EFORWOOD

Sustainability Impact Assessment of the Forestry - Wood Chain

Project no. 518128

EFORWOOD

Tools for Sustainability Impact Assessment

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Final Report on the Industry's Competitiveness and Its Impact on Industry Dynamics

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Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	X
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Summary

This is the *Final report on the industry's competitiveness and its impact on the industry dynamics*. The report is project deliverable PD4.3.10. of the EFORWOOD project and it is based on PD4.3.2 *First report on the industry's competitiveness and its impact on the industry dynamics* .

The plot thread chosen here runs from the theoretical concept of competitiveness described in Chapter 2, through trends and drivers having an impact on competitiveness, to Chapter 4's changes in forest products competitiveness, to the level of individual, representative, hypothetical mills in Chapter 5. The Chapters 2-5 are also presented in PD4.3.2. Chapter 6 analyses the link between the theory and the Eforwood project, especially from Module 4 point of view.

The purpose of the PD 4.3.2 was to give information to other Eforwood partners on the nature of different forest based products from the industry's competitiveness point of view, already in the beginning of the Eforwood project. PD 4.3.2 is strongly linked to PD 4.3.3. *"First report on the Interdependence between the Agents within the Forestry-Wood Chain"* and also to PD 4.3.4. *"Trade projections forest products by country and product"*. Together with PD4.3.3. and PD4.3.4. this study reports about the comprehensive picture of the industry dynamics. The **overall picture on forest industry's competitiveness and industry dynamics** should be kept in mind in the development and interpretation of ToSIA and Eforwood work in general.

Now, when the Eforwood project is reaching its end, PD 4.3.10 *Final report on the industry's competitiveness and its impact on the industry dynamics*, presents in a concise from how competitiveness and industry dynamics has been taken into account in the project.

The main conclusions of PD 4.3.2 and this report can be summarised as:

- The competitive balance between the forest industry actors is not stable but highly dynamic.

- Power shifts in competition can be sudden, e.g. based on exchange rate fluctuations, unfair regulatory atmosphere, the shifts on resource focus, cost and availability and industry restructuring.

- It seems to us there have never been so many strong and weak signals and contradictory trends affecting an industry more global than ever.

- In the Eforwood project, several issues of competitiveness and industry dynamics are covered and for example the selected sustainability indicators cover well the first, second and third line competitiveness. However, because of the level of detail and amount of processes modelled in TOSIA, reliable, representative data is not available for all of the indictors.

- Fortunately, the work done in compiling the indicator lists, defining the indicators and the information and data search linked to the indicators has not been in useless - it has generated valuable information not only on data availability and gaps but also on future development needs.

- In Eforwood as a whole and in Module 4, the definition of the reference futures and the generation of the scenarios have involved analysis and quantification of both main and sector level trends.

- From the industry dynamics vs. TOSIA point of view, there are some problems associated with the feedback loops of some indicators and value chains. At least today, TOSIA should not be used as the only tool in estimating changes in production capacities, e.g. assessing where new production capacity will be built or where capacity will be closed.

In addition to this report, report PD 4.3.3. will be further linked to Eforwoos and TOSIA work. The updated report, D4.3.11 *"Final report on the Interdependence between the Agents within the Forestry-Wood Chain"* will be ready by August 2009.

This report is a joint work of Centre of Competence Paper and Board (KCPK) and Pöyry Forest Industry Consulting.

Summary

Contents 1

1 INTRODUCTION

This report belongs to European Commission's EFORWOOD project, contract number 518128-2. Module 4, who is responsible for this report, is a partnership of European companies focusing on the manufacturing and processing ("gate to gate") stage of the Forestry Wood Chain (FWC) in Europe. This document is a project deliverable PD 4.3.10 – *Final report on the industry's competitiveness and its impact on the industry dynamics.* In this report, the general of competitiveness, current trends and drivers, investments, cost sensitivity and their link to Eforwood project are studied. All these issues have an impact on individual companies and the industry's dynamics as a whole.

Competitiveness in itself is a very broad-spectrum topic. It lurks brazenly in news headlines and political speeches, it echoes in local workplaces when downsizing occurs, it lurks in the corridors of financial power. No-one seems to be able to get a handle on it – in practice. On a theoretical plane it is easier to grasp, but makes high demands on the plot. There has to be a clear progression from concepts to practical details of a mill's daily life.

The plot thread chosen here runs from

- The concept of competitiveness through
- Trends and drivers having an impact on competitiveness to
- Changes in forest products competitiveness, to the level of individual, representative, hypothetical mills
- Analysis of Efowood and industry competitiveness and dynamics

This report is based on PD4.3.2 *First report on the industry's competitiveness and its impact on the industry dynamics.* This means that the report is based on the situation in 2005, the base year of the Eforwood project. However, even now, in April 2009 it gives a good perspective of the economic situation of the time of date.

Current economic climate has however, increased the down side of the industry leading to increased competition between players. The financial crises initiated in the last quarter of the second half of 2008, has hit hard the traditional pulp and paper industry. It is fair to expect that the coming year will speed up the structural changes in this mature industry described in the report. This means also that the position of bioenergy will in future be quite different from what it was in 2005. What comes to solid wood industry, it is doomed to suffer hard from the rapidly collapsing building sector. Historically hard crushes of several European and American housing markets, such as in Spain, UK and the Denmark do not anticipate a fast recovery. This is why it may happen that some trends breaks differing from the traditional demand and supply development curves are quite possible in the near term future to occur. In addition it is fair to estimate that the impact of changes will certainly hit quite differently of different products.

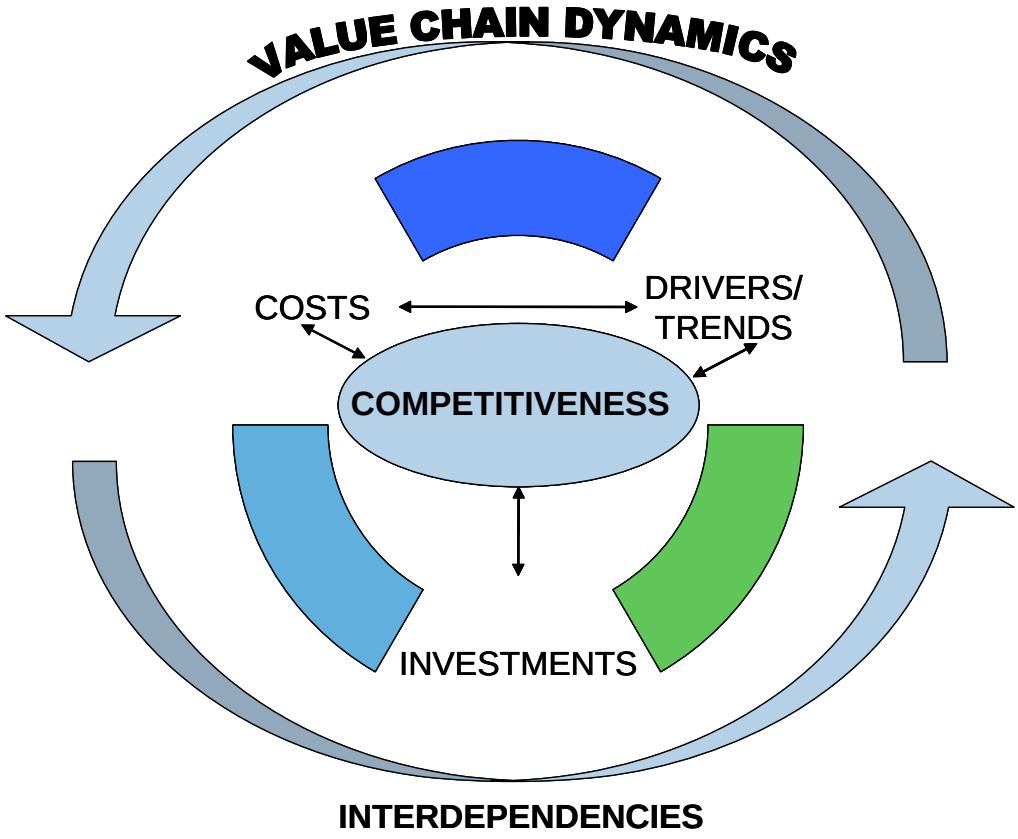
Trends presented in the report point out the right development on a general level. No major changes are currently in sight which would change the described longer term trends.

One positive sign, however, which the industry could profit more from than the report let's to understand is the sharply increasing demand for bio originating and recyclable materials based products.

This report is closely linked to Report PD 4.3.3 *"First report on the Interdependence between the Agents within the Forestry-Wood Chain"* (Figure 1-1), where value chain interdependencies are described in more detail and to PD 4.3.4. *"Trade projections forest products by country and product"*. Together with PD 4.3.2, PD4.3.3 and PD4.3.4. this study reports about the comprehensive picture of the industry dynamics. The information in these reports is and has been essential for example in the definition of the year 2005, reference future and scenario process topologies and in the compilation of the indicator values for reference futures and scenarios. The overall picture on forest industry's competitiveness and industry dynamics should be kept in mind in the development and interpretation of ToSIA and Eforwood work in general.

In addition to this report, report PD 4.3.3. will be further linked to Eforwoos and TOSIA work. The updated report, D4.3.11 *"Final report on the Interdependence between the Agents within the Forestry-Wood Chain"* will be ready by August 2009.

Figure 1-1
Link between Reports PD 4.3.10 and D 4.3.11



2 ASSESSING INDUSTRY COMPETITIVENESS AND DYNAMICS

2.1 Competitiveness Defined

In the mid-1980s, the US President's Commission on Industrial Competitiveness issued its report providing a definition of competitiveness that has since been the foundation of almost any other.

"A nation's competitiveness is the degree to which it can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously expanding the real incomes of its citizens. Competitiveness at the national level is based on superior productivity performance and the economy's ability to shift output to high productivity activities which in turn can generate high levels of real wages. Competitiveness is associated with rising standards [of living], expanding employment opportunities, and the ability of a nation to maintain its international obligations. It is not just a measure of the nation's ability to sell abroad, and to maintain a trade equilibrium." (PCIC, 1985, p. 1).

Only one year later, another very important article on competitiveness developed the concept further (Chesnais, 1986). According to Chesnais, the international competitiveness of national economies is built on the competitiveness of firms, which operate within national borders. To a large extent, then, it is an expression of the dynamism of domestic firms (reflecting management practice) and their capacity to invest and to innovate both as a consequence of their own R&D and of successful appropriation of technologies developed elsewhere. However, international competitiveness also, and increasingly, depends on "structural factors" such as the flexible and proficient productive structure of the national economy's industries, the rate and pattern of capital investment, its technical infrastructure and other factors determining the "externalities" on which firms can build. The externalities refer to economic, social and institutional frameworks and phenomena, which can substantially stimulate or hamper both the productive and competitive thrust of domestic firms. Hence one needs to think broader according to Chesnais, leading to the concept of "structural competitiveness" (UN, 2001).

Economic performance can also be divided into four different aspects:

- Technology competitiveness
- Capacity competitiveness
- Cost competitiveness
- Demand competitiveness

These aspects allow for indicators for competitiveness to be composed and a composite of these to be constructed (Fagerberg et al, 2005). Different indicators linked to these aspects are described in the following section.

2.2 Indicators of Competitiveness

Indicators of industry competitiveness can be functionally categorised into three groups (lines of indicators) in accordance to the breadth of applicability. *First line indicators* include the most basic indicators of industry performance such as productivity and market shares. The importance of understanding the socio-economic fundamentals

affecting the actions of economic agents underlines the need to supplement these with a *second line of indicators*. In turn, these can be complemented with a *third line of performance indicators* that takes a more dynamic approach by considering industry evolution and changing company capabilities (UN, 2001).

2.2.1 First Line

Productivity

The widespread use of productivity measures and their use for benchmarking purposes, frequently internationally, have naturally created considerable debate on the concepts of productivity measurement and on data requirements and constraints. Important issues associated with productivity measurement include the following (OECD, 1996a, 1996b, 1996c, UN, 2001)

a) The choice between partial (e.g., labour) and total factor (multifactor) productivity measures
b) The quality adjustment of price indexes
c) Output measure choice
d) The appropriate measurement of labour and capital inputs
e) The international comparison of productivity levels
f) Productivity measurement in service industries

Market Shares

The relationship between a region's production (or trade) structure and the composition of world demand for the industry's goods is of importance for competitiveness. The better the match, the more favourably the region's industry should be expected to develop, and vice versa (Fagerberg et al, 2005).

One of the basic metrics used by firms to evaluate their competitiveness is market share. Since firms are the foundation of industry competitiveness, the same metric aggregated to the industry level is frequently used as an indicator of the capacity of firms operating within the boundaries of a region to win new markets. At this level, one needs to examine foreign market shares and domestic market share.

Profitability

A third front-line indicator, profitability, can be used mainly as a check for market share results. Firms can always raise their market share in the short term by dropping their prices below marginal cost (UN, 2001).

2.2.2 Second Line

Socio-economic fundamental indicators include relative prices, unit labour costs, capital costs, rate of investment, foreign direct investment/portfolio investment, and rate of exposure to foreign competition. The most important ones are covered in more detail here.

Prices and Costs

Price or cost competitiveness is an indicator of industry competitiveness that has long been focused on. An example of one well defined indicator addressing this is unit labour costs in manufacturing in a common currency (Fagerberg et al, 2005).

Foreign Direct Investment

Bitzer and Görg have studied the productivity benefits of foreign direct investment. Their results show that on average there are productivity benefits from inward foreign direct investment, although they also identify a number of countries which, on aggregate, do not appear to benefit in terms of productivity. On the other hand, a country's stock of outward foreign direct investment is, on average, negatively related to productivity. However, again there is substantial heterogeneity in the effect across OECD countries. Micro level data for developed countries in other studies have shown that foreign direct investment can indeed increase the productivity of domestic firms through horizontal spillovers (e.g., Keller and Yeaple 2003, Haskel, Pereira and Slaughter 2002).

2.2.3 Third Line

The third line of performance indicators considers performance through *industry dynamics.* Dynamics of competition in an industry can be studied through analysing firm entry and exit, the rise and fall of incumbents, patterns of large- and small-firm mobility, measures of market structure, and the intensity of competition. Innovative capability of firms in an industry are studied through the rate of introduction of new products and production processes, upgrade of the product mix, upgrade of quality factors, technology outputs e.g. patents, licenses, technology imports and exports, and R&D expenditure or intensity.

The networking aspect of industry dynamics can be analysed through the participation of producers in regional, national and international production and innovation partnership networks (UN, 2001).

Technology Competitiveness

Technology competitiveness refers to the ability to compete successfully in markets for new goods and services. Hence, this type of competitiveness is closely related to the innovativeness of a region's industry. There is, however, no available data source, which measures innovativeness directly. Instead there are different data sources reflecting different aspects of the phenomenon. R&D expenditures, for instance, measure some (but not all) of the resources that go into developing new goods and services. Patent statistics, on the other hand, measure the output of patentable inventions. This is a very reliable data source, but the tendency towards patenting varies considerably across industries, and many innovations are not patentable. (Fagerberg et al, 2005)

Capacity Competitiveness

Capacity competitiveness is another dynamic aspect of performance. In many respects the distinction between technology competitiveness and capacity competitiveness is crucial. However, although the distinction may be clear enough in theory, in practice it may not be all that simple, since resources that are devoted to developing new goods and services may also be beneficial for the ability to exploit such innovations economically and vice versa (Cohen and Levinthal 1990).

2.3 Industry Concentration

The concentration of firms in an industry is of interest to economists, business strategists, and government agencies (Levin, 1990). Two commonly used methods of measuring industry concentration are the *concentration ratio (CR)* and the *Herfindahl-Hirschman index (HHI).*

These measures are influenced by the definition of the relevant market. For example, the automotive industry is not the same as the market for sport utility vehicles. In addition, the geographic scope of the market, for example, national markets versus local markets must be taken into account.

Concentration Ratio

The concentration ratio is the percentage of market share owned by the X largest firms in an industry, where X is a specified number of firms. The concentration ratio often is expressed as CRx, for example, CR4. If the CR4 were close to zero, this value would indicate an extremely competitive industry since the four largest firms would not have any significant market share.

In general, if the CR4 measure is less than about 40, then the industry is considered to be very competitive, with a number of other firms competing, but none owning a very large part of the market. On the other extreme, if the CR1 measure is more than about 90, that one firm, which controls more than 90% of the market, is effectively a monopoly.

While useful, the concentration ratio presents an incomplete picture of the concentration of firms in an industry because by definition it does not use the market shares of all the firms in the industry. It also does not provide information about the distribution of firm size.

Herfindahl-Hirschman Index

The Herfindahl-Hirschman index provides a more complete picture of industry concentration than the concentration ratio. The HHI uses the market shares of all the firms in the industry, and these market shares are squared in the calculation to place more weight on the larger firms. Unlike the concentration ratio, the HHI will change if there is a shift in market share among the larger firms. The U.S. Department of Justice uses the HHI in guidelines for evaluating mergers.

In case there were only one firm in the industry, that firm would have 100% market share and the HHI would be equal to 10 000, the maximum possible value of the HHI. On the other extreme, if there were a very large number of firms competing, each of which having nearly zero market share, then the HHI would be close to zero and thus indicating nearly perfect competition.

2.4 Industrial Environment Analysis

The strategic environment of a company can be seen as consisting of different levels. The industrial environment is one of these levels (Pitkethly, 2006). According to cognitive school, the main analysis in a company should be directed towards internal resources, capabilities and competences, which are seen as the determinants of success. The traditional view, however, is that the external environment can play a critical role in a company’s success or failure and should thus be analysed continuously. A criticism of these methods of external environment analysis is that they are primarily static as opposed to dynamic. The current structure of the industry is studied rather than analysing the long-term change in structure.

