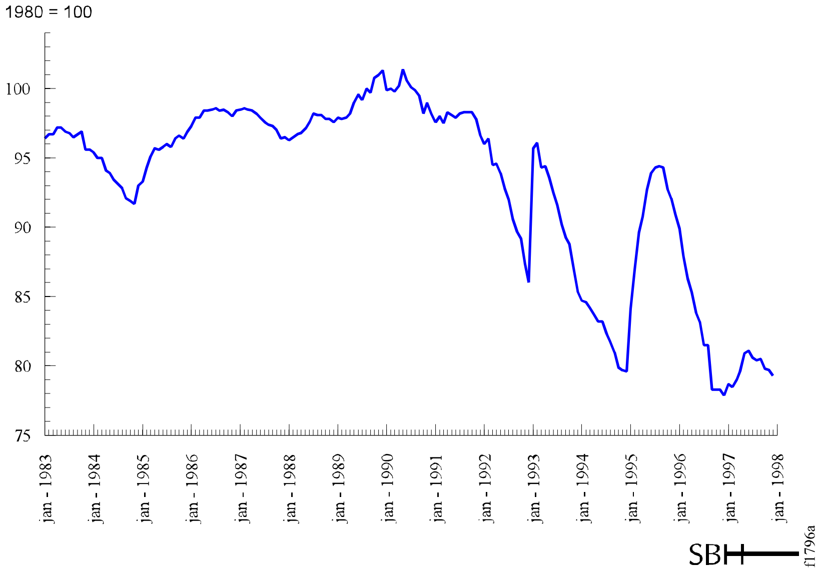
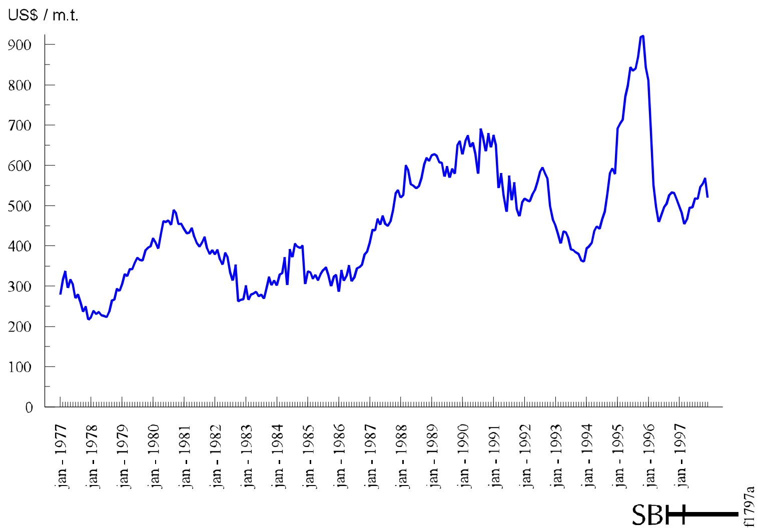


Figure 14
Export price (F.O.B.) of bleached sulphate pulp in Sweden
Source: Official Statistics of Sweden



<u>Conclusions</u>

- Environmental regulations have caused an increase of minimum efficient scale of production in the forest industries and by this considerable increases of capital investments.

- Environmental regulations have created price inelasticity and certain supply of large quantities of secondary raw materials. For (some) forest industries in some countries this has made it possible to survive through specializing in the use of these secondary raw materials as furnish. However, the complex production processes needed for this are very capital intensive.

- Uncertainty of long-term raw material supply leads to disappearance of forest industries like pulp and paper and wood-based panels mills. Construction of new capacity only takes place in regions with a 'guaranteed' supply of wood (fibre).

- It is likely that risk aversion of forest industries with respect to capital investments in capacity expansion will increase in the future.

- As forest industries are attracted to regions where supply of (round)wood is guaranteed, forest owners are able to create a market for their roundwood if they change their harvesting behaviour and are willing to sign a long-term contract to supply the quantities and qualities of roundwood the forest industry needs.

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Chapter 7 - Panel Discussion Report

by Mr. Ed Pepke, Forest Products Marketing Specialist,
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Following presentation of the papers, a panel composed of the presenters responded to the questions from the Timber Committee. As the discussion was disjoint from the presentation of the papers, not all of the authors were present. The panel included: Mr. Johannes Dengg, Dr. Bengt Hillring, Dr. Jan Ilavsky, Dr. Peter Ince and Mr. Jeremy Wall (European Commission, DG III, who presented Ms. Perez Latorre's paper).

An initial question was to clarify a statement in Mr. Dengg's presentation regarding the volume of recycled materials entering the wood fibre steam in Germany. Mr. Dengg responded that the percentage of recycled materials is steadily increasing and that it is theoretically possible that up to one-third of the wood flow in Germany will ultimately be made up of recycled wood and paper fibre.

Following up on Mr. Johan Stolp's report on "Factors influencing capacity decisions in forest industries," the Vice-Chairman requested that he consider the factors related to companies supplies of raw materials from their own lands versus those purchased from non-industrial forest land owners. She also asked about the importance of transportation costs of raw materials in sourcing decisions. The delegate from Norway added that as new sources of fibre supply become available, the industries quickly adapt to changing sources and prices.

The Finnish delegate remarked that the topic is broad and complicated by the interactions with differing consequences on different countries. He noted the continuing problem with markets for the increasing supply of small-diameter timber and especially that wood-based energy is not competitive at today's low prices for fossil fuels without taxation or direct government aid. He said that there is a need to harmonize financial aid throughout the European Union. Dr. Hillring responded that recycled wood is now approximately equivalent to the price of coal per unit of energy and agreed that the use of small-diameter timber currently requires CO2 tax incentives. Mr. Wall responded that the European Commission welcomed proposals from member countries to promote wood-based energy.

The representative of Austria associated his remarks with those of the Finnish delegate and added that wood-based energy fits well with the recent Kyoto Convention. He supported the intent of the European Union's White Paper (formerly titled "Post Kyoto Energy Policy Strategy: The Renewable Energy Sources Strategy and Action Plan"). He advocated incentives for increased implementation of low-cost, wood-based, district heating systems to reduce the inefficient individual home use of fuelwood. He mentioned that coordination with the UN-ECE Committee on Sustainable Energy could be valuable for the Timber Committee in this respect. The Director of the Trade Division responded that the secretariat would present a clear message to the Committee on Sustainable Energy that cross-sectoral cooperation in this field is welcome. Dr. Hillring added that health risks associated with individual wood stoves are reduced through efficient district heating systems and that an added benefit of district heating is the creation of both direct and indirect employment.

The Chairman of the Committee stated in the Russian Federation there was historically a shift from wood-based energy to oil and natural gas. However with the energy and financial crisis during the transition period, there has been a reversion to wood fuels. He summarized the discussion saying that the benefits of wood-based energy and recycling are both for environmental reasons and for rural development. He stated that there needs to be increased diversification of energy sources.