SWOT Analysis

In 1969 Learned, Christensen, Andews and Guth put forward a model in which a company has to balance four elements of company internal strengths and weaknesses, external company opportunities and threats, the personal values of those directing the company and broader social expectations. An abbreviated version of this model commonly referred to as “SWOT” analysis concentrates on the first two elements. The business environment is analysed through scanning opportunities and threats in the industry. The analysis may reveal certain new opportunities for profit and growth, for example:

- An unfulfilled customer need
- Arrival of new technologies
- Loosening of regulations
- Removal of international trade barriers

Changes in the external environmental also may present threats to the firm. Some examples of such threats include:

- Shifts in consumer tastes away from the firm's products
- Emergence of substitute products
- New regulations
- Increased trade barriers

(Pitkethly, 2006)

PEST Analysis

A more in depth categorisation of scanning of the external macro-environment is presented by PEST analysis. It is based on the analysis of the following factors (www.quickmba.com/strategy/pest/):

- *Political factors* including government regulations and legal issues, both formal and informal rules under which the firm must operate, for example tax policy, employment laws, environmental regulations, trade restrictions and tariffs, and political stability.
- *Economic factors* have an effect on the purchasing power of potential customers and the firm's cost of capital, for example economic growth, interest rates, exchange rates and inflation rate factors in the field of macroeconomics.
- *Social factors* include the demographic and cultural aspects of the external macroenvironment. These factors affect customer needs and the size of potential markets. Some social factors include: health consciousness, population growth rate, age distribution, career attitudes and emphasis on safety.
- *Technological factors* can lower barriers to entry, reduce minimum efficient production levels, and influence outsourcing decisions. Some technological factors include: R&D activity, automation and technology incentives.

2.5 Industry Structure and Evolution

An industry can be viewed as being composed of a chain of *competing and intertwined value chains*. Industry structure can also be analysed through the analysis of these value chains and their interactions. This is reported in more detail in PD 4.3.3.

An evolutionary theory basis change on blind variation, selection and retention (Barron, 2006). Innovations are seen to result from variation, the most beneficial of which are chosen through selection. These beneficial innovations spread from the points of origin to other groups through retention.

The number of organisation in an industry is seen to follow an evolution of founding, failure and growth rates. Many different models have been proposed to explain this evolution. For example the density-dependence model first reported by Hannan in 1986 uses functions of density to explain this. The founding rate is seen to be exponentially related to the density of organisations. As density increases, the adding of a new organisation to the industry increases competition at an increasing rate. Higher densities raise the risk of failure and lower growth rates.

One perhaps can differentiate between two strands of literature (UN, 2001). One is rooted in the formal industrial organisation tradition and has concentrated on sectoral structure in terms of e.g. concentration, vertical integration, diversification; the dynamics of sectors in terms of technical progress, entry, firm growth, and strategic behaviour (e.g., Scherer and Ross, 1990; Sutton, 1998). These analyses have paid less attention to knowledge and learning processes, the role of non-profit organisations, the wide range of interactions among agents, and the transformation of sectors in terms of their boundaries, agents, and products.

The second strand of literature is much more heterogeneous, eclectic, and dispersed. Here, one can find very rich empirical evidence on the features and working of sectors, on their technologies, production features, innovation, demand, and on the type and degree of change. Unfortunately, the possibility for an integrated and consistent analytical approach across this group was limited until very recently.

Third, in the literature on “industry life cycles” (e.g. Klepper, 1997, Afuah and Utterback, 1997), the principal focus is the unfolding pattern of industrial evolution over time. Industries and/or product markets are viewed as entities that have historical starting points that often have broadly similar patterns of development and ultimately disappear. Levels of entry and exit, degrees of concentration and other phenomena are shown to vary systematically within the historical time-frame of industry development. Moreover, this longitudinal evidence suggests that often (but not always) industrial evolution is punctuated by relatively sudden “shakeouts” which tend to shape the structure of the industry thereafter.

3 TRENDS AND DRIVERS

The macro drivers presented in this chapter can be found in many articles on trend analysis and scenarios studies in several types of products (KCPK and Pöyry). The selected macro drivers are considered as the most important in driving the trends in industry sectors within the scope of this study. The list was truncated for top three in order to draw the macro lines in development of competitiveness and competitive environment. However, it is undeniable that longer list of macro drivers having an effect on industry sectors within the scope of this study can also be defined.

The first macro driver of *internationalisation is also known as globalisation*. In sectoral case 1 (Chapter 3.2) this macro driver is considered from two points of view: very global, competitive and market-driven environment and increasing trade barriers. The second macro driver, *development of world economy* is likewise considered from two points of view: healthy global economy and stagnating world economy (although some emerging economies are growing). The third of the most important macro drivers is *population development*.

This Chapter consists of three parts: in the first one, general paper and board industry trends are described. Then, an extensive case-study on focusing on packaging illustrates trends and drivers of change in recovered paper industry. Finally, in the trends and drivers in wood products industry are discussed.

3.1 Drivers and Trends in Paper and Board Industry

World demand for paper and paperboard is expected to grow from 365 million tons in 2005 to 494 million tons in 2020 (this corresponds to an average growth rate of 2% per year). This forecast is conditional, based on the following key assumptions:

- The world population is expected to grow by 1.1%/a in the long term, reaching 7.6 billion by the year 2020. In relative terms, the growth will be fastest in Africa, Asia (excl. Japan and China) and Latin America.

- The world's population is ageing. This has a number of implications for the paper industry, including packaging design for the elderly, demand for educational materials and consumer behaviour in the tissue paper markets.

- The world economy is expected to grow by 3.1-3.2% in real terms through 2020. The long-term growth in North America and Western Europe is estimated at 2.7%/a and 2.2%/a while China, the rest of Asia (excl. Japan) and Eastern Europe will grow by 5-7%/a.

- Income elasticities (demand growth/GDP growth) of paper demand have shown a declining trend irrespective of the product area and geographic region. In the 1990s, global paper demand grew 1.2 times faster than GDP, but for the current decade the average income elasticity is estimated at 0.8-0.9, and for the following ten-year period (2010-2020) at 0.5-0.6. The trend toward income inelastic demand stems from the increasing availability of affordable substitutes for paper in a number of applications – mainly in communication and advertising-related areas but also in certain packaging end uses.

- Paper-based advertising media (including newspapers, magazines, direct mail and directories) have been losing market share in competition against electronic media. In recent years, internet advertising expenditure has grown by 15-40%/a, depending on the country and region, while newspaper/magazine advertising has grown slowly, at 2-3%/a on average. On the print side, the biggest gainer has been direct mail, which is benefiting from Do-Not-Call list restrictions on telemarketers, and the suitability of direct mail for targeted marketing.

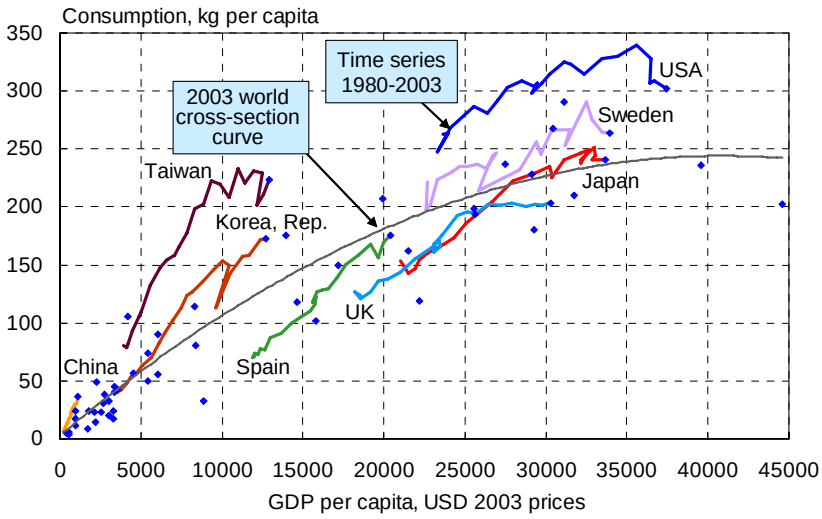
- Competition between paper-based and on-line media will eventually lead to fairly modest growth rates or even declining demand in some graphic paper end uses by the end of the current decade.

- On-line providers are actively promoting the new advertising media, and advertisers are gradually adopting an on-line strategy in their media mix. However, print on paper will remain a powerful advertising medium. The Internet has mainly been used as a complementary medium to magazines, newspapers and catalogues, and so far it has not truly replaced print media except in classified and directory-type applications.

- The positive correlation between industrial production and packaging board demand is evident. During the past 4-5 years, though, the relationship has become somewhat blurred, indicating a trend break in established patterns. The globalisation of manufacturing industries is partly responsible for this, resulting in an apparent discontinuity in packaging board demand in the West. A similar trend break has occurred in the rapidly industrialising countries, but in the opposite direction.

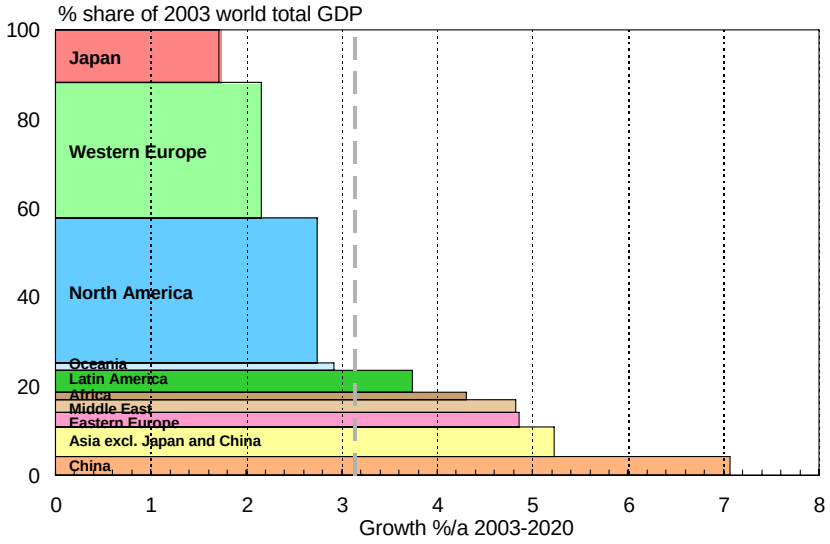
There has been a clear correlation between GDP and paper consumption per capita (Figure 3-1). This relationship is valid both between countries and with respect to time. However, income elasticities have declined in the course of time.

Figure 3-1
Paper Consumption vs. GDP (Source: Pöyry)



Low- to medium-income regions with vast populations, such as Asia-Pacific and Latin America (Figure 3-2), are forecast to represent the biggest potential for the paper industry's growth in the long term.

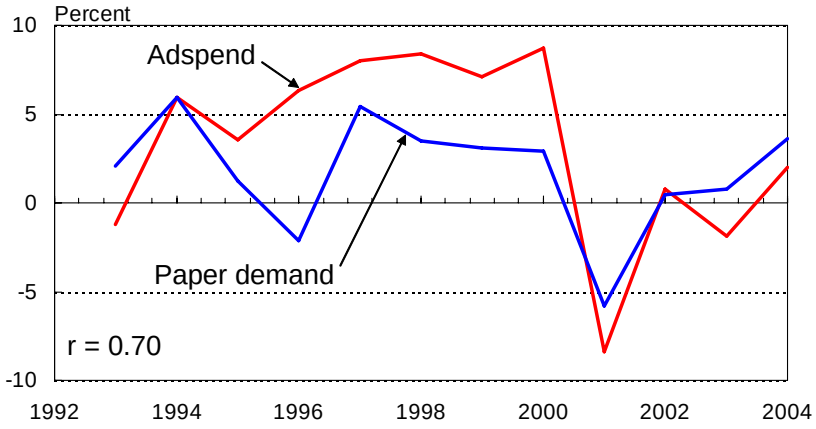
Figure 3-2
Global GDP Growth



Sources: Consensus Forecasts, Conference Board, OECD, national forecasting institutions etc.

The volatility of the advertising sector has resulted in rapid changes in graphic paper (newsprint and printing/writing papers) demand. This relationship is illustrated in Figure 3-3, combining changes in total display and classified advertising spending in real terms and changes in graphic paper demand in North America, Western Europe and Japan. The close linkage between these two variables is expected to continue in the future. Paper's share of the total adspend is expected to decline, though: combining North America, Western Europe and Japan, the estimated share of newspapers, magazines, directories and direct mail of total advertising expenditure is forecast to decline from the current 60% to 50-52% by the year 2020.

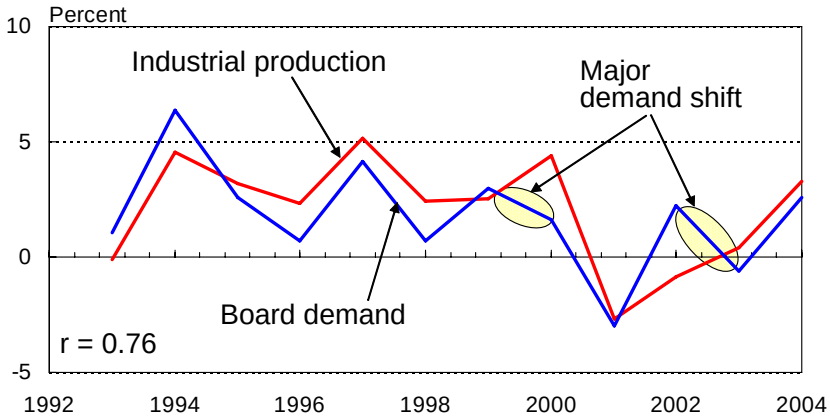
Figure 3-3
Changes in Graphic Paper Demand and Advertising Expenditure 1993-2004
Source: Pöyry



The recent changes in packaging markets in the West suggest that the formerly very close relationship between industrial production and packaging board demand has changed. One of the main reasons for this change is the globalisation of manufacturing industries. Packers have redirected their packaging investments from industrialised countries to emerging regions such as China, Southeast Asia and Eastern Europe, resulting in a demand shift from high-cost to low-cost regions. These issues are discussed in more detail in Chapter 3.2.

Figure 3-4 illustrates the relationship between packaging board demand and industrial production index in North America, Western Europe and Japan. Industrial production continues to drive the demand but in certain countries at a completely new level.

Figure 3-4
Changes in Packaging Board Demand and Industrial Production 1993-2004
Source: Pöyry



Beneath the surge of global macro drivers and trends, a large amount of smaller trends have an effect on the industry of the forestry wood chain. Increasing individualisation, great variety of different life styles as well as tendencies towards lean consumption and sustainability have an influence on the industry. On the other hand, the lack of time throughout society has a partly conflicting effect. Figure 3-5 and Figure 3-6 show the general overview of trends and drivers having an effect on demand for graphic papers and packaging products, respectively. Deeper analyses are presented in the two case studies of which the first concentrates on recovered paper (RP) industry focusing on packaging (Chapter 3.2) and the second on wood products industry (Chapter 3.3).

In addition to these cases, report 4.2.3. discusses shortly the effect of societal development, focusing on new technologies in the light of demands from the consumers and the possibilities to fulfil the needs identified. The more detailed analyses of consumer related trends are represented in Module 5.

Figure 3-5
Demand Drivers for Graphic Papers. Source: Pöyry

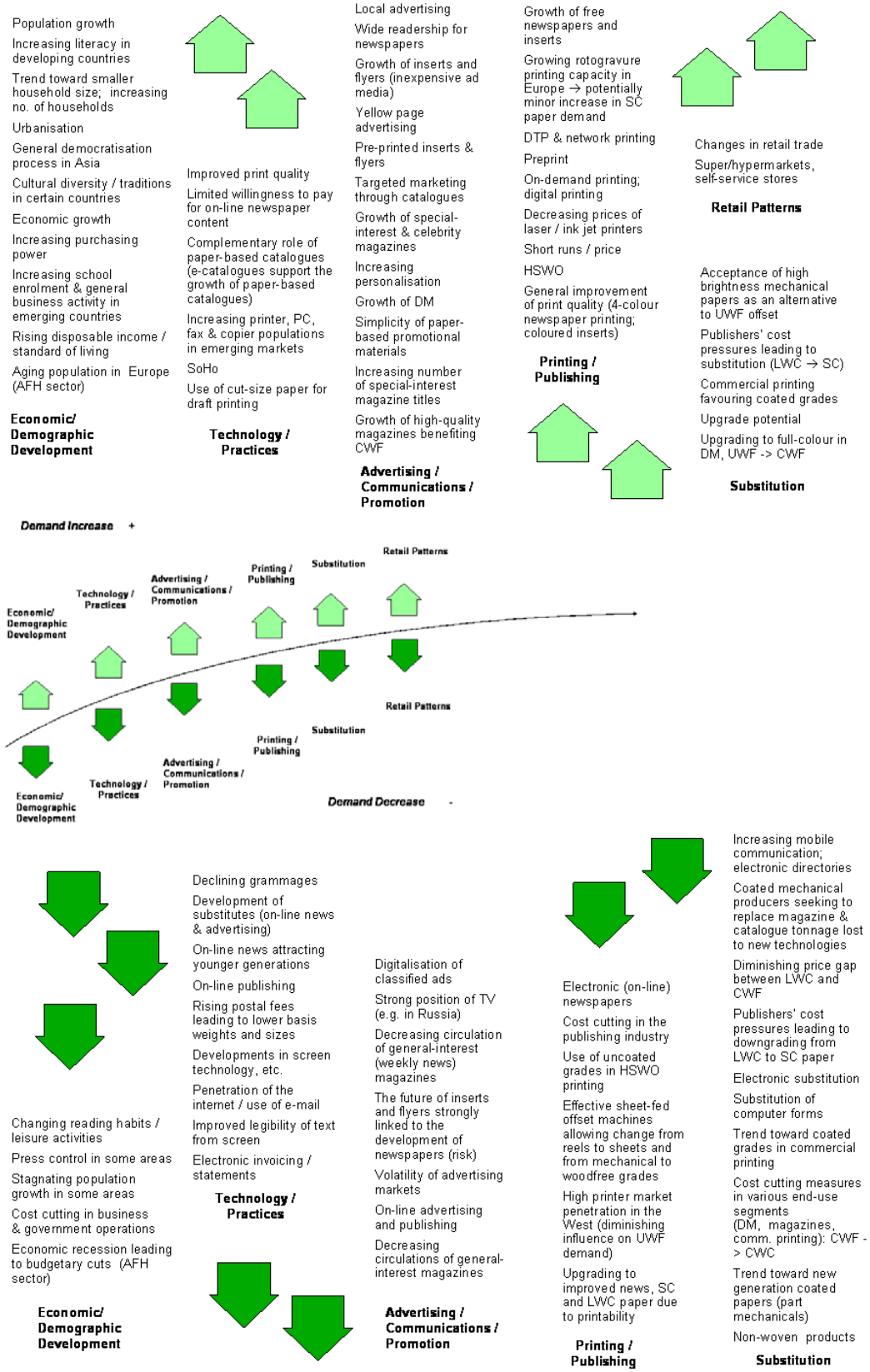
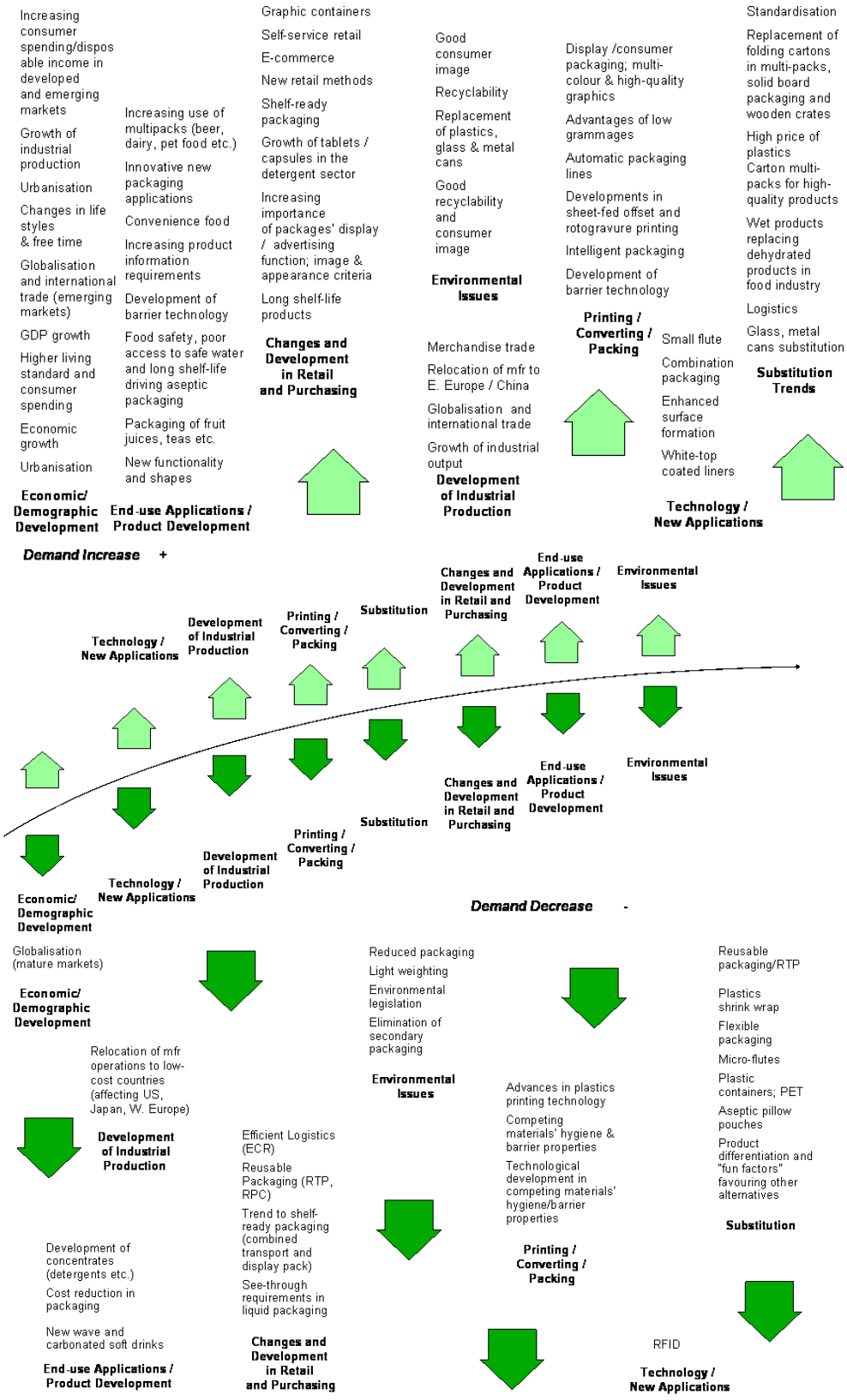


Figure 3-6
Demand Drivers for Packaging. Source:Pöyry



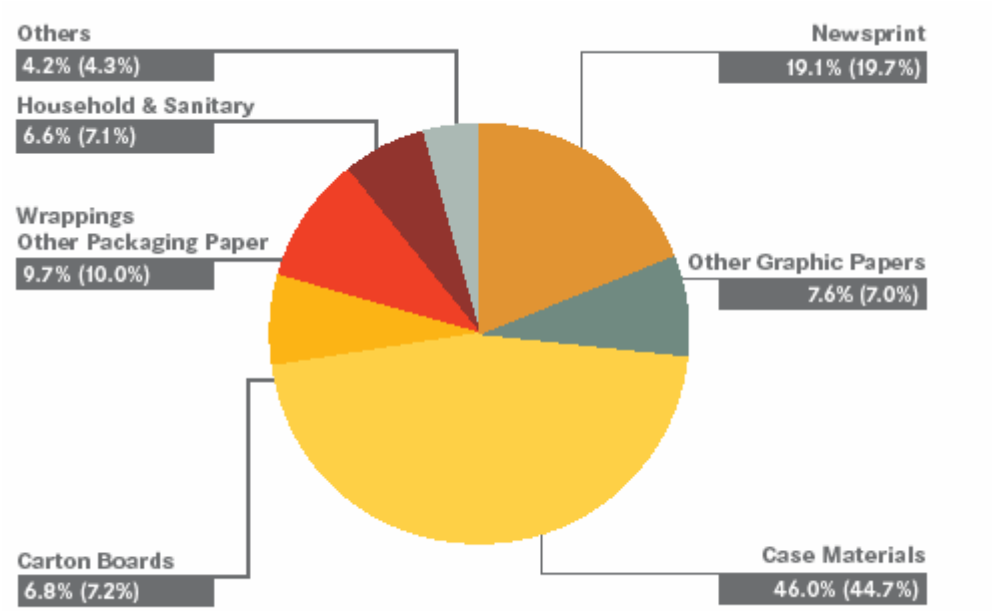
3.2 Case 1: Trends and Drivers of Change in the Recovered Paper Industry Focusing on Packaging (KCPK)

3.2.1 Introduction

Packaging grades used about 62.5% of the total volumes of recovered paper in 2005 (CEPI) as shown in Figure 3-7. A large part of this was used in case materials (46% of total). The second largest sector using recovered paper is the newsprint sector, where about 19% of the total volume of recovered paper was used in 2005 (CEPI). Paper and board packaging are also recycled to a high degree, according to CEPI estimates 77% of all paper and board packaging was recycled in 2005.

This chapter discusses trends and drivers that can have an impact on the recovered paper industry dynamics in the upcoming years. Focus will be on the paper and board industry producing packaging grades, as they represent the largest consumers of recovered paper.

Figure 3-7
Recovered Paper Utilisation by Sector in CEPI Countries in 2005 (2004) Source: CEPI Special Recycling Statistics 2005 – Published September 2006



Traditionally two categories of packaging can be distinguished. Consumer packaging that has besides the function of protecting and containing the product also the function of attracting the costumer to buy it and/or give information about the product. Transportation packaging is the packaging that covers the consumers' packaging during transport. The main function is to protect the product during transportation. Traditionally, transportation packages have not had real presentation function.

We can distinguish several phases in the recovered paper based packaging chain. A simplified representation of these phases is given below:

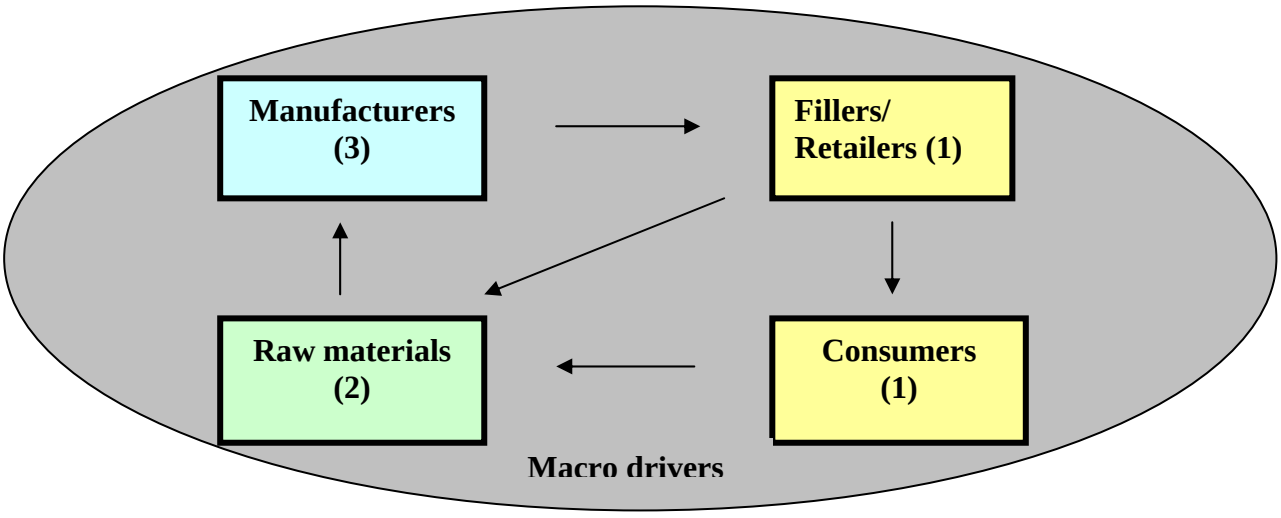
- Paper making: stock preparation, production of papers
- Conversion: i.e. production of corrugated board, production of containers and boxes
- Consumers (fillers, wholesalers, retailers, households)
- Collection: Collection of the corrugated container by businesses and households
- Recovered paper processing: Sorting, processing and baling of the recovered papers

3.2.2 Approach

In this case we will identify trends and drivers that can have an impact on the recovered paper industry dynamics in the upcoming years. Possible impacts of these trends on the sector are pin-pointed. However, we do not aim to predict the future. Given the uncertainty of the future, it should be explicitly stated that we describe only possibilities. Work could be extended to develop scenarios based on identified trends telling us more about "what if" issues that can be more radical and unforeseen than realistic forecasts.

Firstly, we identified three moving areas that can have a large impact on the dynamics in the recovered paper based -packaging sector. We have taken the paper/board mill/converter as focal point and simplified the chain to three levels to analyse the trends in this sector: consumers, raw materials and the manufacturers (Figure 3-8). A covering group of drivers is on macro level.

Figure 3-8
Simplified Overview of Drivers in Recovered Paper Based Packaging Industries



1) The product portfolio and its respective quantities that industry will produce will depend on the customer demands and we will therefore pinpoint some emerging trends in consumers' behaviour concerning packaging. In this report we discuss the final consumer (i.e. households) together with the intermediate consumer (filler) that makes the decision about the packaging.

2) The recovered based paper industry is with its raw material largely dependent on others. The availability of the raw material and its quality have a large impact on the recovered paper and board industry.

3) The third set of drivers for the changing dynamics in the RP based packaging industry originates in the industry itself. Here we discuss technological developments that are exclusively related to the recovered paper and board industry.

On the macro level, we identify European or global trends that can influence drivers in all three groups. Macro drivers are in this case drivers that are hard to influence by any single actor in the value chain.

This study is based on literature research, web searches, conference materials and statistics from associations. Some expert opinions are included.

3.2.3 Macro Drivers

Below follows a list of macro drivers that were found listed in many articles on trend analysis and scenarios studies on several types of products. This list could be much longer, however the three items listed we consider most important in driving the trends in the three identified levels in the RP based packaging industry.

1) Internationalisation or globalisation
   a. Very global, competitive and market-driven environment
   b. Increasing trade barriers

2) Development of world economy
   ii. Healthy global economy
   iii. Stagnating world economy although some emerging economies are growing

3) Population development

For the first two macro drivers, we have listed two opposing scenarios (a and b, and i and ii). The population development in the upcoming 20 years is more predictable.

In the following sections, drivers in the three earlier defined areas of the value chain are identified. Trends are analysed taking into account the different scenarios of the macro drivers where appropriate and possible.

3.2.4 Trends in Consumer Demand for Packaging Products

Packaging plays an important role in the protection, presentation, tenability and logistics of a product. Every day, the typical consumer in Europe interacts with 10-20 pieces of packaging. A significant proportion of these packs are constructed predominantly from paper and board or incorporate paper and board components. The fibres in paper and board provide the packs with strength and structure, and coatings and additives can be combined with the fibres to offer high quality print opportunities, grease resistance and other useful properties (Source: Sustainpack website). In order to identify the trends in consumers' demands for packaging products we take societal trends as a starting point as they can act as an enabler for innovations and developments. Different societal trends are often interlinked. Macro drivers are taken into account later, as they can amplify trends in certain directions.

Individualisation

This trend in society can have an important impact on consumer demands. Important drivers of this trend are the increasing amount of small (1- or 2-persons) households, increased education, liberalisation and increased access to large amounts of information via the Internet.

The strengthening individualisation can lead to an increased consumer demand for niche products, leading to growth in the size of the total product portfolio. The former well-known target groups have largely disappeared and the new ones are small and diffuse. Furthermore, the mature and demanding consumer expects quality products, available at any time and any place. This leads to higher demands on the flexibility of distribution chains. Packaging can play an important role herein. So called 'intelligent' or 'smart' packaging are under development and will be discussed later

Greying Society

The increasing share of elderly people in western society is a result of large birth rates following World War II, decreasing birth rate afterwards and improvements in health care.

The aging society will lead to a further increase in the amount of small households. In terms of packaging, this might lead to demands for smaller packing. Thus, the amount of packaging and the diversification of packaging are expected to increase. The "greying" of society will further emphasis the provision of easy opening systems. Readability of labels for the aged and visually impaired will also require attention in the designing and labelling of packaging. Given their numbers and affluence, marketing will reflect this changing composition of the population.

Virtual World

The booming increase in the use of the Internet (a trend in itself) is also a driver for many new trends and can have a large impact on the packaging industry.

Whereas, traditionally, transportation packaging was used to transport goods from the producer to the retailer and the consumer packaging within the transportation packaging had the function of attracting the end consumer to buy it, the boundary between these two categories have become vaguer by the appearance of e-commerce. More and more people order products via the Internet directly from the producer. This means that the amount of transportation packaging increases: instead of one big box sent to the retailer, now several smaller boxes will go to several households directly. This new packaging concept will have characteristics of both traditional categories: it needs to be strong enough to be transported without a covering box, and since it arrives directly at the consumer, the packaging should be attractive and informative as well.

Changing Lifestyles

Time has become one of the new scarce goods. Many people want to spend the scarce time they have qualitatively in the best way. The increase in two-earner households is an important driver for this phenomenon. Another rising issue in changing lifestyles is health and safety concerns among consumers. An important impact of the first driver is the increasing demand of ‘convenience products’. Especially in the food and beverage sector (the largest ‘consumer’ in the packaging sector) there is a tendency towards convenience food as consumers more and more value time-efficient ways of food preparation. A by-product of this demand will be an increase in the amount of packaging per food unit. Convenience packaging goes beyond the essential purpose of preserving and protecting the product. It enables consumers to quickly turn conveniently packaged food products into meals without sacrificing quality. Much of consumer confidence in the products they buy derives from the knowledge that the product has not been opened or tampered with; the existence of visible seals on products will therefore stay important.

Sustainability

There is increasing awareness of the environment among consumers. Sustainability has become a fashion word that is used (and misused) on many occasions. Consumers indicate that they find the environmental aspects of packaging more and more important, but the question remains if they are also willing to pay for it. Consumers consider the manufacturer the first responsible for environmental friendly packaging (Trendbox).

Concerning the packaging industry, re-use, recyclable and/or bio-degradability are important trends. The paper industry has a long history in recycling and is one of the frontrunners concerning recycling within the packaging industry. Most recovered paper comes from industrial and commercial sources because they are the easiest, cleanest and most economical to collect. Other trends are material reduction (lighter packaging) and the avoidance of redundant packaging.

Technological Development [1]

Cross-sectoral technological developments especially relevant to the packaging industry are biosciences, nanotechnology and printable electronics. They are expected to be enabling a new generation of so-called smart, intelligent or communicative packaging.

Developments in nanotechnology are some of the most important scientific developments in recent years, within many industries, including the packaging industry. Packaging that incorporates nano-materials can be "smart," which means that it can respond to environmental conditions or repair itself or alert a consumer to contamination and/or the presence of pathogens. Another type of smart packaging integrates the packaging into some kind of IT system for tracking-and-tracing or sales management. This kind of smart packaging typically employs RFID or Electronic Article Surveillance (EAS) technology and turns an otherwise conventional packaging into smart packaging, allowing it to be traced through the value chain or through the exit-doors of a retail store. Further examples of smart packaging include packaging that provide self-heating capabilities, or those that provide instructions and pricing on a small integrated screen.

Bio-degradable polymers and bio-based polymers are under increasing development. Fibre based raw materials and bio-plastics are, however, complementary and collaboration along the chain is required for successful application.

Cost-efficiency in the Chain

An ongoing and important driver in the packaging chain is cost reduction especially for the first consumers: the fillers and retailers.

Current trends concerning cost-efficiency in the chain logistics are *material reduction* i.e. lighter weights or smarter design, *optimal loading of trucks*, which asks for the increasing use of standard sizes fitted to the truck content, *efficient handling and storage*, which require easy opening systems and the use of single (not-combined) materials within a packaging product, *total leave out of packaging* and *the use of multiple usage of packaging*. The latter trend might favour the use of other materials than paper or board (i.e. plastics); plastics packaging crates are, due to their higher costs, beneficial only if they are used multiple times. This is only possible in closed systems however, where the packaging returns. The change in retail channels (earlier mentioned virtual world), however, contradicts this trend.

[1] Technological developments are here discussed under consumer trends as we discuss here the trends that are largely related to consumers' demands and that are not specifically related to the paper and board packaging industry. Technological developments within the recovered paper industry will be discussed later. There are, of course, overlapping issues.

Some Remarks about the Macro Drivers:

Changes in the world economy are crucial for the development of consumer demand in Europe and the emerging economies. In Europe the demand for high quality, luxury products and sustainable products is expected to increase when there is positive economic development, whereas in poorer economic development the demand for low-cost and more bulky products increases. In the emerging economies, demand for western products might well result from a positive economic development and vice versa.

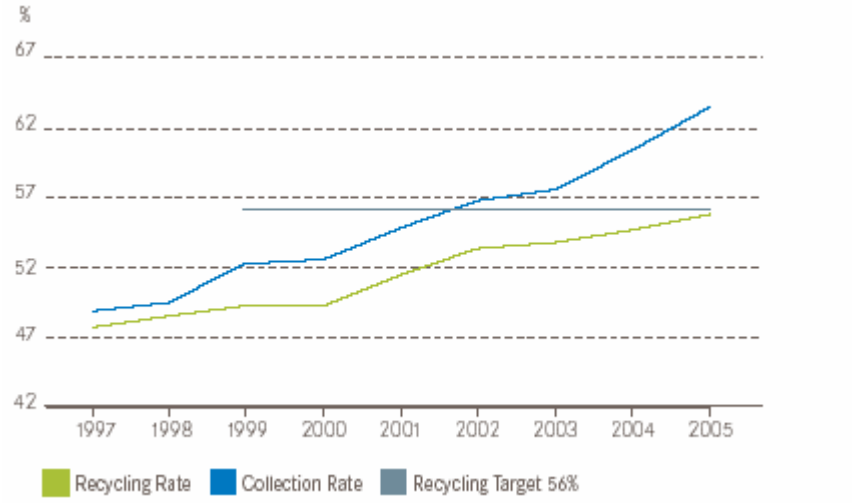
3.2.5 Trends in the Availability and Quality of Raw Materials

Availability and quality of the raw material play a great role in the competitiveness of the recovered paper and board industry. The quality of the recycled fibre pulp influences the processing costs and the quality of the end product. The higher the quality of the recovered paper, though, the higher the price. The price of recovered paper is also dependent on its availability. The availability of recovered paper relies on the amount of recovered paper collected. However, this is not the only factor; other actors on the market might opt for the use of recovered paper (i.e. energy recovery, especially with increasing energy prices) and also the export of recovered paper and the import of packaging material with the import of goods influence the balance of recovered paper availability in Europe. In this section we will identify the main variables and trends that influence the availability and quality of recovered paper in Europe.

Availability

The current level of recycling is already very high in Europe; in 2005, European (CEPI countries) paper and board production was 97.1 million tonnes. Recovered paper collection has grown fast at 4.7%/a, rising from 38.9 million tonnes in 1998 to 53.5 million tonnes in 2005. During 2005, the European paper and board industry utilised 46.6 million tonnes of recovered paper as raw material. The average recovered paper utilisation rate was 48.1%, the collection rate 63.5%, and the recycling rate 55.4%. Consequently, the European paper industry has reached its recycling rate target (see Figure 3-9). The recycling rate is defined as the recovered paper utilisation divided by the total paper and board consumption.

Figure 3-9
Development of Recycling Rate, Collection Rate and Recycling Target, 1997-2005



It is not possible to recover all paper. In addition to non-collectable and non-recyclable paper products (i.e. archives, books, tissue, cigarette papers) that are estimated to represent about 19% of all paper products concerned (CEPI, 2003), it would not be economically viable or environmentally sound to collect and recycle everything that in theory would be possible because this would need an excessive amount of transportation. Furthermore, every time a fibre is recycled, it loses some of its strength, therefore there is a limit to the amount of times a fibre can be recycled.

With the new voluntary Declaration on Paper Recycling (2006-2010), the European Paper and Board Industry as a whole promises to take measures to ensure that by the year 2010 66% (+/- 1,5%) of the paper and board products consumed in Europe will be recycled. In the new declaration, the target recycling rate also includes net recovered paper exports to countries outside Europe (this was excluded in the first declaration).

From the new declaration on paper recycling with a new and higher target we can expect that the recycling level in Europe will keep increasing in the upcoming years (performances vary greatly from one country to another due to differences in market and industry structures, population density, education, transportation distances, etc). There are, however, some factors that might favour or hamper an increasing recycling level (CEPI, 2006):

Factors favouring an increase of the recycling level:

- Increasing use of recovered paper in paper manufacturing. For example, all new newsprint and containerboard investments are based on recovered paper.
- General opinion favours an increase in recovered paper collection and recycling.
- Recovered paper exports to countries outside Europe are expected to increase and these increase the recycling rate.
- Collection activity and volumes in new EU countries (incl. Bulgaria and Romania) are expected to grow fast due to low level at present.
- Collection potential is increasing with packaging material imported with goods.

- Active industry role to increase collection activity (educational campaigns, developing collection and sorting practices, technical research, quality management, etc)
- Wider participation in the new European Declaration on Paper Recycling; chain approach to recyclability.

Factors limiting the increase of the recycling level:

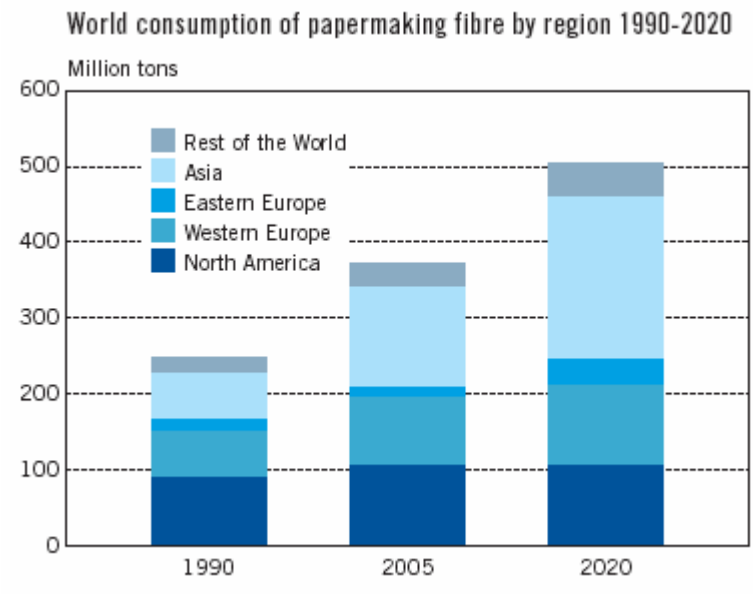
- Possible increase in incineration and recovered paper use for energy production (high energy prices and subventions).
- In some countries recovered paper collection has already reached a high, and further growth is unavoidably slow.
- Recovered paper utilisation in other uses is not controlled by the signatories of the declaration. It is not accounted for and such data is not available.
- Inefficient collection and sorting practices lead to deteriorated quality and unsuitability of the recovered paper for recycling.

So on the one hand, we expect the recycling rate in Europe to increase in the upcoming years (given by the new recycling target for 2010); this is supported by the factors favouring an increase in recycling level. On the other hand, we need to be aware of factors that might hamper the increase in the recycling level.

Europe currently enjoys a rather good volume balance in paper production and consumption. The main industrial threat for the European paper industry will probably become the large production units in tropical and Asian countries based both on fast growing hardwood (mainly eucalyptus and acacia) and recovered paper which is typically not available in those countries but has to be purchased from outside. Their products will be highly competitive partly also due to far lower costs for labour and energy. This might affect the European paper industry not only to the potential development of international prices for virtually all paper grades but also to a much stronger competition in international raw material markets.

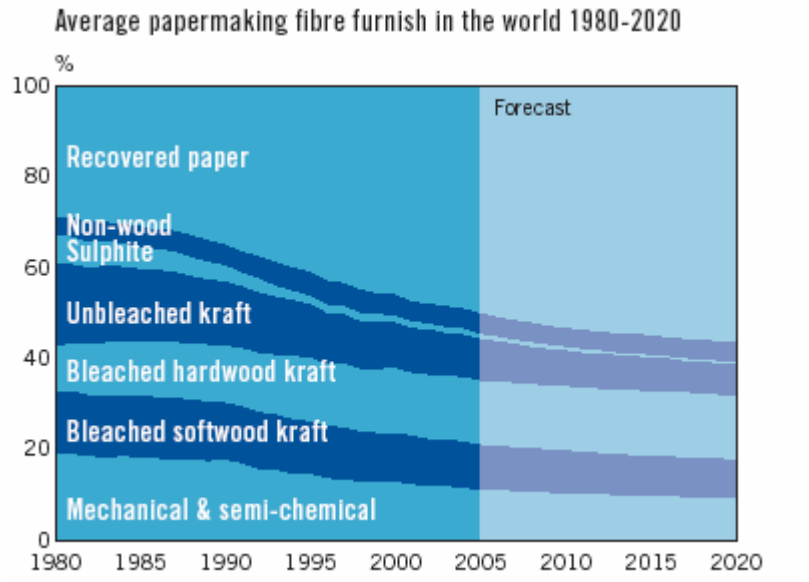
In a recently published article in the Poyry magazine “Know-how wire” January 2007, a world fibre outlook on 2020 is given. This study estimates that world demand for paper and paperboard will grow from 365 million tons in 2005 to 494 million tons in 2020 (this corresponds to an average growth rate of 2% per year). “In line with this trend, the world consumption of papermaking fibre is expected to grow from 370 million tons to 504 million tons by 2020 (Figure 3-10)”. A large share of this growth will be fulfilled by recovered paper (Figure 3-11) due to its low cost compared to virgin fibre pulps. “The world demand for recovered paper is expected to grow by 3% per year through 2020. Its use will grow most substantially in packaging board production. The globalisation of manufacturing industries has resulted in a shift of demand for packaging boards from high-cost to low-cost regions. This trend will continue, curbing the growth rates in the west and Japan, and boosting the growth in emerging markets, Asia-Pacific and Eastern Europe in particular”.

Figure 3-10
World Consumption of Papermaking fibre by Region 1990-2020
Source: Know-how wire, Pöyry Magazine, January 2007



Part of the anticipated growth in China's paper production can probably be satisfied with non-wood fibre raw material and hardwood plantation developments. This will provide the industry with some additional degrees of freedom, particularly if and when the competition for imported recovered paper starts to affect the availability of secondary fibre. "In general though, the Chinese papermaking fibre market will be increasingly based on recovered paper raw materials." (Know-how wire, Poyry Magazine, January 2007)

Figure 3-11
Average Papermaking Fibre Furnish in the World 1980-2020
Source: Know-how wire, Pöyry Magazine, January 2007



Also other studies indicate this trend. In the European network COST E-48, it is stated that the demand for recovered paper is getting stronger all over the world. The impressing number of new mills under construction or in the planning phase in Asia (particularly China), many of which will be based on recovered paper, are a strong indication that it will be the start of a permanent? world trend. This is expected to have a strong influence on the world markets for recovered paper. The utilisation rate (utilisation vs. production) of recovered paper in China is as high as 49% while the collection rate (collection vs. consumption) of recovered paper is below 30%. Furthermore, China produces paper and paperboard with straw and wood pulp, thus the quality of the recovered paper is much inferior to the imported recovered paper which is made of wood pulp. Inevitably, Chinese paper producers will have to purchase imported recovered paper as it is stable both in supply and quality. China's strong demand for recovered paper might raise the price of recovered paper in the international market.

With rising energy prices and the stimulating policies of the EU for the production of renewable energy, there is increasing competition for the use of the paper industry's raw materials as an energy source. From sustainability point of view, it is better to first use the raw material for products, subsequently wood and recovered paper can be used as renewable energy sources, but only at the end of the products' life cycle. Doing so is both environmentally desirable and economically sound (as the added value in the pulp and paper sector is almost nine times higher than its direct use for energy) (CEPI, 2003). Recycling has no influence on paper's energy content. In addition, recycling means that carbon is stored for a longer period of time in the paper, thereby acting as carbon storage. The impact for the European paper industry of the competition for energy will depend on political choices and policy developments as well as the availability of renewable sources in the future.

Summarising, the recycling rate in Europe is expected to increase even more in the upcoming years. Opportunities are there in the new EU countries where collection rates are currently low. With the import of goods, an increasing amount of packaging material becomes available, which increases the collection potential. Recovered paper is more and more used in the paper manufacturing industry and the general positive opinion towards paper recovery together with the active industry role and wide participation in the recycling chain favour an increasing recycling level in the coming years. There is, however, also stronger competition expected on the recovered paper market; especially the Chinese market will continue to increase its demand for recovered paper from the west. Although this also contributes to the recycling rate, it might drive up prices in the international market. A major threat for the paper industry is the competition for its raw materials with the energy sector, especially when policies will keep stimulating the use of these materials for energy in the first place.

Quality

Considering the above, it is rather certain that recovered paper as a raw material for the paper industry is there to stay and its utilisation is likely to increase over years. One of the decisive criteria, besides availability and price, for the future utilisation of recovered paper is its quality. Here, three aspects are distinguished that are related to quality with an increased recycling.

Firstly, when the utilisation rate of recovered paper is enlarged, it will more and more require the exploitation of resources that are lower in quality or more contaminated. Especially in countries where recovered paper collection has already reached a high level, the industrial sources of recovered paper have already been exploited almost fully. In these countries, an increase in the collection rate is mainly possible by increasing the recovered paper collection from households, which is in general a lower quality source. In some new EU countries, the collection activity and volumes are expected to grow fast due to the low level at present, it will depend on the organisation of these collection activities how it will influence the quality.

Secondly, every time a fibre is recycled it looses some of its strength and the fibre length decreases. After being re-used about six (five?) times (generally thought) the fibres become too short for papermaking. Each time fibres are reused, the fibre wall degrades a little further, until it is completely worn down. Recycled fibres can become broken or damaged and they have different physical properties from virgin fibres (e.g. micro-fibrils on the surface of fibres tend to be collapsed), resulting to weaker inter-fibre bonding and consequently to lower strength in paper. The effect of fibre damage due to recycling can be reversed, however, for example by the use of milder beating technologies, refining, or the use of enzymes (Van Kessel and Westenbroek, 2004).

The third quality aspect related to an increase in recycling is that recovering and re-using paper as a raw material for the paper industry results in the establishment of a partially closed (new paper - old paper) loop. Like in all such systems, the consequence is the build-up of concentrations, in this case the addition and accumulation of various fibrous and non-fibrous components (e.g. fillers and chemicals). This will have a negative impact on the recycled pulp quality. Besides, the amount of recycling residues will also increase.

According to CEPI, every 5% increase in recycling will lead to a 7.5% increase in recycling residues. Furthermore, the continued mixing of paper qualities also results in a decreased quality in the paper loop. In 2001, the European list of Standard Grades of Recovered Paper and Board EN 643 was adopted. The Standard is to assist in the buying and selling of the raw material intended for recycling by the paper and board industry, it secures the quality of the recovered paper supply to the paper mills and improves the traceability of the paper industry’s raw materials.

It has become clear that paper production from recovered fibres requires special processes to deal with lower quality fibre raw materials. At this moment, the quality is decreasing and in order to be able to maintain production capacity and paper quality in the future, new developments are necessary in the area of restoring fibre quality and potential. New developments in fibre processing are essential to create a sustainable equilibrium between future demands for fibre resources and recycle possibilities. New technologies in recovered paper production are treated in the next section.

Apart from technologies that are important in the process of dealing with and restoring recovered fibre and pulp quality, also social aspects and policies are important drivers in optimising the quality of the raw material. The collection of recovered paper from households will become an increasingly important source and the quality of this source depends directly on human behaviour and inherently their awareness and acceptance. Also, the collection and sorting systems in place play an important role and these are

mainly decided for by local authorities. Separate collection of recovered paper has made it a valuable source of raw material for the industry. Policies should not hamper the process of separate collection (by recognising recovered paper as a fibrous raw material to be recycled, instead of considering it a waste not needing separate collection).

Summarising, quality of recovered paper (together and interlinked with availability and price) is an important aspect for the competitiveness of the recovered paper and board industry. Quality is expected to decrease by increased recycling; this counts for the recovered paper supply to the mill, as well as the pulp quality and the individual fibre quality. Technological developments can help to counterbalance this effect, but also in the area of policies and social matters action is essential.

3.2.6 Trends in the Production Process of Recovered Paper and Board Industry

As discussed in the previous sections, growth in the demand for recovered fibres has stimulated an increase in technologies for processing recovered fibres. Significant innovations and optimisations have led to the possibility of processing even lower quality recovered fibres into still higher quality products. In this section, some of the main areas of new technological development will be described:

- Technological developments directly related to the recovered paper and board industry have evolved and are still developing in different steps of the chain. From outside the direct paper and board industry for example: improved collection and sorting systems, which increase the quality of the recovered stream by retrieving purer grades.

- Also the prevention of waste on forehand by the substitution of metal wires for paper bails with alternative equivalents in form of plastic wires and paper ropes to reduce the impact of the non recyclable and non paper fractions in recovered paper in combination with the prevention of accidents (Ing. Klaas Heijs and Bartek Stawicki. Reducing recovered paper rejects during recycling. Paper Technology Volume 47, Number 7. Oct/Nov 2006.)

- Within the recovered paper industry new developments are found and expected in various steps of the process: Sensor development for the first step of the process where raw material enters the mill. These sensors are better able to check the quality of the incoming raw material, e.g. by assessing humidity and chemical or microbiological contamination, unusable material presence and ratio and raw material compositions according to EN 643.

- New upgrading techniques in the paper making process have been developed in order to minimise the degradation effects as well as to improve recycled fibre characteristics. Chemical, enzymatic and mechanical methods are under development for prevention of unnecessary fibre damage and for upgrading of damaged fibres. The proposed technologies enhance fibre potential. Implementation of the new technologies will result in more sustainable usage and increased availability of fibres.

- Also further in the process new applications are developing for the better use of rejects that arise during the production of recovered paper. Some examples of useful application are already known e.g. at CDEM in The Netherlands, de-inking sludge is used as an alternative raw material for the cement industry. Another application that is growing fast is the production of secondary fuels for recovered paper industry rejects.

- Finally, a hot topic in technological and systematic developments in the recovered paper industry is the concept of the bio-refinery. This concept is about the efficient use of the entire potential bio-based raw materials and by-streams and creating more value out of the bio-based raw material. In this concept wood and recovered paper as well as agricultural raw materials and other by-streams are combined treated towards a broad range of novel products. The idea is that all by-streams are valorised in cascade (first removal of components with highest value and recyclability). Furthermore, it might lead to new fibre raw materials for paper and board production from agricultural by-streams and cooperation in development of innovative efficient technologies.

Summarising, technological developments in the recovered paper industry focus on improving quality and combating decreasing pulp and fibre qualities. Another focal point is the prevention, reduction and useful application of paper industry rejects. Due to the increasing prices of waste treatment and landfill these are economic as well as environmentally desirable developments. Of course also improvements in other paper production aspects are important in the recovered paper industry e.g., increasing surface quality properties and reducing the weight of the paper. However, since these types of technologies are not strictly related to the recovered paper industry they are not mentioned here. A further and more in depth analysis of technological developments in the paper (incl. recovered paper) industry is provided in PD 4.2.3.

3.3 Drivers and Trends in Wood Products Industry

In this chapter the most important sectoral trends and drivers of change in wood products industry are represented. The subject is covered from several points of view. The trends and drivers related to availability, end uses and technology development are discussed first. After that the trends and drivers of competitive environment and markets are considered.

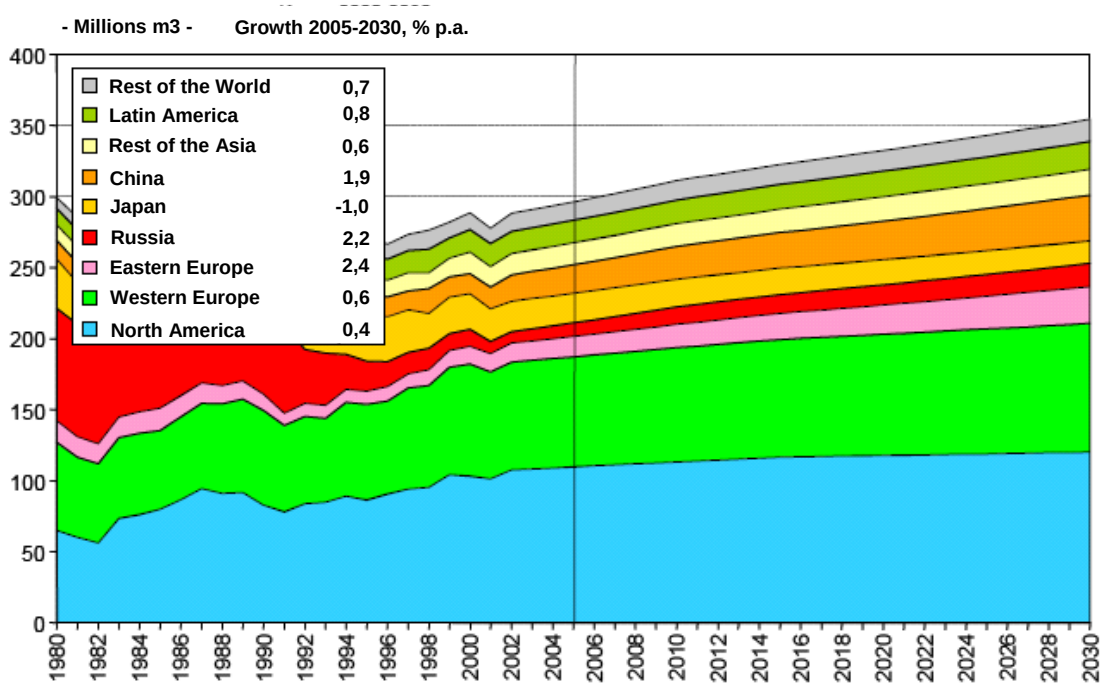
The most notable drivers having an effect on availability of wooden raw material are the increasing use of Russian and Eastern European wood resources, increasing supply of low quality softwood logs and increasing supply of hardwood fibre based on quick-growing plantations.

By 2020 the growth in net export of Russian softwood has been estimated to be bigger than the growth of consumption in Western Europe. This driver combined with limited availability of softwood logs seems to be leading to structural changes in softwood related industries in Western Europe. However, the recent news on increased wood tariffs in Russia can have a significant effect on this driver.

One increasingly considerable driver in European wood market is the growing supply of "local" softwood of poor quality. The softwood supplied is predominantly the sawn wood and logs of coniferous wood. The driver is not a threat to competitive position of clean timber and sound knotted wood, but the supply of wood of lower quality in Western Europe will most probably be influenced by the Russian and Eastern European import.

The consumption of softwood sawn wood is estimated to grow 58 millions m^3 (0.7 %/year) by 2030 (Figure 3-12). The volume equals to 2.3 millions m^3 annual growth in consumption in that period. The strongest proportional growth in consumption is estimated to be located in Eastern Europe, Russia and China. The slow increase in consumption in Western Europe and the export opportunities offered by growing markets mainly in Asia form the driver having an effect on competitiveness. Typically part of the production of upgraded softwood sawn wood products is located near the end product markets. This restricts the growth potential via upgrading industry.

Figure 3-12
World's Consumption of Softwood Sawn Wood



Source: Jaakko Pöyry

The strongest technology drivers of quality and quantity of logs in sawmills are the growth of sawmill capacities, mushrooming of engineering products, prolonging the maintenance-free life span of wood products, the development of production suitable for usage of round wood of small diameter and the even more specific identification of raw wood material quality.

The most important technology trends related to quality and quantity of amounts of wood used in mechanical wood industries are the technologies improving sawing of small-dimensioned wood and innovations in products of wood panel industries, e.g. MDF, OSB, and in engineering products.

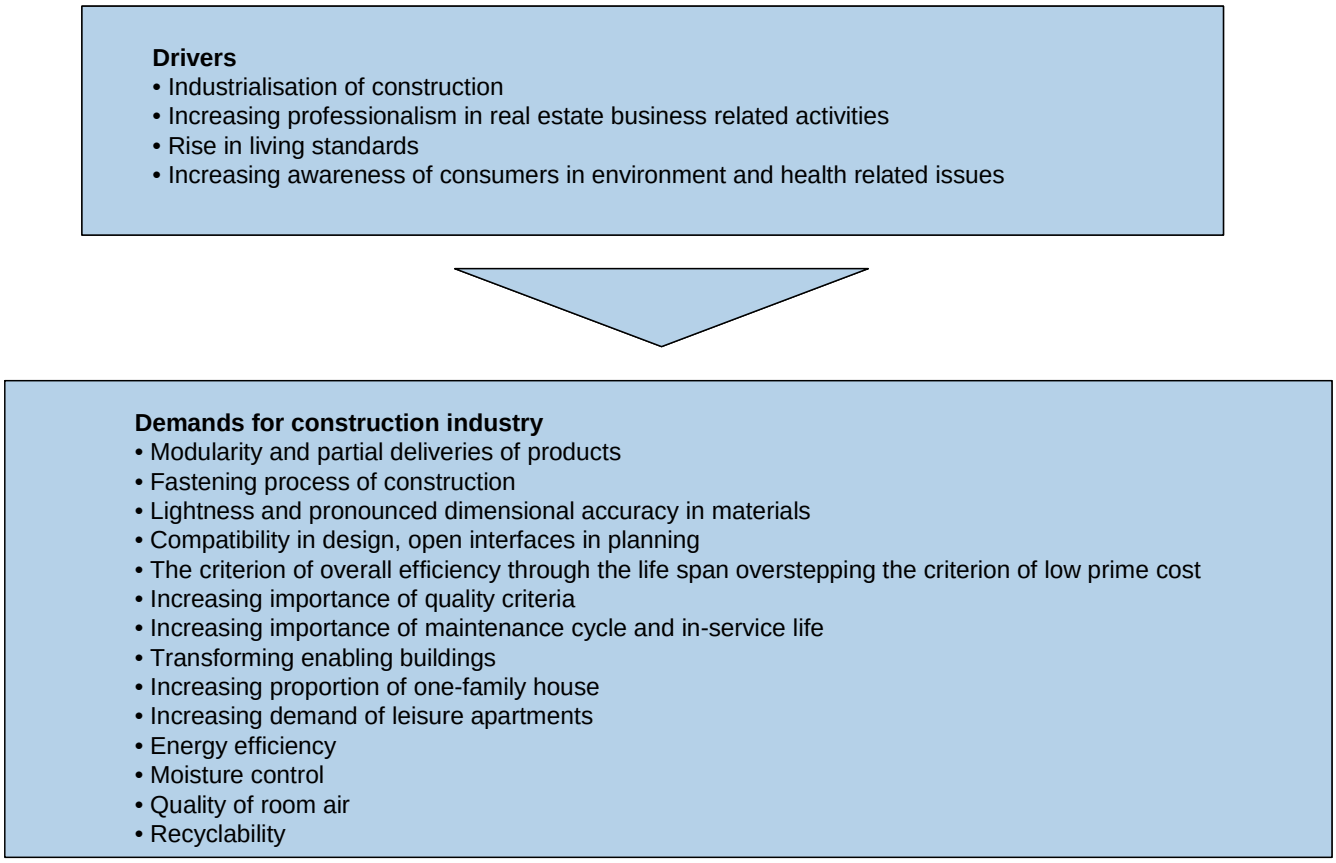
The drivers of quality and quantity of logs in sawmills have an effect on competitiveness environment in several ways. The growth of sawmill capacities is leading to concentration of wood procurement. The evolution to the surgical product has a positive influence on the competitiveness of sawn wood. At first, the sawn wood based engineering products are increasing, but the OSB products with supporting structures characteristics that are currently under development will become common later. The need of logs with wide diameter will decrease because of OSB products with supporting structures characteristics and better possibilities to use high quality small-dimensioned wood.

The trends and drivers of end uses point towards the relatively favourable future when competitiveness is considered. The proportion of new constructions related industries is growing slowly in the Western Europe. However, the positive driver for exploitation of wood reserves is the increasing proportion of restorations.

When compared to competing construction materials, the uprising challenges of future can be well answered by wood. End uses related product substitutions are more common between wood products than between wood and other construction materials.

Wood construction can be divided in the end use categories of skeletal structure, external cladding, joinery industry products, the uses of wood during the construction processes, and earth and hydraulic construction including the segment of backyard and garden construction. The main drivers having a noteworthy effect on the use of wood in construction can be identified to be the industrialisation of construction, increasing professionalism in real estate business related activities, rise in living standards and increasing awareness of consumers in environment and health related issues. The drivers are shown in Figure 3-13.

Figure 3-13
Drivers and Demands for Construction Industry Source: Pöyry



Recycling of Wooden Packaging Materials – an Example from Finland

The main form of wood packaging is wood pallets. Other types of wooden packages include box pallets, frames, barrels and cable reels. In Finland the main consumer of wooden packages is construction industry (25 %) followed by food industry and forest industry (20 % each). In 2005 approximately 200 000 tons of new wooden packages were sold to the market in Finland.

European Union set in 2004 a target that 15 % of wooden packages need to be recycled. The target has to be met by the end of 2008. This sets challenges to Finland because approximately 90 % of wooden packages are burned (with energy recovery) which is not considered as recycling. Approved methods of recycling include utilisation as raw material for wood-based panel industry, as chipped for green areas, composting and use for producing new packages or repairing old.

In many European countries, especially Germany, France and UK, wood packages are widely utilised in particleboard production whereas in Finland particleboard industry is rather small-scale and uses mainly sawmill residues as raw material. This sets challenges to meeting the EU target by 2008.

In the future the price of wood raw material will continue to increase in Europe. Therefore it would be essential for the competitiveness of wood product industry to be able to utilise all potential raw material sources.

4 INVESTMENTS

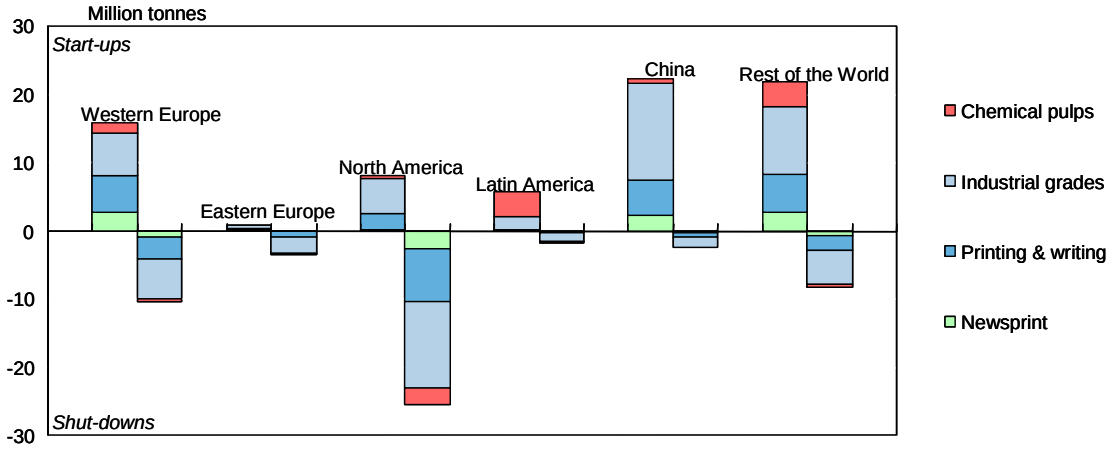
4.1 Pulp and Paper Industry

Today, paper mills are often located close to consumer. As technical development has made possible a high percentage of recycled pulp for almost all paper grades, a location close to consumers also often means close to the raw material. On the other hand, especially market pulp, but also some paper grades are and will continue to be globally traded products (see Report PD 4.3.4), meaning that they are produced at one place and consumed at another.

Historically, demand growth has varied considerably between regions. For example, the Asian markets have grown dramatically in the 1990s and 2000s, surpassing North America and Western Europe in overall size. In 1980, North America and Western Europe dominated the world markets, accounting for 38% and 24% of total demand. At that time, the share of Asia was about 19-20%. Today, Asia accounts for 38% of world paper and paperboard consumption, leaving both North America and Western Europe behind with 27% and 22% shares, respectively.

The shift in growth from west to east and from north to south has been particularly dramatic in 2001-2005, with Asia accounting for 70% of the global demand growth, while North America and Western Europe contributed only 4% and 7%, respectively. Considering its relatively small share of only 4% of global markets, Eastern Europe has been another rapidly growing market with 11% of the global demand growth during 2001-2005.

Figure 4-1
New Paper Machine And Pulp Line Start-ups And Shut-downs 1995-2005 for Selected Grades (Source: Pöyry)



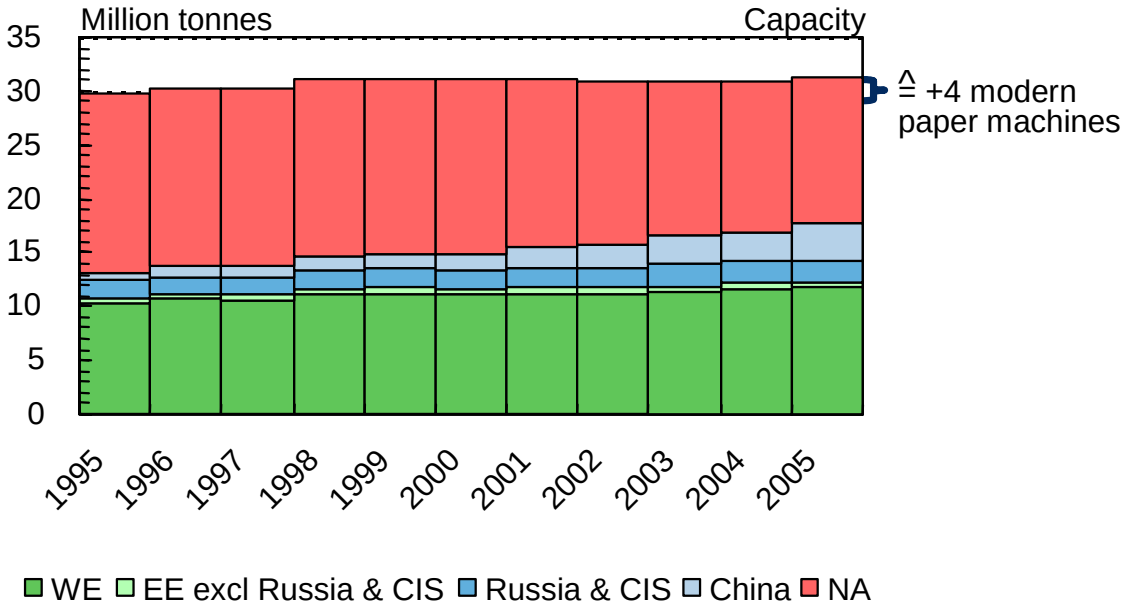
The paper and board industries have sought growth and new business by expanding their geographical area of production via investments Figure 4-1 the high cost environment primarily in Europe, the existing facilities have continuously been optimised to improve cost competitiveness. North American producers, not having had the efficiency incentive in the form of high fuel unit prices, have been forced to close down under-invested production facilities. The new mills coming up on stream in China and South America are the largest ones ever being built thus realising large economies of scale.

Newsprint

Western Markets, together with Japan, no longer offer any significant growth opportunities for newsprint companies. Eastern European and Asian (most importantly Chinese together with Indian) markets will be central for growth-driven newsprint firms, whose investment actions have already manifested this trend for some time.

Especially North American newsprint industry has experienced several capacity closures, and the total capacity there has declined significantly during the past ten years, having had an all-time peak in 1995. A lot of new capacity has, on the contrary, emerged in China and other parts of Asia (Figure 4-2). In Europe, in strive for cost competitiveness, most investments in new capacity have been simultaneous with closure of old one within the same company.

Figure 4-2
Newsprint Capacity Changes per Region 1995-2005 (Source: Pöyry)



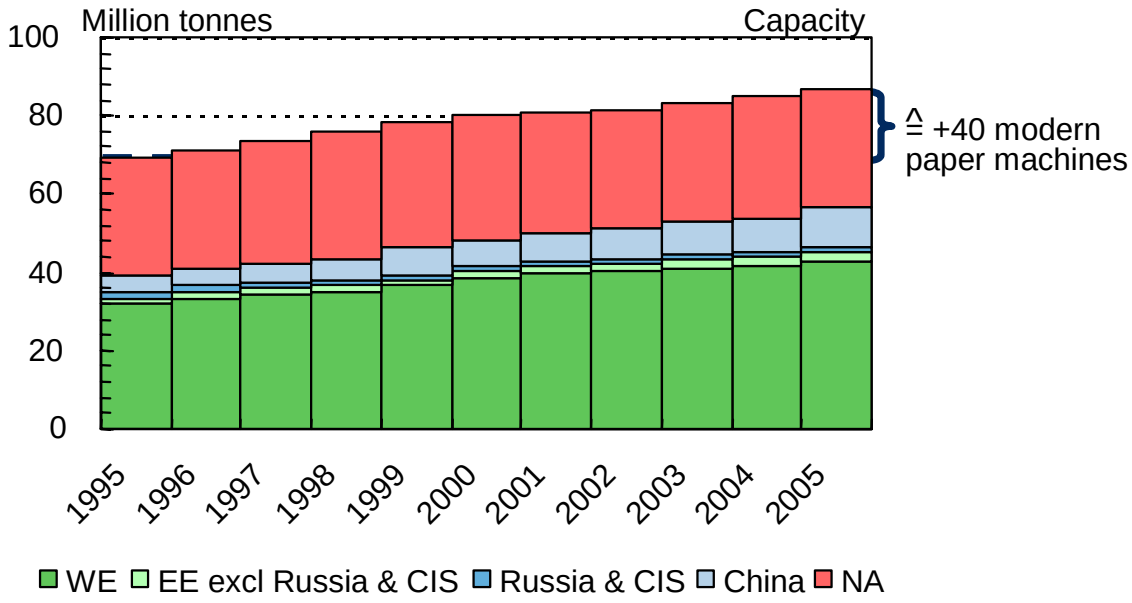
Printing & Writing Papers

The production as well as consumption of coated and uncoated mechanical printing and writing paper grades is dominated by North America and Western Europe. In woodfree grades, they have also been the major areas, although China has already taken quite a share especially in uncoated woodfree paper (Figure 4-3).

The growth of capacity in uncoated mechanical papers has been quite rapid both in Europe and in North America. European investments have been partly done for export to North America in these grades.

The capacity of coated mechanical papers experienced strong growth in Europe in 2000-2002. Part of this new capacity has been targeted for export to North America and Asia. Since that the growth has flattened.

Figure 4-3
Printing & Writing Paper Capacity Changes per Region 1995-2005 (Source: Pöyry)



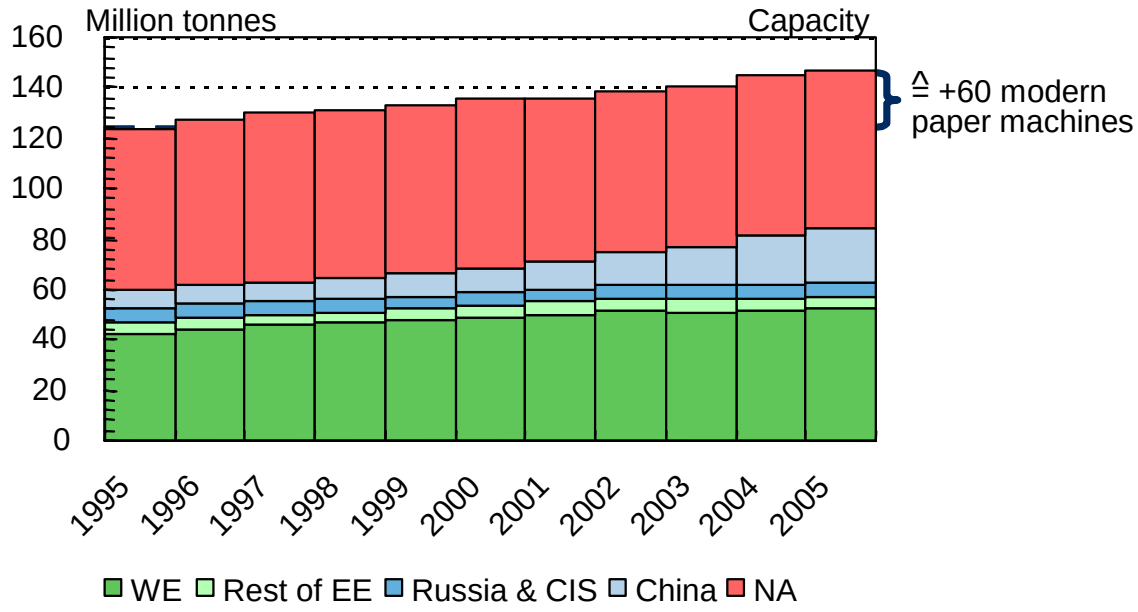
Industrial Paper & Board Grades

Industrial grades, consisting mainly of containerboards and cartonboards, have globally been produced and consumed mostly in Western Europe and North America. The growth in these regions has however flattened, having resulted in quite flat net capacity development (Figure 4-4). The effect of the growth of Chinese industry has already generated plenty of investments in the area in the industrial grades.

Production of recycled fibre based containerboard grades has outpaced virgin fibre grades during the past ten years in Western Europe. Eastern Europe has experienced strong growth in virgin fibre based kraftliner capacity, although recycled fibre based grades are also there a majority. The virgin fibre based industry is dominated by North American companies. The assets in North America are generally large but technically old, while the Western European machines are rather well invested in. Some subgrades, such as unbleached kraft papers, have been in decline in North America already since 1995 (P. Ince et al. 2001), although the majority of the North American significant decline in capacity of industrial grades has occurred after the turn of the millennium.

In cartonboards Asia has been a stable net importer, although the capacity has almost doubled during 1995-2005.

Figure 4-4
Industrial Paper and Board Grades Capacity Changes per Region 1995-2005 (Source: Pöyry)

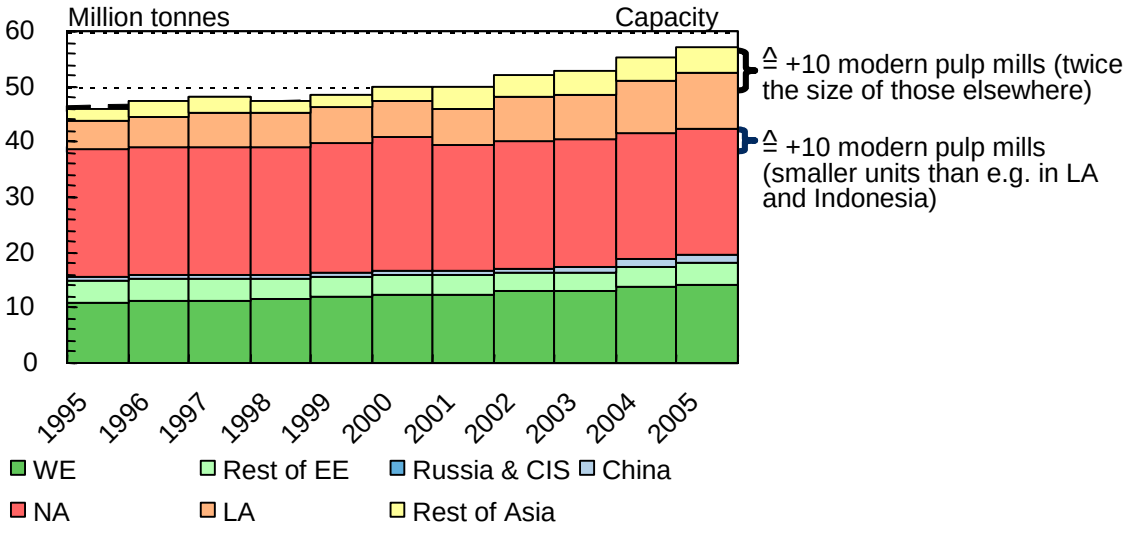


Market Pulp

The consumption of market pulps (dried pulps sold to external customers plus export captive pulps) has grown and is growing faster than that of integrated pulps. Much of the new pulp capacity is being built close to fast-growing plantation resources in Latin America and Southeast Asia (Figure 4-5). As a lot of this capacity is far from the paper consumption centres, the production tends to be exported rather than consumed locally. Large paper companies also tend to secure their fibre supply through investments in captive pulp manufacturing for export. As the more economical way to transport fibre is in the form of pulp, pulp mills are built close to the wood resource – if large enough – to avoid transporting the wood to a pulp and paper mill in another country.

Though wood pulp production in the USA and Canada has had a great influence on global market balances and trade flows, the role of North America in the world pulp industry is weakening. Low investment spending in the North American pulp and paper industry has caused the region's assets to deteriorate during the past few decades. For example, recovery boilers in the North American pulp industry are, on average, remarkably old. One reason for this is that around the mid-1990s the competition from Southeast Asia pushed US South mixed hardwood pulps from the Asian markets. Consequently, the production of market BHKP in the USA dropped by 900 000 tons within a period of three years.

Figure 4-5
Market Pulp Capacity Changes per Region 1995-2005 (Source: Pöyry)



4.2 Wood Products Industry

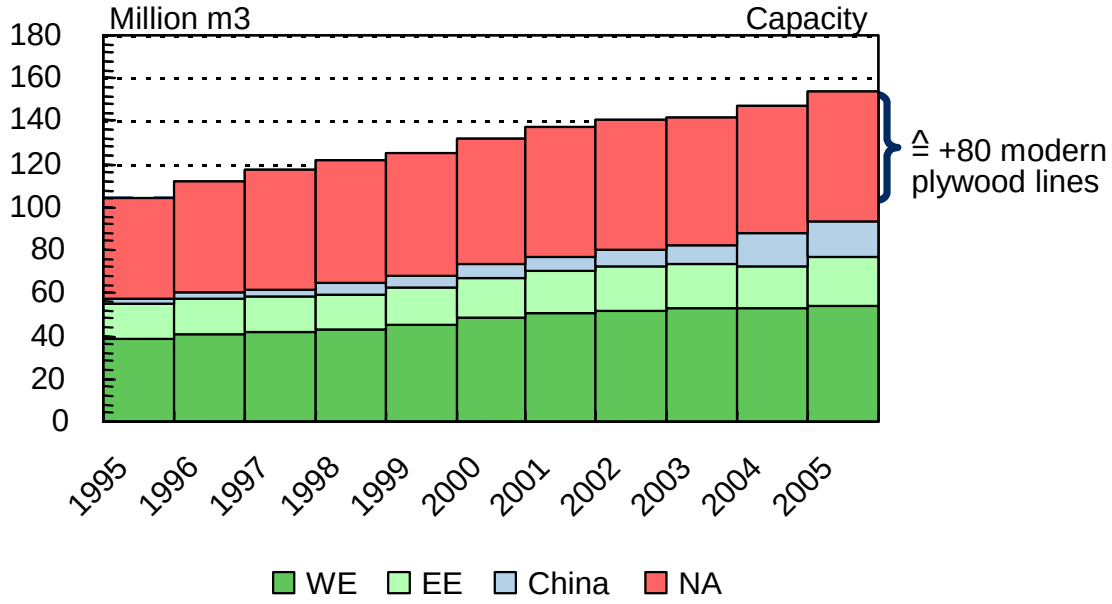
In wood products industry, reconstituted panels are typically home market products and not traded within long distances. Local demand determines the panel production capacity changes.

In the 90's there was a significant technology shift from multi-opening presses to continuous presses. This technology shift was the main reason for closing old capacity in Western Europe and building new to replace it. Also in Eastern Europe old small mills have been closed and modern large-scale mils have been built. MDF has been and still is the fastest growing panel type.

In North America the average mill age is higher than in other continents. North American investments have been driven by OSB, this panel type is which has been needed in strongly growing residential housing construction. Softwood plywood has been substituted by OSB.

China has been growing especially in MDF, which is used in the furniture industry.

Figure 4-6
Wood Based Panels Capacity Changes per Region 1995-2005 (Source: Pöyry)



So, the wood based panel industry has experienced a production move from West to East (Figure 4-6). In Europe the focus has shifted to Eastern Europe and Russia, where new large scale production units can include panel processing business, energy/fuels and other wood processing industries and sometimes even sawmills. The panel industry is also expanding in China by local investments.

Both particle board (PB) and medium density fibreboard (MDF) industries are relatively mature in Western Europe. Recent investments have been mostly replacement/ upgrading of old capacity. Big western producers expanded their production capacity in Eastern European countries (Poland, Czech Republic, Slovakia) in the 90s. The movement is now going more eastwards (Russia, Ukraine).

The oriented strand board (OSB) industry in Europe is still relatively small and concentrated in Central Europe. Capacity jumped in the beginning of 2000s, but lately there have only been a couple of investments.

In Russia the capacity that is dating from the communist era is severely outdated. Replacing investments started with MDF a few years ago by western companies. Now the major part of the capacity is modern and efficient and fulfils demand. The same is happening with PB with a delay of a few years compared to MDF. There are several investments lately started-up or ongoing in the region. In PB the involvement of domestic companies is stronger than in MDF. In plywood (PLW), the upgrade of capacity has not been such dramatic but new investments are steadily going on, mostly by domestic companies.

Turkey has been and still is expanding strongly the domestic PB and MDF capacity in spite of already saturated markets.

Major driver in the global PLW industry is the wood shortage in South East Asia, which has lead to capacity closures there. The demand is partly fulfilled by birch PLW production in Finland, Latvia and Russia. PLW production/capacity has increased rapidly also in China, where production is to a large extent based on imported logs.

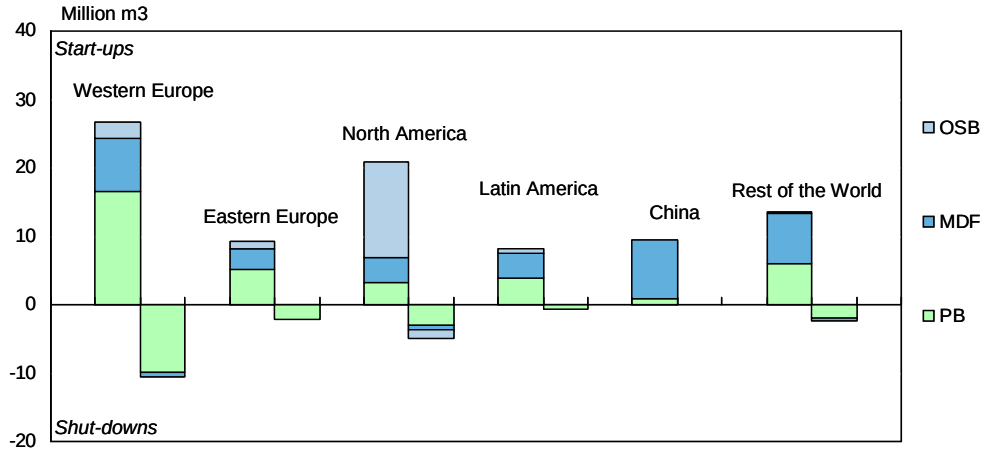
The North American wood based panel industry is mainly OSB, the product in which North America has the major share in the global markets. Consumption has been growing along with general economic growth and substitution of softwood PLW. There have been several new investments in high capacity production units in recent years. The recent weak market development along with the capacity growth has lead to price erosion and closures/hibernation of old capacity.

PB and MDF in North America have been stagnating along with the furniture industry, which is struggling with Chinese imports. This has lead to only marginal investments in recent years.

The Chinese MDF industry has been booming in recent years, and China is currently clearly the biggest MDF producer in the world. The capacity is still largely based on small-scale facilities with Chinese machinery but the majority of the new capacity is based on western mill concepts. The average mill size, however, is usually smaller than in Western countries.

The PB business in China is lagging behind MDF, and is clearly smaller in market size than in MDF, while in most countries PB is bigger than MDF. Nevertheless, investments in large-scale modern mills have been committed to some extent in recent years.

Figure 4-7
New Panel Line Start-ups And Shut-downs 1995-2005 for Selected Grades (Source: Pöyry)



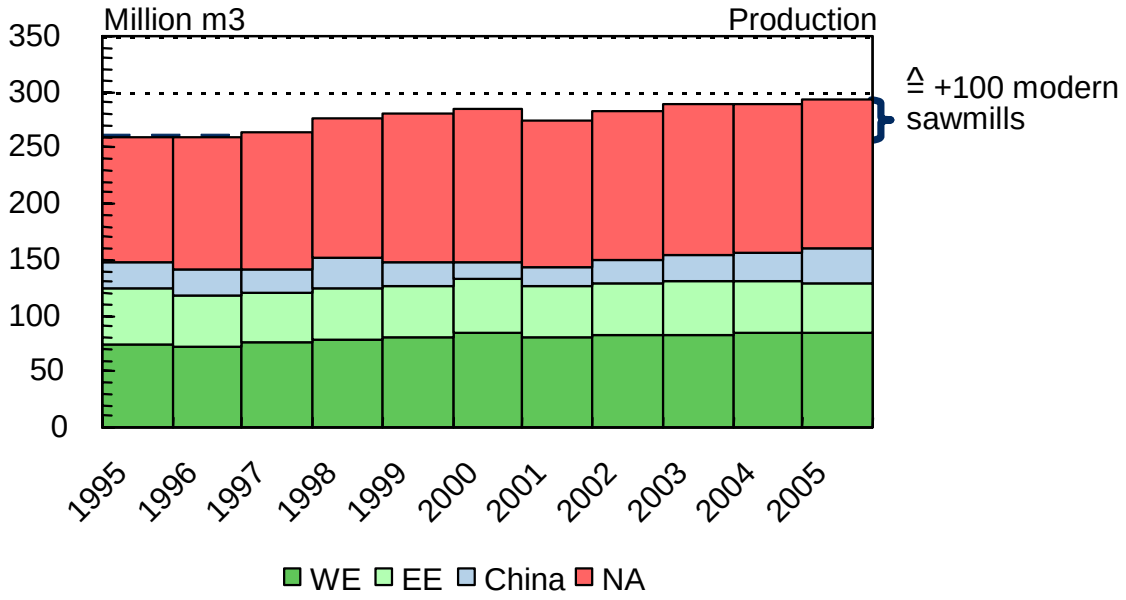
4.3 Solid Wood Industry

Hardwood sawnwood (1/5 of global capacity) is with few exceptions manufactured by small, local companies, particularly located in South-East Asia, Africa, South and North America. Softwood sawnwood (4/5 of global capacity) is produced in larger industrial businesses, normally with regional or even global operations.

The largest producers of softwood sawnwood normally have 10-30 mills with an average size of 150 000 - 400 000 m^3/a. In the traditional major areas of production i.e. Canada, USA, Sweden and Finland the production has reached its peak during 1995-2005 shifting the investment focus to Eastern Europe and Russia as well as Latin America and Oceania (Figure 4-8).

Behind the net capacity development, a lot of closures and new capacity installations have taken place. E.g. in North America, over 150 sawmills were closed during 1995-2005, while over 25 new mills were opened. The most remarkable capacity increases have, however, been due to existing capacity upgrading, having resulted a positive net capacity development (H. Spelter, 2002).

Figure 4-8
Sawn Wood Capacity Changes per Region 1995-2005 (Source: Pöyry)



5 SENSITIVITY OF PRODUCTION FOR COST INCREASES

The paper and board industry is very capital intensive, and the main paper and board grades are to a large extent bulk products. Production capacity has more or less reached or even exceeded the demand in saturated markets, such as the Nordic and Western Europe. This has lead to economies of scale and a reduction of companies' profit margins. When new capacity is installed, what essentially happens is that a new mill starts to reorganise and combine raw materials in its own way to form a product (or products) as cost efficiently as possible. Companies are thus very vulnerable to raw material price variations – and swings in e.g. energy price have made this vulnerability open and explicit.

The cost effectiveness of paper and board production is in practice a function of two major factors: the scale and concept of the mill, and the price level of raw materials and personnel available in the region. Thus, differences in production costs between two mills producing exactly the same product emerge by and large from differences in the mills' technical modernity, and its geographical location. These differences can be remarkable. Whilst the position of the former factor is fixed, the latter factor, affecting the price level for the mill inputs, can alter over time. Moreover, raw material prices can deviate irrespective of the product sales price, having a remarkable effect on production profitability.

In the following, an illustration of the effect of raw material price increases in representative Nordic and Western European mills producing four different grades is presented.

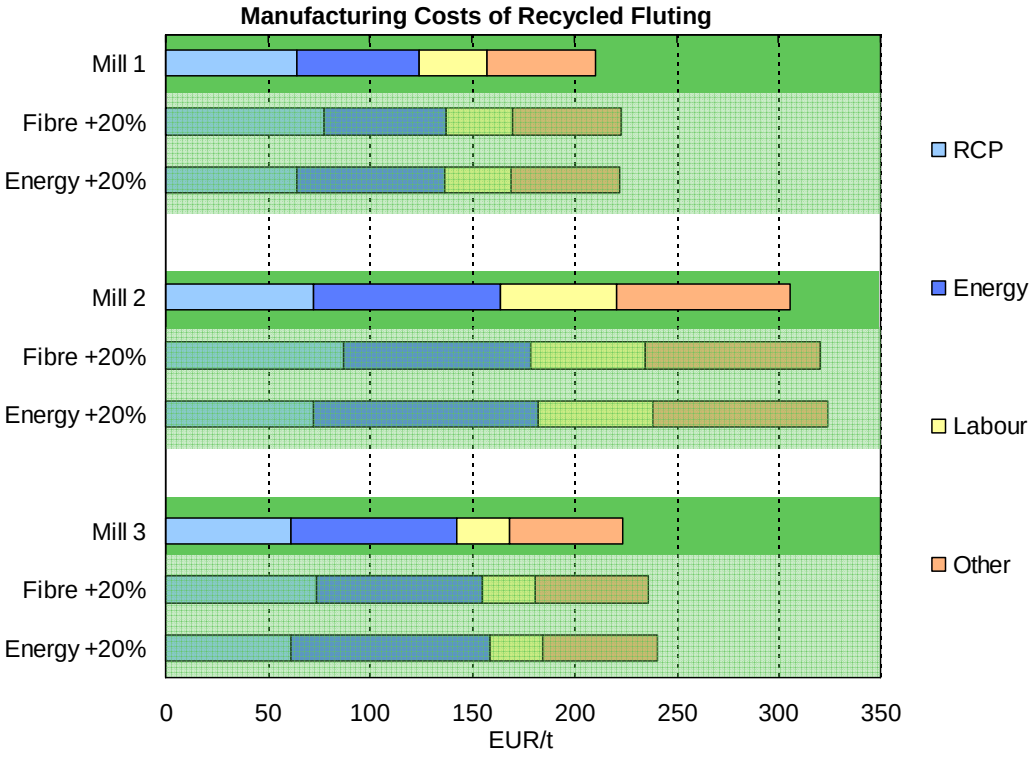
Recycled Fluting

The main raw materials in the production of recycled fluting are recycled paper and board together with energy. In Figure 5-1, three mills with different cost structures are presented, together with scenarios where either fibre or energy costs have increased by 20%. The ultimate effect of this to total manufacturing costs varies mill by mill, as the initial level varies. Those mills having e.g. already high consumption of high cost energy face severe profitability problems if the cost of energy still increases.

In Figure 5-1, the greatest proportional damage from a 20% energy price increase is allocated to Mill 3, raising the mill's total manufacturing costs by 7%, while Mills 1 and 2 face a 6% total cost increase. The increase may, however, still be more crucial to Mill 2 than it is to Mill 3, as Mill 2's total costs are already remarkably higher than its counterparts'.

When investigating the effect of fibre's 20% cost increase, the mills face a 5-6% total cost increase. In absolute terms, however, Mill 2 faces the most severe burden, as its initial fibre cost is the largest. As the increase of manufacturing costs by a few percent may not seem very dramatic, it is worth noting that the divisions of the European companies having production of recycled fluting made operating profit of some 6% on average in 2004-2005. As cost increases flow straight to the bottom line, the cost increases in scrutiny may be a question of life and death for the less efficient mills.

Figure 5-1
Manufacturing Costs of Recycled Fluting

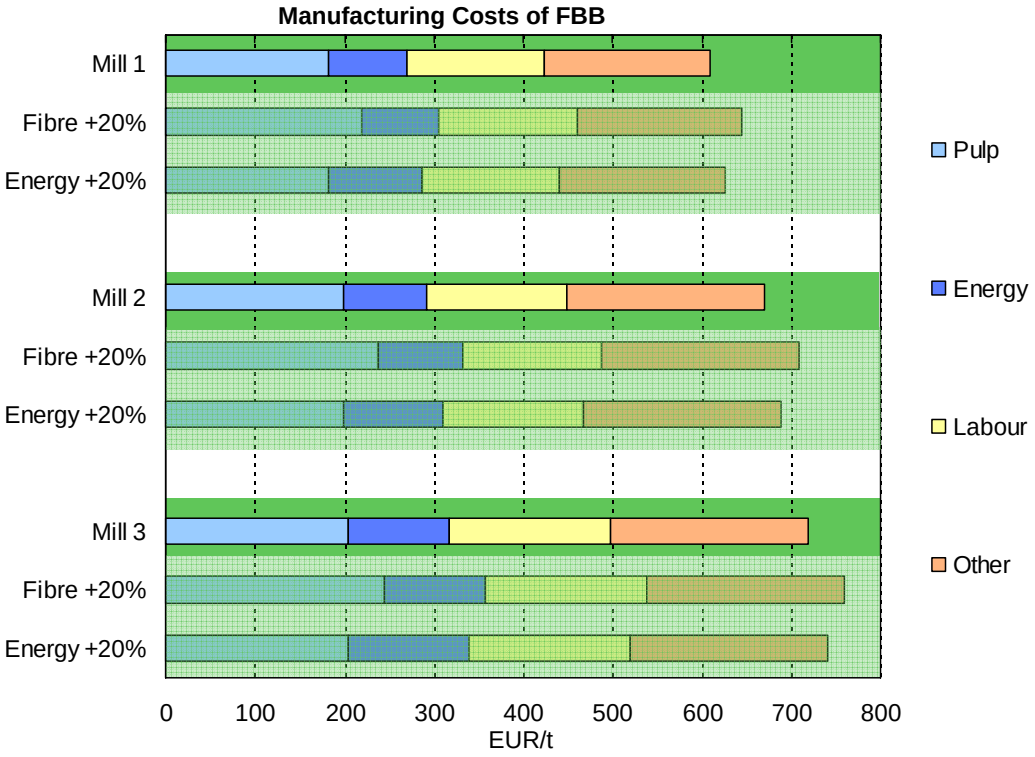


FBB

The main raw materials in the production of folding boxboard (FBB) are chemical pulp and energy. Personnel costs per tonne are also higher than e.g. for recycled fluting as the product is somewhat more complicated, but as wages are usually more stable than actual raw materials, they are left out from the sensitivity analysis.

The cost structure of the mills compared in Figure 5-2 is very uniform. The difference is that all the costs are the smallest for Mill 1 and highest for Mill 3. The effect of fibre and energy increase by 20% on total manufacturing costs for all the mills is +6% and +3%, respectively. In absolute terms, Mill 1 suffers the least and Mill 3 suffers the most. The operating margin for FBB producing company divisions in Europe averaged around 10% during 2004-2005, which leaves still some lack in the margins even after the tested price increases.

Figure 5-2
Manufacturing Costs of FBB

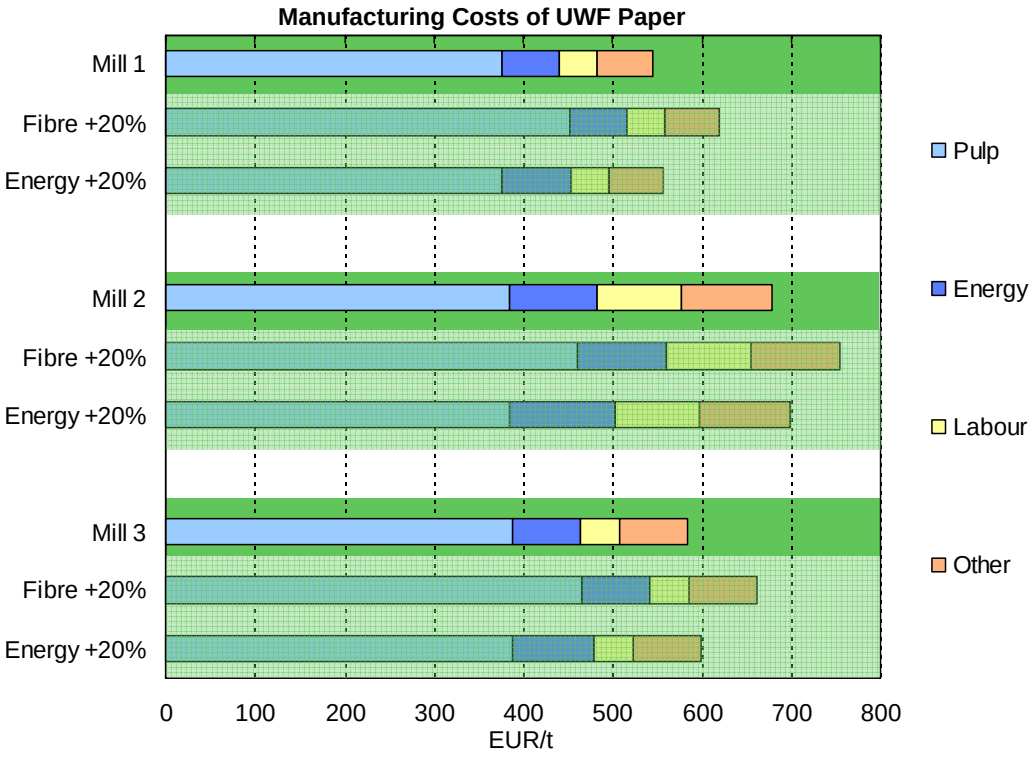


UWF

The main raw materials in the production of uncoated woodfree paper (UWF) are chemical pulp and to a lesser extent energy. In Figure 5-3, three different mills in different regions are presented. All purchase their pulp at market prices, but the consumption and also the mix of hardwood and softwood pulp vary. Mill 1 is the peer group's most efficient by all cost factors, while Mill 2 has clearly the highest costs despite the pulp cost component, where it loses slightly to Mill 3.

The most severely affected mill after a 20% price increase of pulp would be Mill 1, whose total manufacturing costs would increase by 14%. Mill 2 would face 11% total cost increases. But as Mill 2's initial level is higher, both mills would end up losing the same euro amount in margins. As Mill 2 is a relatively expensive producer, this might imply severe consequences for the mill, as UWF production in Europe has only generated some 3% operating profit for the paper companies involved in its production during 2004-2005.

Figure 5-3
Manufacturing Costs of UWF Paper



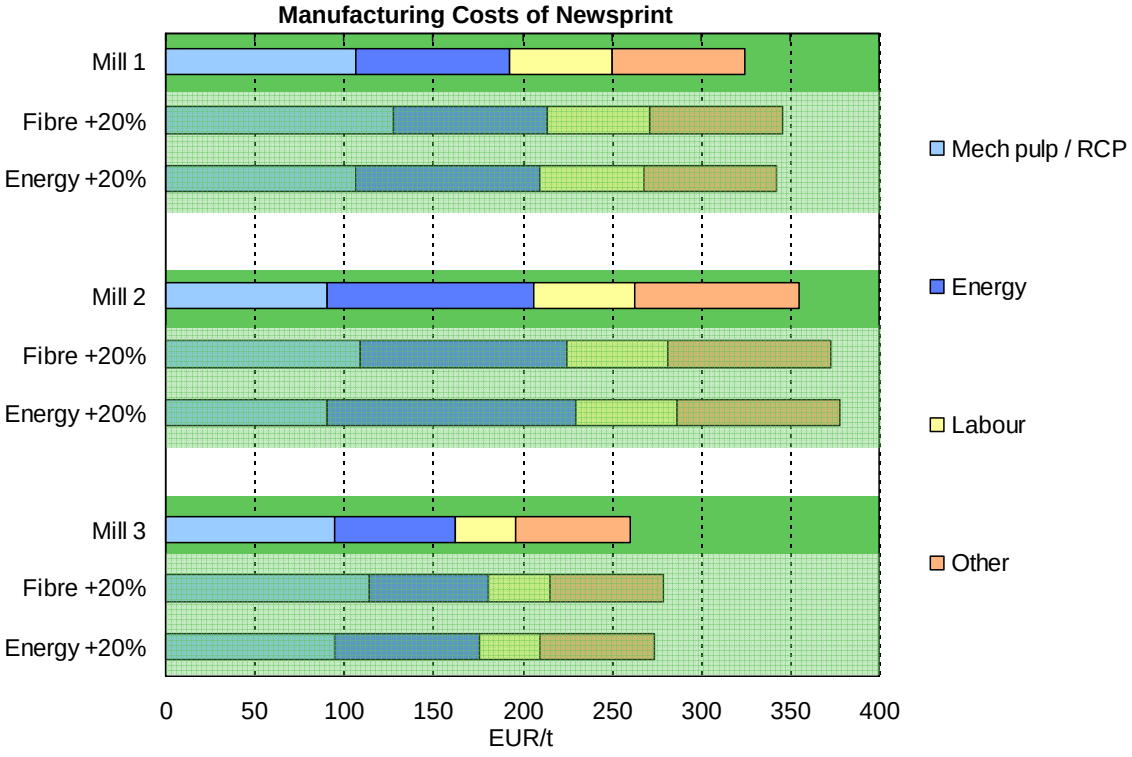
Newsprint

The main raw material items for newsprint production are recycled fibre based pulp, or in some cases mechanical pulp, together with energy. In Figure 5-4, three newsprint mills with mainly recycled pulp furnish are presented.

Mill 2 is very energy intensive, and it thus suffers the most from energy cost increases. The total effect from energy price increase it faces on manufacturing costs is +7%, while for Mills 1 and 3 the effect is +5%. As Mill 2 is the most expensive producer to begin with, it also suffers the most in absolute terms.

While the energy part in the cost bars is the greatest for Mill 2, its fibre costs are the lowest in the peer group. While the other two mills confront the issue of 20% fibre cost increases by cumulating +7% for total manufacturing costs, Mill 2 survives with only 5% total cost increase. All these increases are nonetheless significant for Mills 1 and 2, as the average European newsprint producer cashed in only 3% of operating profit during 2004-2005. Mill 3 is in better position, as apart from fibre, it has a significantly lighter cost structure than the other two mills.

Figure 5-4
Manufacturing Costs of Newsprint

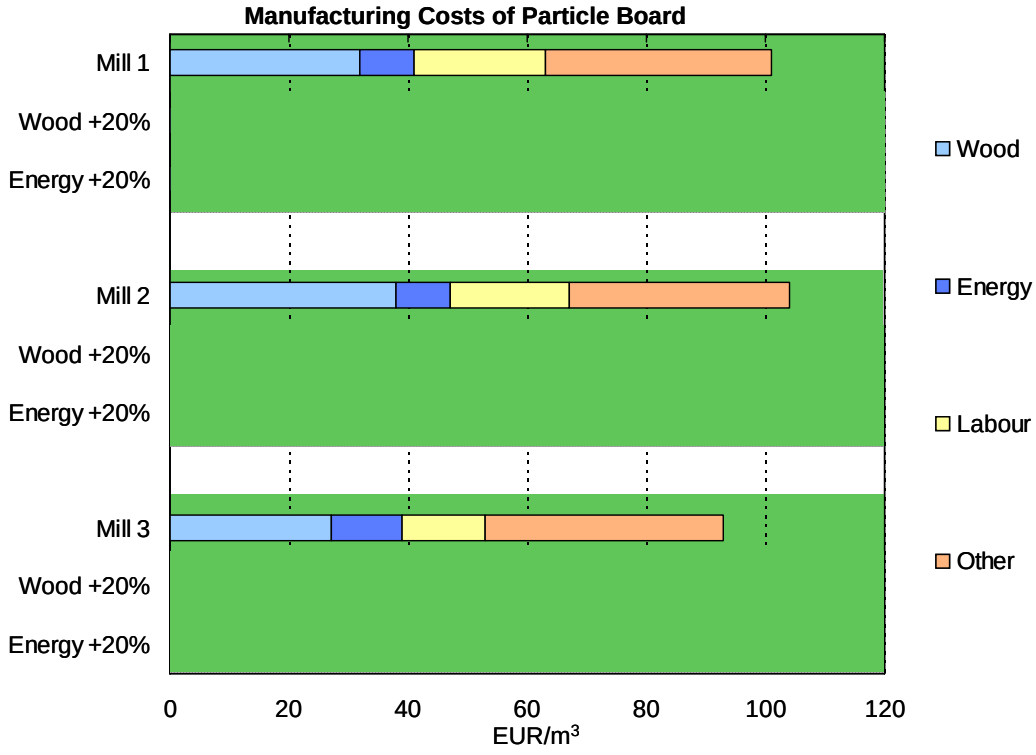


Particle Board

The main raw material for particleboard production is chips, sawdust as well as low diameter roundwood. In Figure 5-5 three particleboard mills based on chips and sawdust are presented.

Mill 2 has the largest wood cost and it therefore suffers the most from wood price increase. Mills 1 and 2 have the largest labour costs whereas Mill 3 has biggest energy costs. Mill 3 has the lowest overall cost level of all the mills and it is not as vulnerable to price changes.

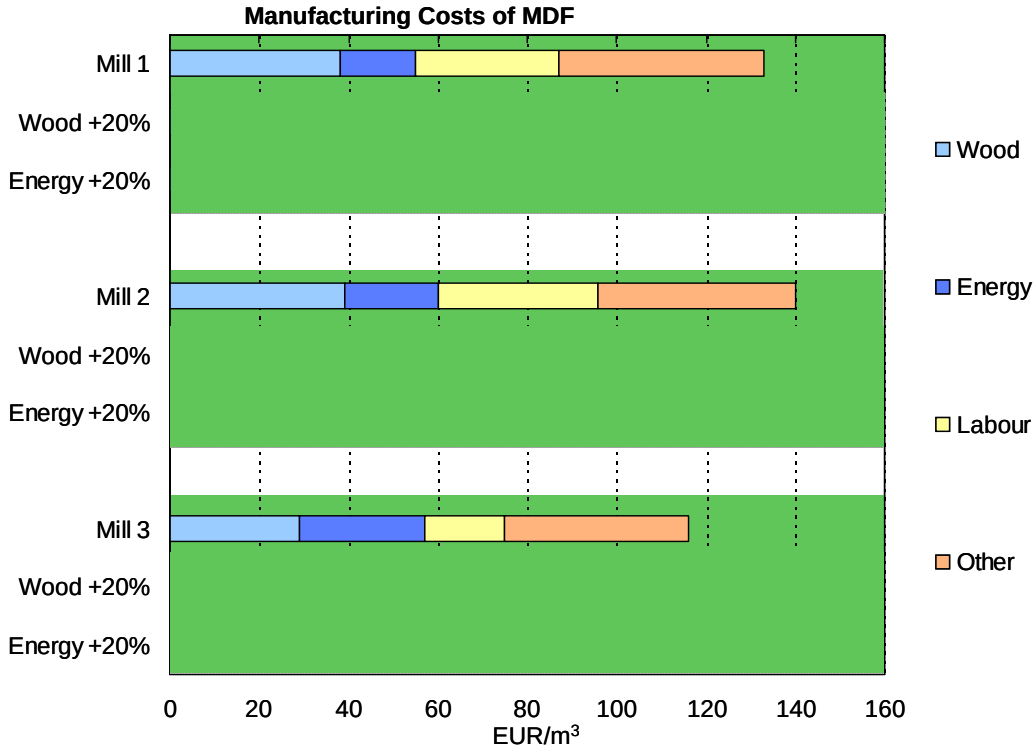
Figure 5-5
Manufacturing Costs of Particle Board



MDF

In Figure 5-6 three MDF mills based on chips and sawdust are presented. Mill 2 is the most energy intensive one, followed by Mill 1. Mills 1 and 2 are also sensitive to wood price changes. Labour costs of Mills 1 and 2 are almost double to the costs of Mill 3. Mill 3 has the lowest production costs overall.

Figure 5-6
Manufacturing Costs of MDF



6 EFORWOOD, INDUSTRY COMPETITIVENESS AND DYNAMICS

6.1 Assessing Industry Competitiveness

In the Eforwood project, several issues of competitiveness and industry dynamics are touched. Sustainability indicators 1-9 used in the TOSIA tool are all linked to economic competitiveness presented in Chapter 2 of this report (DCG 2008). These indicators are a representative set of *first, second and third line of competitiveness indicators:*

(1) Gross value added

(2) Production costs

(3) Trade balance

(4) Resource use, incl. recycled material

(5) Forest sector enterprise structure

(6) Investment and R&D

(7) Total production

(8) Productivity

(9) Innovation

Because of the level of detail and amount of processes modelled in TOSIA, reliable, representative data is not available for all of these indictors. Thus not all of the indicators are quantified in TOSIA.

Indicators on gross value added (indicator 1), production costs (indicator 2) and resource use (indicator 4) are relatively well covered in TOSIA. The applicability of trade balance (indicator 3) as a process level indicator in TOSIA is still under discussion – but it is clear that trade balance will be included in TOSIA in one way or another. The same applies to indicators 5 and 7 – forest sector enterprise structure and total production. Indicator 8, productivity, has not been used in all cases but this is not a large disadvantage, because productivity has some overlap with indicators 1 and 2. The quantification definitions of indicators 6 – investment and R&D and 9 – innovation has been challenging. The data available on these, as such very important indicators, is so case specific, that it has not been reasonable to generalise the information to the describe situation on country and process level.

However, the work done in compiling the list above, defining the indicators and the information and data search linked to the indicators has generated valuable information not only on data availability and gaps but also on future development needs. These needs will be discussed in the final reports of the Eforwood -project, for example on *D 4.3.11 Final report on the interdependence between the agents within the FWC.*

6.2 Assessing industry dynamics

Assessment of industry dynamics – for example *industry concentration, industrial environment and industry structure and evolution* presented in Chapters 2.3-2.5 of this report – is not an easy task. Indicator 5 – Forest sector enterprise structure - is liked to *industry concentration*, even though no concentration ratio (CR) or Herfindahl-Hirschman index (HHI) is calculated. Also indicator 7 – Total production describes on aspect of industry structure.

In Module 4 work, questions linked to both to industrial environment and industry structure and evolution have been discussed and analysed in several occasions, for example:

- when creating the topology of TOSIA, in other words when the processes and their intra and inter module links have been defined,
- in the work associated with the reference futures and scenarios, both in the creation of the future chain topologies and in the compilation of the new indicator values

The large amount of partners working with these tasks - both inside Module 4 but especially in Eforwood as a whole – has its advantages and disadvantages. The partners have a substantial amount of knowledge and insight on the industry dynamics and its development, especially inside their own special field of expertise. However, the way this knowledge is harnessed and then harmonised to serve the enormous amount of details needed in the TOSIA is a challenging task of coordination. This coordination has probably been much more time demanding than initially estimated, and the success of it cannot be fully assessed at this point of the project.

On the other hand, it is important to remember that there is no universal model that would be able to assess all possible cases and feedback loops linked to industry dynamics. Individual models are good in modelling selected, partially predefined cases. But, especially in more demanding questions, the analysis should be made case by case, using both models suitable for the case in question and human brain power. This applies also to TOSIA - at least today, TOSIA should not be used as the only tool in estimating changes in industry dynamics.

6.3 Trends and drivers

Trends and drivers are closely linked to competitiveness and industry dynamics. In Eforwood as a whole and in Module 4, the definition of the Reference futures A1 and B2, and the generation of the scenarios – Baden-Würtenberg's bioenergy scenario, Scandinavian technology scenario, Iberian consumer scenario and the European level Nature 2000 scenario – have involved analysis and quantification of both main and sector level trends.

The quantification of the main economic trends and drivers associated with the reference futures and some of the scenarios, e.g. GDP, oil price, development in labour related questions described in PD 1.4.7, generated a good and uniform base for compilation of process specific indicators. There several reports, e.g. *PD 4.3.8 Draft*

description of response function framework and examples describe this work in more detail.

Still, also here the problems associated with the feedback loops of some indicators and value chains must be kept in mind. Chapter 3.3. in PD 4.3.8 gives an example of such a feedback loop.

6.4 Investments and sensitivity of production for cost increases

Investments and capacity changes are a very important aspect of competitiveness and industry dynamic. In addition, due to several reasons for example the decline in sales prices and consumption of some of its products, both pulp and paper and wood products industry is very sensitive to production cost increases. It is clear that this sensitivity is also linked to investments and capacity changes. These issues are very delicate and political in nature, especially in the current economic situation (April 2009) and ongoing changes in industry structure.

Some actors and research organisations have developed for example equilibrium models for the analysis of regional capacity changes. As mentioned above, at least today, TOSIA should not be used as the only tool in estimating changes in production capacities, e.g. assessing where new production capacity will be built or where capacity will be closed.

7 CONCLUSIONS

The purpose of this report is to give information to other Eforwood partners on the nature of different forest based products from the industry's competitiveness point of view. This report is based on PD 4.3.2 *"First report on the industry's competitiveness and its impact on the industry dynamics"* and it is strongly linked to PD 4.3.3. *"First report on the interdependence between the agents within the forestry-wood chain"* and also to PD 4.3.4. *"Trade projections forest products by country and product"*. Together with PD4.3.3. and PD4.3.4. this study reports about the comprehensive picture of the industry dynamics. The overall picture on forest industry's competitiveness and the industry dynamics should be kept in mind in the development and interpretation of ToSIA and Eforwood work in general.

The main conclusions of this report can be summarised as:

- The competitive balance between the forest industry actors is not stable but highly dynamic.
- Power shifts in competition can be sudden, e.g. based on exchange rate fluctuations, unfair regulatory atmosphere, the shifts on resource focus, cost and availability and industry restructuring.
- It seems to us there have never been so many strong and weak signals and contradictory trends affecting an industry more global than ever.
- In the Eforwood project, several issues of competitiveness and industry dynamics are covered and for example the selected sustainability indicators cover well the first, second and third line competitiveness. However, because of the level of detail and amount of processes modelled in TOSIA, reliable, representative data is not available for all of the indictors.
- Fortunately, the work done in compiling the indicator lists, defining the indicators and the information and data search linked to the indicators has not been in useless - it has generated valuable information not only on data availability and gaps but also on future development needs.
- In Eforwood as a whole and in Module 4, the definition of the reference futures and the generation of the scenarios have involved analysis and quantification of both main and sector level trends.
- From the industry dynamics vs. TOSIA point of view, there are some problems associated with the feedback loops of some indicators and value chains. At least today, TOSIA should not be used as the only tool in estimating changes in industry dynamics and production capacities, e.g. assessing where new production capacity will be built or where capacity will be closed.

Fortunately all this makes the situation more interesting than ever for scientific analysis. Unfortunately all this makes the situation more complex than ever for the actual forest industry.

ABBREVIATIONS AND DEFINITIONS

Cartonboards: Generic term for stiff paper usually made in several layers, widely used for packaging (e.g. folding cartons) and graphic applications.

CIS: Commonwealth of Independent States (former USSR excl. Baltic countries)

Coated fine paper (or coated woodfree paper): Fine papers are printing and writing papers, which are made of chemical pulp and may also contain recycled fibers. Coated fine paper grades use uncoated fine paper (jumbo) reels as the base material, upon which one or more thin mineral coatings are added to smooth the surface and improve printability. CWF is used for printing for instance high quality books, e.g. art books, and also high quality magazines, annual reports, company magazines, catalogues and brochures. (Source: CepiFine)

Coated mechanical paper: This group can be split into two sub-categories - Lightweight Coated (LWC) and Medium Weight Coated (MWC). These papers can have either a glossy or matt finish, and are used mostly for catalogues, magazines and advertising material using rotogravure or offset printing. They are made from a blend of chemical and mechanical pulp with a content of fillers and are mineral coated on both sides, either on or off machine. LWC has a basis weight of up to 72 g/m² and anything above 72 g/m² is classed as either MWC or Heavy Weight Coated (HWC). (Source: CepiPrint)

Kraft liner: Board generally made from bleached or unbleached sulphate pulp and used as an outer ply or as facing for corrugated board.

Kraft pulp: or sulphate pulp is chemical pulp produced by cooking wood in a liquor containing sodium hydroxide and sodium sulphide as active chemicals. Originally a strong, unbleached coniferous pulp for packaging papers, kraft pulp covers today also bleached pulps from both coniferous and deciduous woods used in manufacturing of e.g. printing and writing papers.

EE: see Eastern Europe

Eastern Europe (EE) Albania, Armenia, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkmenistan, Ukraine

Gluelam: Glued structural timber, large beams are produced by bonding layers of specially selected lumber (usually high-quality spruce or pine) with strong, durable glues which can be dark or light- coloured. Finger-joints enable production of longer and wider structures. Glulam beams are used with structural wood panels for many types of heavy timber construction. Gluelam beams have better strength properties than sawn wood with same dimension. In relation to its own weight, gluelam is stronger than steel. The various dimensions of gluelam make it an interesting product for designers and architects and it is a competitive alternative for steel constructions in public buildings.

Industrial paper and board grades: A group of paper and board grades consisting e.g. of e.g. sack paper, kraft paper, wrapping tissue, special industrial and packaging papers (e.g. absorbent paper, bakery paper, creped paper, grease resistant and greaseproof paper, laminating base paper), construction paper and board, and technical special papers (e.g. abrasive base paper, filter papers, flame resistant paper), wallpaper and board and core board.

LVL: Laminated veneer lumber, it is produced of wood veneers laminated together by a waterproof resin. Production process is very much alike plywood production. All veneers are usually laid-up parallel to the grain (in plywood crosswise). In some special products there are some veneers which are laid-up crosswise to improve strength and stiffness. LVL has better strength and elastic properties than sawn wood and gluelam. It has also uniform quality and does not warp. LVL end-uses are for example in single-family houses to build higher rooms, big windows and balconies. In addition, LVL can be used as partition wall beams and in outer wall structures. In public buildings LVL can used in load-bearing structures, roofing, intermediate floors and base floors. With LVL diversified structures can be constructed. In addition, LVL can be used in constructing pavilions, renovations and prefabricated building. LVL is also suitable for large concrete formworks.

MDF: Medium density fibreboard is a wood-based panel made of wood fibres bonded together with resin. The board is relatively homogenous throughout its thickness without distinctive surface or core layers. MDF is easily moulded, painted or overlaid and it is used mainly in the furniture industry.

NA: North America

Newsprint: an uncoated paper that is mainly used for printing newspapers. In the past, it has been made largely from mechanical pulp, but today, an increasing amount of recovered paper, mainly old newspapers (ONP) and old magazines (OMG), also goes into the production. The weight of a sheet of newsprint usually ranges from 40 g/m² to 52 g/m², but can be as high as 65 g/m². Newsprint is white or slightly coloured (eg, pink Financial Times), and is supplied in reels for rotogravure, offset or flexo printing. (Source: CepiPrint)

OSB: Oriented strand board is a wood-based panel made of wood strands bonded together with exterior grade resin. The board has a three-layer construction where surface strands on both sides are oriented to the same direction while the core strands are oriented cross-wise to surface strands. OSB panels are mainly used in construction purposes, mainly residential single- and multi-family houses. Typical residential construction end-uses are sub-flooring, roof sheathing, ceilings and wall sheathing.

Particleboard (wood-based) (PB): Particleboard is made of small wood particles bonded together normally with an interior type resin (UF, urea formaldehyde). In some cases, particleboard for exterior purposes is produced with phenol resin. The board is structured so that fine particles are on the surface and coarse particles in the core. Particleboard is mainly consumed by furniture industry and in construction.

Plywood: Plywood panels are made of thin sheets of wood veneers. Veneers are stacked together with the direction of each veneer´s grain differing from its neighbours by 90

degrees. The plies are bonded together under heat and pressure which adhesives, most commonly phenol formaldehyde resin. There is a number of varieties of plywood and their end-uses vary widely depending on quality and wood raw material. Main end-use areas are furniture, construction, packaging and transport.

Recovered paper: Used paper that can be collected and re-used. Does not include e.g. tissue or paper recycled internally by the paper industry

Uncoated mechanical paper: This category covers a wide a range of publication paper grades, including directory paper, thin printing grades and book paper. The basic furnish is the same as for newsprint, but the basis weight starts at 28 g/m². *Supercalendered Magazine Paper (SC)* is primarily used for the publication of consumer magazines, catalogues and advertising material using rotogravure, offset or letterpress printing. It is made from mechanical pulp with a large content of mineral filler. This grade is split into sub-categories based on brightness: SC-A+, SC-A, SC-B. (Source: CepiPrint)

Test liner Board mainly produced from recovered paper and used as even facing for corrugated board or as liner of solid board.

Uncoated fine paper (or uncoated woodfree paper): Fine papers are printing and writing papers, which are made of chemical pulp and may also contain recycled fibers. The majority of the *UWF cut-size paper* is A4, which is used in offices at work and home for printing and copying purposes. *UWF folio sheets* are used for printing books, direct mailings and materials for corporate communications. *UWF reels* are used for producing writing pads, envelopes, books or business forms, for instance. (Source: CepiFine)

WE: see Western Europe

Western Europe (WE): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK

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